Universidade de Aveiro
Universidade do Porto
2022

Imran Khan

Cenários comunicacionais baseados em IOT para a promoção do bem-estar físico, psicológico e social dos séniores

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Universidade deAveiro
Universidade do Porto

2022

Imran Khan

Cenários comunicacionais baseados em IOT para a promoção do bem-estar físico, psicológico e social dos séniores

Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Informação e Comunicação em Plataformas Digitais, realizada sob a orientação científica da Doutora Lídia de Jesus Oliveira Loureiro da Silva, Professora Associada com Agregação do Departamento de Comunicação e Arte da Universidade de Aveiro.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

o júri

Presidente

(Portuguese mandatory)

Prof. Doutor José Fernando Ferreira Mendes,
Professor catedrático da Universidade de Aveiro

Vogais

Prof. Doutor Shahid Mumtaz,
Professor Catedrático, Nottingham Trent University, United Kingdom;

Prof. Doutor Armando Manuel Barreiros Malheiro da Silva,
Professor catedrático, Universidade do Porto;

Prof. Doutora Katia Santos de Morais
Professor Adjunta, Universidade do Estado da Bahia, Brasil;

Prof. Doutora Ana Lúcia Silva Terra,
Professora Auxiliar, Universidade de Coimbra.

Prof.ª Doutora Lídia de Jesus Oliveira Loureiro da Silva
professora associada com agregação da Universidade de Aveiro

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Acknowledgement

To all those who have accompanied me on a hard and long journey and contributed financially, emotionally and professionally, directly and indirectly, to achieve this goal.

First of all, I would like to thank you Professor Lídia Oliveira, for the excellent guidance, availability and professional support over the years, but above all, for the trust and motivation for this research.

To my parents, Ghulam Bilal Khan and Kouser Bibi. To my elder brother and sisters shahid Bilal khan, Salma khan, Shameem khan and my younger brothers and sisters Sher Bano Khan, Neelam Khan and Kamran khan, for making me what I am, because they always supported my education financially and emotionally. Last two years my wife Erum Zehra stood with me in good and bad times while writing my thesis, she courage me to move forward when I lost hope.

Finally, I would like to thank my Glorious and Holy Allah for letting me through all the difficulties. I have experienced guidance day by day. you are the one who let me finish my degree. I will keep on trusting My ALLAH for my future.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

palavras-chave Idosos, IoT, bem-estar social, comunicação passiva, comunicação intencional

Resumo

O principal objetivo desta pesquisa é projetar e validar um modelo de cenário híbrido social baseado em IoT que tenha o potencial de promover o bem-estar psicológico e físico entre os idosos. A principal razão para projetar e validar o modelo é o crescimento da idade, os idosos enfrentam problemas psicológicos, físicos e de bem-estar social que aumentam o comprometimento cognitivo leve e a fragilidade entre os idosos. Assim, para superar os problemas dos idosos, o estudo propõe e valida um modelo de cenário híbrido social baseado em IoT. Os recursos do modelo contêm comunicação passiva na qual médicos, cuidadores e familiares podem monitorar os dados físicos dos idosos a longas distâncias. As características do modelo também contemplam comunicação intencional em que os idosos podem interagir online por meio de texto, áudio, videochamadas, compartilhamento de imagens e atividades online como pintura, exercícios e culinária. Além disso, os idosos podem fazer atividades ao ar livre convidando colegas, amigos ou familiares; as atividades podem ser jogos de IoT baseados em localização, passeios pela cidade, jardinagem em grupo e jantares. Os resultados da validação do modelo indicam como as características da IoT podem promover o bem-estar físico, psicológico e social e fornecer uma oportunidade para os idosos passarem sua vida de forma independente.

A investigação que dá corpo a esta tese inclui 411 universidades portuguesas seniores localizadas no continente e na ilha de Portugal. Utilizando metodologia de pesquisa descritiva, onde são analisados resultados quantitativos, os resultados indicaram um cenário holístico de comunicação passiva e intencional no contexto da promoção do bem-estar entre idosos. a partir daqui, delineia-se o cenário social híbrido, um modelo híbrido que oferece comunicação passiva e intencional entre idosos, médicos de família e médicos no contexto da promoção do bem-estar. O desenho e as características do modelo baseiam-se no conhecimento existente e nas necessidades dos idosos, familiares e também médicos. Tal modelo é um composto de características passivas e intencionais que ajuda a reduzir os problemas relacionados com a saúde mental e física. As características de comunicação passiva e intencional são capazes de criar um ambiente para que os idosos cuidem de sua saúde psicológica e física e também aumentem suas atividades sociais físicas e online, essas atividades ajudam a promover o bem-estar dos idosos e melhorar o estilo de vida diário.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

keywords **Elderly, IoT, social wellbeing, passive communication, intentional communication**

Abstract

The main objective of this research is to design and validate IoT based social hybrid scenario model that has the potential to promote psychological and physical wellbeing among older adults. The main reason to design and validate the model is age growth, older adults face psychological, physical and social well-being problems that increase mild cognitive impairment and frailty among older adults. Thus, to overcome older adults' problems, the study proposes and validates an IoT-based social hybrid scenario model. The model's features contain passive communication in which Drs, caregivers, and family members can monitor older adults' physical data from long distances. The model's features also contained intentional communication in which Older adults can interact online by text, audio, video calls, sharing images, and online activities such as painting, exercises and cooking. Moreover, older adults can do outdoor activities by inviting peers, friends or family members; the activities can be location-based IoT games, city tours, groups gardening and dinners. The outcomes of model validation will indicate how IoT characteristics can promote physical, psychological and social well-being and provide an opportunity for older adults to spend their life independently.

The research that embodies this thesis includes 411 senior Portuguese Universities which are located mainland and on the island of Portugal. Using descriptive research methodology, where quantitative results are analysed, the results indicated a holistic scenario of passive and intentional communication in the context of well-being promotion among olderadults. from here, the social hybrid scenario is outlined, a hybrid model that offers passive and intentional communication between olderadults, family and medical doctors in the context of well-being promotion. The design and characteristics of the model are based on the existing knowledg, and needs of older adults, family members and also medical doctors. Such as model is a compound of passive and intentional characteristics that helps to reduce problem-related mental and physical health. The Passive and intentional communication characteristics are capable to create an environment for older adultsto take care of their psychological and physical health without any intervention and also increase their social physical and online activities, these activities help to promote the well-being of olderadults andd improve the daily lifestyle.

THIS PAGE WAS INTENTIONALLY LEFT B

Summary

Index of Figures

Index of Table

INTRODUCTION

The modern society's population is ageing. Gradually, ageing is becoming a complicated situation for developed nations to ignore the rapid growth of older adults and decrease in birth rates in the societies. The rapid growth of the older adult indicated that older adults' numbers are competing with youngster numbers. If the situation remains; soon, Older adult numbers will be more than young people in developed countries. More Older adults in society mean reducing the workforce, and a huge number of older adults will be a burden on the state economy because, in developed countries, after retirement, the state takes the responsibility to take care of older adults' healthcare and economic issues.

According to a United Nations report in 2017, a huge number of older adults' population will increase by 2050. There is another report that reveals UN databases (United Nations, 2017) predicted that older adults would double between 2017 to 2050. Thus, the growth of older adults in society causes many healthcare and social challenges, and it is impossible to deal with all these challenges at the same time. Therefore, the Older adult population has many socially, psychologically and physically problems (Partridge et al., 2018). There are several reasons behind physical and psychological health issues such as social isolation, reduction of social contacts, less interaction with the public, and fewer outdoor physical activities, likewise, these severe reasons can cause a high level of depression and amount of sudden death (Storrs, 2016). Although the Older adult population needed health care facilities on an emergency basis. However, there are many countries' governments, the private sector, and institutes that neglect Older adults' physical and psychological health issues and there is no determined effort visible that highlights and resolves Older adults' issues (Partridge et al., 2018).

Consider that, the growth of physical and psychological health issues in older adults are increasing the demand for health care services. The public and private levels cannot provide all older adults with healthcare, medical service and social services at their doors, the reason behind it most of the Older adult population are living in remote areas or are far from the medical or health care facilities services, making it harder for government and private sector to approach them. Therefore, there is a need for time to find alternative ways to overcome the Older adult health care issues and provide the opportunity to spend their healthier and happier life.

In Older adult health care regards, information, and communication technology (ICT) replaces the traditional healthcare system and offers innovative healthcare systems based on the internet. ICT is improving human life quality. Therefore, many novel concepts are emerging into our daily life, as is

the case with the idea of the “Internet of things” (IoT). In a smart world, IoT is an innovative and growing concept, in which digital things are connected with computers, mobiles, actuators, vehicles and everyday objects (Tamrakar et al., 2022). The IoT is a concept that represents a mixture of different networks, where physical objects and sensors can connect through electronic devices, and software applications, that allow the physical objects to gather data from various destinations, such as browsing websites and sending email, and multimedia content. Due to the importance of IoT applications in many developed countries, such as the United States of America, Japan, and Europe, IoT is a field of novelty and development, both at the academic and commercial levels. Therefore, numerous universities and industries are researching IoT technologies (Da Xu, 2022).

The IoT is a unique and suitable concept to design an environment in which it is possible to promote the social and physical wellbeing of older adults as this study proposed a social hybrid scenario model that will help to improve older adults’ life quality. After considering extensive aspects of IoT technologies, this study will purpose a design of a social hybrid scenario model, to be validated. The model of the social hybrid scenario will provide two types of communication services, namely passive communication, and intentional communication.

Intentional communication includes social interaction, participation and sharing of ideas, namely through social media, and outdoor activities. At the beginning of internet services, interactive media’ (social media) communications were minimal, because users had only email or message services, allowing them to communicate with a limited number of people. However, over time, people integrated social media into their lives for different purposes, such as education, communication, knowledge exchange and the development of opinions about an issue (Boyd & Ellison, 2013). Due to secure access to the latest technologies, isolated communities, such as the Older adult population, are becoming active members of the digital world, through smartphones, laptops, and computers (Sixsmith et al., 2022). The latest smart devices are equipped with multimedia content that is persuading the Older adult population to use these devices in a different context. According to Na-songkhla (2011), “The interactive media is a so-called white road”, in which we can design anything that interacts with people according to their desires.

Many modern societies (Europe, the USA, & Australia) are using interactive content (social media) for interaction, entertainment, education, and cultural sharing. Therefore, there are many people using dozens of interactive media devices, such as a computer, smartphones, and television. These smart devices are disseminating interactive media content via new innovative technologies such as the internet. Innovative technologies are providing a different platform for social interaction, participation, and discussion. Likewise, the isolated Older adult population can minimise their physical isolation and loneliness by using these platforms (Facebook, Instagram, and Twitter) and

interacting with other people (Kim, Kyungmin. Jasmine, 2020) (LaRose, Strove, Gregg, & Straubhaar, 2011).

The IoT can make the devices and objects smart with the help of different application domains that help to improve passive communication in the context of healthcare and medical services. Due to IoT technologies, it is possible to design modern health care and social environment that will make it possible to provide intentional and passive communication scenarios (Punj & Kumar, 2018). Passive communication is important for health care personnel and doctors because they can receive physical data of the patient and real-time monitoring, such as information about heartbeats, level of oxygen in the blood, body temperature, heart pulse or how many steps patients walk per minute, hours, or a day. Moreover, through these IoT devices, relatives, friends or loved ones, can also get information about older adults, such as information about geographical positioning and daily activities.

This study will design and validate a social IoT hybrid scenario model, intended to promote the physical, psychological, and social well-being of older adults. The prototype will support both intentional and passive communication: functionalities for intentional communication will help the older adult to communicate with relatives or other community people for social interaction, participation, discussion, and outdoor activities; features for passive communication will take care of the patient's physical health condition. We believe that the study findings will help to promote the psychological, physical, and social well-being of older adults.

Motivation

As stated before, the rapid growth of the Older adult population in developed countries is increasing the demand and costs of social and medical services, along with a higher pressure on the public institution to provide them with better health care and social services. When you have a huge population aged, it is hard to provide social and health services to every single aged person. thus, most older adults have poor social and physical activities that make them socially isolated and feel lonely. Loneliness and social isolation are key factors that increase the intensity of physical and psychological health issues (Rodrigues et al., 2022). Furthermore, the Older adult population has less engagement with others, less social contact and poor quality of the relationship which causes physical and psychological disorders (Shimada et al., 2014). Social interaction, however, is essential for human well-being because a good relationship or social interaction are core component for the improvement of human health (Holt-Lunstad, Smith, & Layton, 2010).

This study has a very comprehensive motivation to design and validate a social hybrid scenario (IoT) model for the older adult population by using the internet of things. Due to the IoT characteristics, older adults will have a healthy lifestyle and will be capable of living their life

independently because IoT including smart sensors can provide an environment in which older adults can monitor their physical health data such as blood pressure, heartbeat, pulse rate, blood pressure, and body temperature. likewise, older adults don't need anybody to take care of their physical data. IoT is a game-changing concept in the fields of social interaction and health, especially considering IoT's communication and data-sharing features. This technology helps to promote the physical, psychological, and social wellbeing of the Older adult population at lower costs, offering personalised medical and social services without human interference.

The IoT is a compelling and adequate way to make it possible to provide health care and social services on the same platform for its users. Furthermore, IoT devices can communicate and collaborate through specific applications and software without time and location restrictions. These applications can provide social, personal and enterprise online monitoring services to their users (Yang, Liu, & Liang, 2010, Bandyopadhyay & Sen, 2011; Rajan Jeyaraj & Nadar, 2019).

One more motive to conduct this study is to explore the characteristics of information and communication technology (ICT), especially in the IoT context that is playing a vital role to overcome societal challenges. Individuals who have difficulty connecting in a face-to-face context may benefit from ICT-based media since it allows them to express themselves, connect with a peer support network, and promote social contact ICT based media could provide an opportunity for self-expression, access to a peer support network, and facilitate social interaction among individuals experiencing difficulties interacting in the face to face setting (Naslund et al., 2020).

How can we use these characteristics in a novel way to enhance the social circle, educational expertise, and medical facilities and overcome environmental and agriculture challenges by using ICT applications? Therefore, this study will propose the initial design and validate an IoT social hybrid scenario, intended to promote the physical, psychological, and social well-being of older adults. In this way, the thematic is related to how technology and social media, precisely an IoT social hybrid scenario, must be designed and implemented, to support the communication activities fully and to convey the necessary information, to be considered a promoter of the physical, psychological, and social well-being of the older adults.

Objectives of the study

The presented thesis is framed by the notions of passive and social communication, trying to contribute to the materialisation of these two concepts. In this sense, it seeks to fill a gap in the state of the art of accessibility and inclusion of design, since it focuses mainly on the design of a prototype social hybrid scenario and its adaptation of structures that develop a communication environment, which tends to improve the physical, psychological, and social wellbeing of the Older adult population.

The design plays a fundamental role in this process, which drives by its responsibilities in the development of platforms and applications that sustain and organise society's structure. Thus, this research presents the main objectives.

Main objectives

1. To Sketch, design and validate IoT social hybrid model that is capable to promote well-being among older adults.
2. To understand the role that this kind of situation can have in the promotion of the physical, psychological, and social well-being of the older adults

Description of main objectives ~

1. The reason to achieve this objective is to design and validate the social hybrid scenario which is the main motive of this study. The first main objective can be considered the backbone of this study because this objective represents three main stages of research, (i) the early stage is conceptualisation which first needs to design various passive and intentional communication scenarios on basis of existing literature and knowledge that helps to promote the wellbeing of older adults. (ii) the second stage is to develop the questionnaire that will be based on a well-being scale. The reason to create this questionnaire gets to know the perception of older adults about this kind of scenario (social hybrid scenario). iii) the validation of a social hybrid scenario, this validation provides vital evidence the how model characteristics promote the wellbeing of older adults.
2. Secondly, to explore the different aspects and characteristics of IoT-based social hybrid scenarios and how this scenario is worthful for the older adult's wellbeing. Through this objective, it will be easy to understand the capacity of novel technologies and how these technologies are enhancing the well-being of its user and what are the critical components of the social hybrid scenario that are playing a vital role in the promotion of Older adult physical, psychological, and social wellbeing. This objective is only possible to achieve after the achievement of the first main objective. After the development of a social hybrid scenario, the prototype will be tested in the real context, and then it will be possible to analyse the social hybrid scenario and its components that will provide essential information on how the social hybrid scenario can promote the well-being of older adults.

General objectives

1. To undertake a comprehensive Literature review on the role of technology, namely IoT, and social media in the promotion of physical, psychological, and social well-being
2. To understand the use of IoT systems, digital platforms, and social media in the context of the physical, psychological, and social well-being of the older adults

3. To identify (and eventually adopt) scales to measure the physical, psychological, and social well-being of the older adults

Description of general objectives

1. To achieve the goal, must review the existing knowledge on the overall contribution of technology to human life. Through, literature review scholarly articles, surveys books, and other sources relevant to a technology namely the Internet of things (IoT), provide a comprehensive description, summary, and critical evaluation of IoT technology and social media in the promotion of physical, psychological, and social wellbeing of the Older adult population. In fact, in this study, the design of the literature review provides an overview of IoT and social media services that help to explore physical, psychological, and social well-being that demonstrate how this research fits within a superior field of study.
2. This objective will help to make a comprehensive understanding use of technologies effectively and what procedures to apply IoT, digital and social media platforms that enhance physical, psychological, and social wellbeing. Technologies have numerous components, and each element has its quality to improve the human being's lifestyle as technology can improve physical health through remote technologies, and technologies provide social media platforms, through these platforms it is possible to enhance the social life of users. Therefore, through this objective, it will be likely to understand IoT dynamics, characteristics, and the correct use of these technologies.
3. This is a general and comprehensive objective because this objective will help to identify the well-being scale. After all, without the well-being scale, it is hard to know the perception of people about the IoT hybrid scenario. Therefore, to achieve this objective, it needs to survey different well-being scales, and identify the scale which will have the potential to measure the physical, psychological, and social well-being perception of IoT-based scenarios.

Research question

Concerning the study problem statement and envisioned goals, a study research question is drawn according to the standard procedure of evaluation feasibility, viability, and relevance (Campenhoudt& Quivy,2005).

To what extent a social IoT hybrid scenario model of passive and intentional communication can be a promoter of the physical, psychological, and social well-being of older adults?

The stated question will answer by using Quantitative research methods such as literature review, surveys, analysing of the survey data, and designing for the validation of the prototype social hybrid scenario.

In the context of the problems presented and in compliance with the principles and procedures for the design of research questions (Quivy & Campendhout. 2005), the following primary research question was developed to drive the study.

To what extent a social IoT hybrid scenario of passive and intentional communication can be a promoter of the physical, psychological, and social well-being of older adults?

RQ Justification.

The question of this study argues two aspects of the IoT social hybrid scenario; one is Intentional communication, the intentional communication based on social media interaction for the Older adult population. Intentional communication is a type of communication that promotes the development of social - communication skills. Simply put, social and emotional skills are the ability to comprehend and manage oneself, relate to others, and make responsible decisions based on one's own and others' needs (Montana, 2020).

It is not entirely understood; how social media changes the behaviour of the Older adult population, especially the behaviour of the Older adult population who are isolated. Many big companies are getting social media data for analysis. The social media data helps to find out the best choice for social media users about products (Taylor, 2012). On interactive media platforms (social media) users are learning many social values. When social media users interact with each other at that time, they are sharing their values, tradition, and norms, and at the same time, they are also positively learning about others' cultures. Sharing and learning process individual gives an effective response to other users that established a positive behaviour.

Social media is a platform that is also called a learning community due to specifying the design of interactive media that motivates people to enhance knowledge by joining the community. A learning community is a group of people who exchange their collective ideas, emotion, and beliefs. The community is an influence. Social media has a significant impact on our Older adult population's life because users (older adult populations) are not only getting an education, news, and language but also changing their behaviour by learning another behaviour. The concept of a community fulfils the user's desires. The community always gives support to share their events, experience, and emotions within the community. Social media sites are popular in the world due to their characteristics such as Participation, in which users could give comments and feedback about the online content. Social media has billions of active users and many more becoming part of social media (Facebook) because, on social media platforms older adult populations can express their feeling and experience others' cultures, languages, and knowledge (Sedghi, 2014). Intentional communication will enhance social interaction communication that will cause to improve the physical and

psychological well-being of older adults. Social connections play a huge role to provide outdoor activities, participation, and sharing of ideas. Most of the time, the older adult population live alone or far away from their loved one or doctors. Due to the poor health condition of the Older adult population, they are unable to visit a medical doctor. The older adult population needs a technological platform where somebody can do remote monitoring of them, even if they are not physically near to them.

Secondly, this study has one component that is passive communication in which people can take of the older adults from a long or a short distance. Passive communication plays a very vital and comprehensive role to improve the physical health of older adults. Therefore, the design of passive communications provides a platform where people, who have a direct or indirect connection with an older adult's health condition in which concerning people can get data about the older adult's physical location, level of blood oxygen, Heartbeats, and body temperature.

To consider that, IoT is one developing technology that attaches numerous everyday devices and systems in the forms of sensors, appliances, mobile phones, and computers. Therefore, a system equipped with lasted technology can build a bridge between humans and devices in the context of passive and social communication. Due to the characteristics of IoT, it is possible to provide passive and intentional communication on one platform. Older adults can improve their physical and psychological. The study will develop a social hybrid scenario for the promotion of the physical, psychological and well-being of older adults. It is extensively needed time to develop a prototype IoT social hybrid scenario because there is a lack of knowledge existon an IoT social hybrid scenario that promotes physical, psychological and well-being of older adults concerning passive and intentionally knowledge. Considering the older adult issue, this study will bring a comprehensive prototype social hybrid scenario that will highlight the older adult issue and provide an environment where the older adult population will be able to live a healthy and normal life.

Contribution

One of the main contributions of this study will consist of designing passive and intentional characteristics of an IoT social hybrid scenario that will promote the physical, psychological, and social well-being of older adults. Moreover, an extensive analysis will be carried out on multiple investigations related to this research, focusing on different concepts, including passive communication, intentional communication, social isolation of the older adults and IoT technologies. The common ground among them, we believe, is the impact they may have on the older adult population's physical and psychological health issues. In this context, the design of the prototype IoT social hybrid scenario will be capable of analysing the two significant concepts concerning psychological (intentional communication l) and physical (passive communication) interaction. As a

result, the final design of the IoT social hybrid scenario will maintain an equal balance between two concepts (passive and intentional communication experience), that will equally be treated.
The development procedures of the IoT hybrid social scenario' prototype will bring together the present knowledge on IoT, health care, the older adult population, and social isolation, highlighting the different main characteristics associated with physical, psychological, social well-being and IoT components. As many studies have been conducted on IoT technologies, especially in medical fields and associated older adult problems, but in this study, the prototype IoT social hybrid scenario will bring remote control healthcare and social interaction services on one platform.

The presented prototype IoT social hybrid scenario will provide an environment which has not yet been adequately investigated although the prototype IoT social hybrid scenario will be able to promote the physical, psychological, and social well-being of the older adult population. The design of the prototype IoT social hybrid scenario will lead to two types of communication services named passive and intentional communication. In this context, the outcomes will explore how IoT social hybrid scenario will improve the physical and psychological health issues of seniors because through the prototype IoT social hybrid scenario it will be possible for the older adult population to interact with their peers, friends, and relatives for entertainment or knowledge enhancement. Unlike, the prototype IoT social hybrid scenario also can provide physical health data to older adult populations' doctors and their loved ones (family members, friends, and relatives).

In addition to the prototype IoT social hybrid scenario, this study will contribute with a social well-being experience scale, that will be adequate and capable to evaluate the emotional perception of the older adult population, according to different prototype IoT social hybrid scenario design characteristics. Likewise, based on the results of the well-being scale, it will be possible to understand the older adult population's perception of the IoT social hybrid scenario. From this stage, two characteristics will be evaluated, namely: intentional communication, in which the older adult population will engage by interacting with other people, sharing their ideas, and participating in civic, outdoor, or online activities; and passive communication. After understanding the perception of the older adult population via the well-being scale, the understanding of the older adults will work as a based stone that will help to draw an original sketch of the IoT social hybrid scenario.

This study will also evaluate the IoT social hybrid scenario design's components, by analysing data about the older adult population's perception of the Prototype design, mechanics, and interface. However, the well-being scale will be essential for the prototype design and development; predictably, the well-being scale may have some limitations, therefore, after the development of the prototype IoT social hybrid scenario will be tested in a real context (on the older adult population). The test of prototype IoT social hybrid scenario in real context will help out to improve the design,

mechanics, and interface of a prototype that will not be clear in Older adults population perception information.

In the end, validation of the IoT social hybrid scenario model will, hopefully, help to promote the physical, psychological, and social well-being of the older adult population. Through the reduction of social isolation, increase social contacts, and outdoor activities such as meeting with people, and participating in civic events and doctors and loved ones can monitor the older adult population's physical activities like geolocation, heartbeat, oxygen level in the blood, and how much distance he or she walks in the day, week, or month.

Structure of the thesis

This thesis is structured in six chapters, and one introduction of section of thesis. First three chapter such as 1,2, and 3 chapters are based on literature review that discuss characteristic of Internet of things, Portuguese older adult population, wellbeing application and scales. Chapters 4,5,6 are based of methodology, empirical results of survey, proposed design of model and discussion.

To contextualization the study **chapter 1** presents vital understanding, how IoT based applications invading out health, industry, education, and agriculture by providing advanced technological solutions. Moreover, this chapter 1 presents development of IoT technological, its usage by different generations. First-generation, which experienced embedded things and a Second-Generation**,** a complex social web of things, and a third-generation experience involving autonomous social objects and cloud computing. Finally, this chapter present and discussed about the different definition of Internet of things. This discussion helped to understand different theories and vital characteristics of IoT. In **chapter 2** This chapter gave readers a more comprehensive picture of the older adult's population in Portugal. This more comprehensive picture gave insight into the characteristics of old Portuguese people, such as their level of education, skills, type of household, average age, and access to healthcare. Finally, this chapter presents various wellbeing scales that designed to measure the wellbeing of older adults and helps to understand the level of wellbeing among the older adults.

The chapter 3 that describes the Personal Healthcare Device (PHD), ZigBee wireless technologies, Ambient Assisted Living system (AAL), Wearable Body Sensor Network (WBSN) health care system, and Biomedical Wireless Sensor Network (BWSN) are just a few examples of passive health care services for older adults. These Internet of Things (IoT) apps are made to gather physical information from older people over short and large distances. Moreover, this chapter describes social internet of things (SIoT), which stands for purposeful communication, is the focus of this chapter's second section. The goals of the social internet of things (intentional communication) paradigm are to keep people and things apart, to allow for the existence of social networks for objects, and to allow for the imposition of rules by humans to protect their secrecy or privacy. Intelligent things do not change

anything because they are merely physical data, whereas social IoT apps significantly improve user social connection. Social IoT devices connect items with people and people with social communication objects.

Chapter 4 uses a research technique that highlights the conceptual foundations of the design decisions we made for this project. The methodology chapter explains in detail to the readers how we conducted our research and supported our design decisions: this methodology chapter discusses the ontological, methodological, and epistemological stances taken in the thesis. Additionally, the comparative and interpretive analysis of the adoption and convergence process under study in this thesis will search design and methodology, data gathering technique, and presented theoretical underpinnings

Chapter 5 proposed the final design of a social hybrid scenario model after analysing and interpreting the empirical data of the questionnaire. The chapter describes the different functions and characteristics of the social hybrid model. The final section of the thesis is based on

Chapter 6 addresses the institution theory used to interpret and analyse the results. The entire chapter is built around a core methodological strategy that can reveal the nature of the study objects and provide the answers to the issues posed. The theoretical and methodological framework defines the study position from a methodological and empirical implementation standpoint. The second stage focused on various stages and phases of creating a social hybrid scenarios model with an application of empirical investigation in older adults' everyday lives. Furthermore, this chapter presented a descriptive way to answer the main question and goals. Chapter 5 discusses and interprets it to explain how the adoption process of novel technology such as IoT among older adults can enhance their physical and psychological well-being.

Finally, the thesis, the last section of this study, presents the conclusion, limitations, contribution of this study, and clues for future

CHAPTER 1: IOT: GENERATIONS, CHARACTERISTICS, SCENARIOS OF USAGE AND DEFINITION

Industrialists have already understood the technological worth of IoT applications; and have therefore started to use them as a technological solution for societal challenges in areas such as health, education, industry, and agriculture. This chapter presents the different evolutionary phases of IoT and different generations of IoT that have experienced IoT technologies in different eras defined as a first-generation, which experienced **embedded things and a Second-Generation,** a complex social web of things, and a third-generation experience involving autonomous social objects and cloud computing. This chapter analyses the characteristics of IoT such as Interconnectivity, Intelligence, Heterogeneity, Safety, Monitoring and Control, Big data, Analytics, Information Sharing and Collaboration. Furthermore, this chapter describes the different usage of IoT scenarios applications in agriculture, education, healthcare or medical fields, and environmental and renewable energy scenarios. To conclude, this chapter presents the latest definition of IoT in the present technological context, which helps to understand IoT's extensive nature, theories, methodologies, and potential for IoT application.

For the writing of this chapter, a literature review was carried out that took into account the following keywords

Internet of things, ICT, IoT, Social internet of things, characteristics.

1.1. Characteristics of IoT

The IoT has a very sophisticated and complex infrastructure with several unique characteristics designed to perform different tasks. In IoT design, every characteristic differs from one domain to another domain. There are some general and comprehensive characteristics described below.

Interconnectivity

The primary goal of IoT is to interconnect many smart devices through advanced application assistance (Baccelli, 2018). IoT provides a worldwide communication and information platform infrastructure where every single device is interconnected with each other. It is comprehensive for IoT devices to be interconnected globally through a communication and information infrastructure (Patel & Patel, 2016; Souri et al., 2022) because through interconnection, devices can collect information and communicate data for meaningful purposes.

Intelligence

Smartness is often based on hardware and software components equipped with algorithms and computation (Elena-Lenz, 2014 &Sinha & Dhanalakshmi, 2022). In this way, algorithms and computation enhance IoT's ambient intelligence, which helps improve the IoT working strength in which things can communicate and carry the task intelligently(Ali et al., 2022). IoT intelligence provides a platform where things can smartly do the tasks and increase the interaction between devices that making the product intelligent; the product can think, estimate, and execute the tasks effectively.

Heterogeneity

In the future, it is predicted that the IoT will be the main component that will empower smart cities through IoT services. The IoT's design is based on the universal network system, in which several devices, objects, sensors, and RFID embedded objects are connected for communication and information sharing. As such, it is predicted that in the future trillions of smart devices will be capable of communicating with other objects that will be sophisticated to serve humankind via a machine with the help of IoT technology (Sudan Jha, 2022). Investigation into IoT technologies is in the early stages. Nowadays, service designers are designing an IoT system that will equip heterogeneous devices and systems. This system and devices will be capable of connecting with a wide range of networks, protocols, and communication procedures. The heterogeneous nature makes devices capable of communicating across multiple series and networks.

Connectivity

Connectivity in the IoT allows network accessibility and compatibility. The accessibility enables the consumers to use the network through Wi-Fi or wired networks, but on the other hand, the compatibility enhances the ability of devices to consume and generate information for users (Patel & Patel, 2016).

Safety

The Internet of Things is a novel idea that can change our way of life; IoT can revolutionise our education system, healthcare, transport, and entertainment and enhance the interaction with the public department. When many IoT devices are standard in the public domain, then security and freedom threats will increase. Therefore, the designer needs to develop a design to ensure our personal and well-being, our safety, and our security (Maple, 2017).

Monitoring and Control

Monitoring plays a vital role in collecting data from the IoT devices, such as consumption of energy, and environmental conditions, and permits the device managers and automatic controllers to maintain and monitor the working strength of the device in real-time at any time and place.

Big Data and Analytics

In 2015, Gartner (2015) presented a definition of big data as "high volume, high velocity, or and high variety information assists that require forms of processing to enable enhanced decision making, insight discovery and process optimisation". IoT applications are monitoring the information and digging into the massive amount of data collected by IoT devices. Therefore, all IoT objects equipped with data collection sensors required some protocol, for instance, message, queue telemetry transport and data distribution service.

Despite the numerous benefits that IoT brings, such as the revenue increment, the decrease in production costs and the enhancement of working capability, gathering a massive amount of data is not enough. To take reliable advantage of the IoT's application, time is needed to construct a platform in which it will be possible to gather, analyse and monitor the big data, and only then will such a massive amount of data be measurable (Riggins & Wamba, 2015).

Information Sharing and Collaboration

The Business Dictionary defines collaboration as a "cooperative arrangement in which more than two parties work towards a common goal", though the system is a purposefully organised structure that consists of interrelated and interdependent elements. These elements continually influence one another to maintain their activities and the system's existence to achieve the system's goal.

Generally, collaboration only occurs between human-human face to face or over computers networks. However, in IoT, information sharing, and collaboration are possible between humans, humans to machines, and machines. IoT's sensors have the responsibility to gather the information, share it and collaborate with other devices for enhancing awareness, and avoid distortion of information, especially in the supply chain area, such as a store manager or relevant person getting alerts on his mobile phones from refrigerators sensors that are placed in a retail store when a refrigerator's sensors detect any failure in the system and so pass this information to the store manager (David, Nait-Sidi-moh, Durand, & Fortin, 2015).

1.2. IoT Generations: Chronological Approach

Currently, the Internet is one of the most demanding and valuable technologies to perform the activities of daily life, especially in the education, entertainment, and business sectors. The relationship between devices and Internet technology provides smart platforms; devices on these platforms have the freedom to make decisions and solve problems by themselves without any human intervention (Ammar et al., 2022)

In the first forty years after the invention of the Internet technology by ARPANET (Tjörnbo & McGowan, 2022; Ye & Huang, 2011), people used Internet technology to create person-to-person or person-to-group connections via e-mail and social media networks(Akrim & Sulasmi, 2020). Later, the usage of the Internet increased into all domains of human life, most notably in areas such as education, entertainment, and medical purposes. It is expected that in the future with the help of Internet technology, it may be possible to link every single device, machine, and object through wired or wireless Internet protocol networks.

Internet technology integrates different types of applications and protocols to build a comprehensive and interconnected computer network system. Moreover, billions of users interact with each other through computer network systems for educational, social, or business purposes. One can agree that humanity is passing through an era in which communication and connectivity with other humans is not the great challenge it once was. Lately, attention has diverted to developing systems in which it will be possible to integrate humans and digital devices. Integrating humans and digital devices is called IoT (Internet of Things) (Roshani, Sandeep, Zdzislaw, 2022). Because IoT is new a paradigm which has changed the old ways of living into a high-tech lifestyle, such as the smart home, smart city, energy-saving pollution control, transportation, and smart industries are so transformational due to the Internet of Things (Nesi & Pantaleo, 2022)

Many novel concepts are emerging from the concept of the "Internet of Things" (IoT) and into our daily lives. In a smart world, the IoT is an innovative and growing concept in which digitally augmented everyday things are connected to each other and with computers, mobiles, switches, actuators, and vehicles (Ali et al., 2022)

IoT is a concept that represents a mixture of different networks, in which objects are physically connected through electronic devices and software applications, allowing the physical devices to gather data from various destinations, such as browsing websites, sending e-mails, and multimedia content such as text, audio, images, animations, or video. Many developed parts of the world such as the USA, Japan, and Europe, consider IoT as a novel idea and a developmental step, both at an academic and a commercial level. Therefore, numerous universities and industrial research centres

are doing extensive research into IoT technologies (Miorandi, Sicari, De Pellegrthe ini, the & Chlamtac, 2012; Chung & Jeong, 2020; M. & Ravi, 2020).

There are currently millions of devices in the world that can obtain and collect information, communicate, and share data with other devices, all of which are interconnected through an internet protocol called MQTT (Message Queuing Telemetry Transport). An MQTT IoT-based object can regularly collect data, analyse them, and take appropriate action, helping to improve human life, health, management, and decision-making domains, among others.

The IoT design has three main features: 1) any object can be uniquely identified; 2) any object can communicate with other objects, devices, or humans; and 3) every object is ready to interact with other objects or humans, at any time or place, within a specific network or protocol(Gallala, A., Kumar, A. A., Hichri, B., & Plapper, 2022). At an individual level, the IoT concept will be equipped with smart machines or things, but tasks will be completed with the help of internet technology. Therefore, smart devices will get internet services through internet routers, hosts or terminals (Pal et al., 2022; T. Qiu et al., 2018)

In an IoT system, smart devices and sensors can communicate and store data in the cloud through Wi-Fi___33, Bluetooth, and wired Internet technologies. When data is stored in clouds, different software applications can access and process that information for appropriate actions (Gavrillovic& Mishra, 2021; McClelland, 2017).

The term Internet of Things is a hub of a network of physical devices, objects, sensors, and other digital electronic appliances and applications that enable these objects and devices to gather and communicate information with other devices and objects for common goals. The IoT application offers a smart cosmos through remote sensing and controlling services to directly integrate physical into the smart computer-based environment that enhances productivity (Gokhale et al., 2018; Nesi & Pantaleo, 2022).

Due to IoT characteristics, IoT can interact with its various nodes without human presence. Various IoT-based health, automotive, transportation and health applications have been developed. The IoT is still in the development stage; however, various novel applications have been introduced to integrate digital devices with smart sensors on internet platforms. The IoT technologies involve infrastructure, interface, protocol, standards, and communication.

Although the IoT concept appeared on the digital market over two decades ago, the maturity of IoT applications indicated that IoT had developed many decades before due to a rapid process of evolution. The roots of the IoT come from ARPANET Project. ARPANET project was conducted in 1969, with the primary goal to enhance computer research productivity through interconnectivity among

and between computers. These computers could share and link to other computers for specific defence or public sectors (Maalla, 2021Bolt; Beranek, & Newman, 1981). The development of IoT technology is currently three generations old to date. The first-generation experience includes tagging and embedded technology platforms. The second generation was a complex social web of things in which billions of devices communicate with each other for social and professional purposes: while the third generation experienced autonomous social objects and cloud computing.

The following section briefly discusses the development of IoT by describing the three IoT generations and the different IoT applications in each period

First IoT Generation: Embedded Things

The internet of things has been in the focus for the past decade. It is considered one of the disruptive technologies of this era (Manavalan & Jayakrishna, 2019) and so far, has caught the attention of researchers, society and industry as a way of technologically enhancing day-to-day activities, creating new business opportunities, services, product and as a broad source of investigation subjects and ideas; several associations, institutions, enterprises and even governments have understood its importance and recognized the possible benefits that can be obtained from the IoT, leading them to undertake strategic projects and initiatives aiming to develop this field and profits from it.

One more essential technology for the IoT is the embedded computer system. The IoT term was used for the first time in 1974 and explains a computer that is physically integrated into a larger system whose core function is not data processing and is vital to such a system from a design procurement and operational controls perspective (Ibarra-Esquer et al., 2017).

These systems are installed by using tools like microcontrollers and single-board computers and have newly earned popularity with good affordability and ease of use for prototyping. In 1991, Mark Weiser presented a unique concept called ubiquitous computing, which later became known as "pervasive" computing. In pervasive computing, computers work behind the scenes without making their presence known. Embedded computing technologies are an essential part of ubiquitous computing because it makes it possible to organise ubiquitous computer networks on a large scale (Weiser, 1991).

In the mid-'90s, several technologies were developed based on sensor nodes, such as wireless communication. These tiny sensor modules are intelligent and autonomous, capable of sensing the data, processing, and communicating with other devices or humans using the digital network. The massive number of sensor nodes allows the deployment of sensors in various fields such as health, education, corporate and weather sectors (Ghaffari & Bannaeian, 2017; Landaluce et al., 2020).

Thus, at the beginning of the IoT development journey, it provided a platform in which Electronic Product Code (EPC) could be stored, tracked, measured, and cross-referenced. Electronic Product Codes are capable of storing radio frequency identification (RFID) tags and have specific numbers that recognise the items in the supply chain (Imani et al., 2020). This concept can remove very many hurdles in the supply chain for the wholesaler, retailer, and consumer alike, and enhance the productivity gains illustrated by the barcode idea on a global level. The Electronic Product Codes (EPC) were embedded with the objects.

Likewise, in the early research of IoT, the RFID chip became an essential component of IoT applications (Ibarra-Esquer et al., 2017; Salih, K. O. M., Rashid, T. A., Radovanovic, D., & Bacanin, 2022). After introducing RFID technology, most users had thought to use this technology for tagging objects and giving them a unique identity because, through this concept, it was possible to ensure the privacy and security of objects. Consequently, IoT was considered an emerging worldwide technology that made it possible to provide reliable services in which people exchange objects and services on a global level without compromising security and privacy(Al-Turjman et al., 2022). While advanced development in RFID was in progress, other novel technologies reached a maturity level, for example, Wireless Sensors Network (WSN) (Atzori et al., 2017; Costa et al., 2021)

Features of Electronic Product Code Global

RFID tags: The primary function of Radio Frequency Identification RFID tags is to permit computers to detect, identify, evaluate, and take actions. The second generation of RFID Tags is capable of automatically collecting the data and processing that data in real-time (Rao et al., 2022)

RFID readers: RFID readers are a comprehensive identification technology that gathers information related to object identification from the tags to readers. RFID is a technology that works behind the scenes over both long and short distances. The RFID reader can identify a large amount of data with fast and accurate results, so it is an appropriate technology for the surveillance of mobile objects. In fact, for such surveillance, each object is embedded with RFID tags and readers that are designed to monitor the motion of the object (Ammar et al., 2022).

Electronic Product Code: The electronic product code is a scheme based on a numbering mechanism. This scheme can recognise the accurate location of the object on the network, production record version, manufacturer name, and product serial numbers and recognises the specific identification of every single RFID tag (Habib, 2019).

Filtering Middleware: The primary responsibility of the EPC global (Electronic product code global) network is to collect data or information through filtering middleware. The EPC information

service is the primary source of EPC that contains two standards. First, one interfacing capturing the signal, the interface can collect information about an ECP event, and the second one is THE query interface that permits the users to retrieve the information about the event. The filtering middleware control scheme uses to solve the issues associated with a large amount of RFID data. Likewise, the filtering middleware data searching method is based on an electronic product code (Hui et al., 2022).

Object Name Service: In EPC Global, object name service is a method that influences the domain name system (DNS) to find information related to desired products and services that are coming from Electronic Product Code (EPC). The Object Same Service (ONS) is an independent digital networking service; it is a service that is an alternative to a domain name system (DNA) that gathers information from digital sites through smart computers (Atzori, Iera, & Morabito, 2017).

EPC Information Service: The primary function of electronic product code information service (EPCIS) is to set the level of methods that permit capturing and sharing movement information during the development of physical objects. The electronic product code can set reliable parameters for the web information system of IoT (Internet of things). The EPC characteristics are compatible with RFID technology and sufficient to handle various sensor data in an IoT cosmos (Byun, Woo, Tolcha, & Kim, 2018).

In 1980, the first generation of Machine-to-Machine communication technology was introduced, such as in telecommunications. The first-generation mobile telecommunication system was based on analogue transmission systems and could only operate on low-quality voice frequency. Comparatively, the first-generation technology mechanism was not an ideal framework because it was based on a weak voice link, weak working capacity, and no mechanism to ensure user data security yet existed. First-generation mobile telecommunication contains many standard protocols between advanced mobile phone services like the Nordic Mobile Telephone (NMT) and Total Access Communication Systems. The first generation used this standard protocol for frequency modulation techniques to process the voice signal and decision-making (Caritech Communications, 2015).

Machine-to-machine learning is an independent interaction mechanism in which many digital devices do several jobs such as sensing, actuation activities and data or information processing without human interference. The digital device's architecture and design are based on a smart grid, (A smart grid is a modern electric system it uses communication, sensors automation and computers to improve flexibility, security, reliability and efficiency and safety of the electricity system). Electronic servers and navigation techniques are used to gather information via digital networks. The main characteristic of machine-to-machine communication is to provide monitoring services without a human presence (Panda et al., 2022; Verma et al., 2016)

Second IoT Generation: A Complex Social Web of Things

In the future, Internet technology will represent a massive number of devices that, via high-quality communication procedures and specific addressing schemes, will provide data or information and specific services. Indeed, it is expected that billions of objects and devices will play a vital role to bring biological data into the digital world through a networking scheme in which people will access different contents and services. Consequently, the object networking model, described as the Internet of Things, provides many opportunities for the users, services providers, and content producers, with various applicable characteristics in various fields, such as health, education, environmental issues, agricultural and security-related issues.

Nowadays, due to the virtual characteristics of the IoT, it is possible to locate, address and read the information and activities of personal things. Through the IoT, digital objects and devices can produce and consume the Internet of Things services and communicate with each other for mutual goals.

Web of Things (WoT)

In recent years, the development and transformation of the Internet of Things into the Web of Things (WoT) provided new scenarios and applications for users. Due to this transformation, the Internet permits objects to interact with other objects and humans.

The usage of wireless networking applications such as WiFi and Bluetooth technologies has been increasing in daily life. Over the last decades, the development of networking technology has been emerging with sensing applications that can deliver remote and seamless access to sensory information and data. This information is extensively compatible with a web application to provide health solutions safer and more reliable (Rana et al., 2022).

Improvements to technology and its development act as a cornerstone for the Web of Things (WoT) and its services. The applications of WoT provide very comprehensive services that can enable people to perform everyday activities. WoT applications use the Internet of Things platforms as operational platforms. In the same way, digital websites use the Internet to perform their functions. The extensive development in web services pushes them to the next stage, where the Web can host services that use real-world things. Therefore, the WoT concept links two different worlds, the physical and virtual worlds. Web services are essential for accessing information, and it is impossible to access information without web services (Rahman & Hussain, 2020). Web services are mature with the passage of every decade and transformation from an information platform to virtual, social, business, and educational communities. The virtual community sets social trends and leads to enlarging social and professional circles of users.

Moreover, the development of Web technologies is conceptualising technical procedures that can enhance worldwide communication and networking ability, especial for enterprises. Due to a new digital application, the simple internet protocol transforms into IoT, and Web applications transform into WoT. Thus, in WoT, real-world things can use the abilities of physical objects to make decisions, detect and react for making effective changes in their surroundings.

There are various platforms available for enabling sensors for web services. These sensors are a meagre cost, measuring the consumer's experience and endorsing the growth of third-party applications capable of relying on sensor data and taking appropriate actions. The applications motivate the consumers to use them and to follow new technological trends to enhance demand and supply through liking sensors via data analytics results through web applications worldwide. Due to the new digital application, it is quite easy to program the embedded sensors (Courtois et al., 2022), and these sensors are demonstrated through different procedures that define the complex digital applications network (Shehab et al., 2022)

Semantic Web of Things

The web protocols develop WoT with the help of internet technology and the semantic Web. The semantic Web plays a vital role in developing guidelines for the Web. The primary role of the Semantic Web is to organise the content and make them meaningful for the user on the Web. Moreover, this content's organisation technique leads to investigative interference, which manages the Web intelligence and makes the applications more intelligent and autonomous. The intelligent data created by real-world devices and services leads to an offer of the semantic Web of things (Singh et al., 2022) and is about to bring semantic Web and Internet of Things or Web of Things on one platform. The main objective of this technique is to make it easy for real-world objects to access data and information. The semantic Web of things provides the interconnectivity that makes it possible to manage heterogeneity and enhance the productivity of seamless objects and services. Therefore, a modern, heterogeneous web of devices has a great motivation to adopt the internet protocol version 6 (IPV6). Consequently, the integration of things at the connectivity level has brought novel solutions like IPv6 Addressing pixies, GLoWBAL IPv6, and 6LoWPAN (Hui, 2011, Jara, Zamora, & Skarmeta, 2012& Jara, Moreno-Sanchez, Skarmeta, Varakliotis, Kirstein, 2013, Javed, Afzal, Sharif, & Kim, 2018).

After the maturity of internet connectivity through 3G,4G and 5G technology, a protocol was needed for data transportation and application layering for better communication for its users. In this context, the world wide web is used as one of the more extensive application protocols for data and information transportation, such as Hypertext Transport Protocol (HTTP). Recently Hypertext Markup Language (HTML) started a leading role that constructs logic and intelligence services through

JavaScript and resources such as HTML5. These two components are developing a desktop application for the digital Web platform and providing a platform where the applications can change information and data (Marinescu, 2019). When smart objects connect with Web sites through internet technology, this action can be called the Web of Things (Jara, Olivieri, Bocchi, & Jung, 2014& (Zyrianoff et al., 2022)

Furthermore, the "Internet Engineering Task Force" (IETF) is a comprehensive group of researchers. The ETF is the group working to enhance the strength of IoT applications with web technology and provide unlimited access to the Web and provide an opportunity to connect the digital sources, discoveries and directories for distribution of discoveries (Shelby, 2013 & Ni, 2020). The WoT enables digital objects and platforms to interact with each other. Thus, this method constitutes an extensive, multifaceted service. The interaction between things and systems becomes mature through an Application Programming Interface (API) by using a different protocol such as Hypertext Transfer Protocol (HTTP) and Constrained Application Protocol (CoAP). Likewise, the protocols scheme provides an interface capable of publishing related data information and providing the data publishing updates in the systems (Qian et al., 2022)

The semantic Web of Things, where the sensors are integrated into the Internet through CoAP or HTTP protocols, helps develop the application. Likewise, through sensor integration, the developer's request and process data provided by smart sensors. However, it is impossible to measure the data manually because this method requires machine-readable information from sensors. In this context, these requirements are fulfilled by the semantic Web of Things because the Semantic Web of Things (SWoT) enables the machine to read and understand information, process this information, insert the information data in the organised description of sources and insert the open data as a framework, produces that integration on an emergency basis and make them meaningful by (Pal et al., 2022; TIM BERNERS-LEE, 2001)

The SWoT is a platform in which the Web of Things works autonomously with the help of semantic web characteristics. Therefore, the semantic web characteristics can provide essential tools to enable continuity in the information flow using the World Wide Web platform (Sheng et al., 2018)

Social Things and Networking Technologies

In the present technological era, social media plays a significant role on the Internet of Things by using Internet technologies. Therefore, the growth of social media, its usage, and its influence have been increasing in society(Botta et al., 2016; Khanna & Kaur, 2019)

The effectiveness and productivity of the Social Internet of Things are the same as that of human social networks in the real world. The reasons behind the development of the Social Internet of Things are the popularity of social websites such as Facebook, Twitter, and other social media platforms (Kim & Park, 2020)

Consequently, the Social Internet of Things acquired a prominent position among academic and cooperative researchers and developed a new paradigm of networking, sociology, E-education, and business. On the other hand, a method called 'homophile' was proposed by Fielding and Taylor in 2002, which intended to establish a mechanism with an advanced level of trust that will enhance relations between, and productivity between, smart things (Fielding & Taylor, 2002)

Furthermore, Marry (2013) argued strongly in favour of increased integration of Social Thing's role in the future Internet (Ang et al., 2022). The main objective to adjust social networking into IoT is the integration of the objects into IoT services and applications. Moreover, the second objective to enhance the growth of human social networks services (SNS) platforms is to improve the user expertise to share their data with their friends or relatives generated by consumers' smart objects.

During this 2nd generation of IoT development, it was possible to obtain different goals through social networks on the basis and foundation of the IoT. Social networking platforms are capable of sensing data and communicating via smart objects to which information is accessible communication platforms. Holmquist (2001) presented an object socialisation concept. Holmquist's ideas mainly focused on those key factors that could enable wireless devices, especially wireless sensors (Holmquist et al., 2001, & Atzori, Iera, & Morabito, 2017) the author observed that it is possible to control the sensors node that executes the communication process effectively.

The latest studies highlighted various innovative applications that have an architecture based on 2nd generation objects and devices. These objects took a vital position in people's daily life activities due to novel behaviours and intelligent characteristics. These characteristics have great potential to enhance the interaction with each other, which was not possible in the past. The things and objects connected with internet technology are very different from those things that are part of the Internet of the social network because things on the Internet of social things are equipped with Embodied Microblogging (EM) technology, and challenges that present vision of IoT (Nazzi & Sokoler, 2011& Balakrishnan, Sheeba Rani, & Ramya, 2019). Embodied Microblogging has two leading roles: a) enhancing human-to-human communication, and b) recording the information and data that notice daily life activities (Kranz, Roalter, & Michahelles, 2010). Although Social networking technology is a unique phenomenon that introduces a web of communication, objects or devices can also take part in a conversation with a human. In the past, it was only humans who had the means to lead different types of conversation. Smart objects have very comprehensive characteristics that can

sense the dynamic of community structure, and these objects also enable impulsive networking architecture on the bases of information disseminated (Mendes, 2011& Ozioko & Dahiya, 2022).

Third IoT Generation: Autonomous Social Objects and Cloud Computing

Social Internet of Things (SIoT)

The Social Internet of Things is a platform that can enable the making of innovative services at breakneck speed and can provide help to existing services through IoT technologies. The main objective of the social Internet of things is to establish a social connection with other objects, and devices and work autonomously concerning human beings (Atzori, Iera, Morabito, & Nitti, 2012& Ray, 2018). Moreover, SIoT provides an ecosystem that permits people and intelligent devices to engage with themselves within a digital social cosmos (Belli et al., 2020; Zammit & Kenna, 2016).

The universe of the Social Internet of Things (SIoT) has extensive organisational support; SIoT can collect various information and data through this support. This information passes through different interfaces for intelligence and smartness enhancement (Babar & Arif, 2017). Therefore, the smartness form of information and data by a broad objective of innovative platforms, and services, successfully, going beyond distributing and specific quality of information reading concerning image, and text. Furthermore, the boundaries of social network services have been increasing from a single person to an organisational level with the help of IoT applications that enhance company collaboration (Yuan, Liu, & Antonopoulos, 2018).

Thus, the IoT is becoming the most popular communication tool that provides an opportunity for new technologies such as embedded technology. Interface protocol (IP) allows embedding intelligent devices and objects for short and long-range communication for gathering data and analysis and effective communication. The presented characteristics of SIoT provide a platform in which it is possible to discuss the different variety of research in designing digital platforms for SIoT atmosphere, and the vitalisation of SIoT application is being discussed (Afzal, Umair, Asadullah Shah, & Ahmed, 2019).

Information-Centric Networking (ICN)

The historical development of internet technology supports the reliable connection of smart devices that provides novel approaches, through these approaches, it now being possible to manipulate online content, and this has generated new challenges, and empowered new technologies, applications, and protocols. The integration of low-cost, smart, and effective sensors

and the expansion of wireless technologies enable the digital connection of devices through internet technology. Likewise, internet technology helps to deploy the Internet of Things, in which digital devices and objects are converted into smart devices for the enhancement of better communication and data collection. Various networking ideas have been suggested to promote IoT usage and applications in an emergency (Sheng, Yang, Yu, Vasilakos, McCann, & Leung, 2013 (Tsao et al., 2022).

Various novel solutions have been proposed in communication technologies like the ICN (Information-Centric Networking). The main feature of Information-Centric Networking gives identification to the digital content, enlisting the data and information inside its infrastructure without trusting internet protocol identifiers (Vasilakos, Li, Simon, & You, 2015 Zhang. L, 2022). In 2009, Information-Centric Networking was proposed. The ICN method was based on a network of information architecture, published, and subscribed to Internet technology (Jacobson et al., 2009, Dannewitz et al., 2013& & Hussaini, Naeem, Kim, & Maijama'a, 2019).

Specifically, the "Named Data Networking" method was extensively adopted on an immense scale due to its features such as transparent communication, light configuration, and operational management methods (Huo et al., 2022). Information-Centric Networking proposes an identification approach without any specific topology and offers extensive routing for a reliable forwarding approach. Furthermore, the Name Data Network offers effortless, smooth, and robust receiver-driven communication based on an exchange between two types of pockets. In the current scenario, the ICN has appeared as a novel approach to overcome identifiers restriction and can assist numerous IoT scenarios such as smart homes, smart cities, and smart manufacturing (Belli et al., 2020).

Also, Information-Centric Networking (ICN) enables a comprehensive communication framework by using the machine to machine (M2M) technology, capable of connecting the smart devices or objects equipped with smart sensors that ICN operates autonomously and permitting the construction of various communication services in the IoT atmosphere. The ICN is also useful as extensive support for specific communication between constrained objects and gateway (Amadeo, Briante, Campolo, Molinaro, & Ruggeri, 2016). The deployment of Information-centric networking (ICN) and specific digital data networking addresses the problem of electric energy saving in the IoT atmosphere (Amadeo et al., 2016)

Cloud Computing

IoT needs a platform that will be capable of storing virtual data and information without human interference. In this context, the IoT need to adopt cloud computing methods, helping to enhance the productivity of smart object without any human interference. IoT based sensors devices use limited energy resources, such as RFID readers, thus using much less energy and providing

positive outcomes (Al-Turjman et al., 2019), Cloud computing is the need for IoT devices for digital counterparts because IoT devices permanently use Internet technology by using Internet servers (Firouzi et al., 2022) and provide platforms in which digital devices and applications interact with each other. In the present digital technology scenario, the scientific community predicted that the next step for IoT is to integrate into cloud computing; this prediction defines the future of the cloud of things (Costantini et al., 2022; Tei & Gurgen, 2014). Cloud computing offers different innovative services such as data storage, communication, and running the IoT applications over the Internet. Smart devices are energy-efficient and computationally accomplished; it is mandatory to bring changes in hardware and software applications and enhance the collaboration among the manufacturer and smart devices designer (Al-Turjman, Altrjman, Din, & Paul, 2019)

All technologies have different features that make them unique in the technology world. Likely, cloud computing also has very general characteristics that help to control its operating functions. Data storage over the Internet can be defined as a technological framework that consumes TCP/IP to connect servers and digital storage devices and aids with storage solution placement. Another term called Storage over Internet Protocol (SoIP) is also used for storage over the Internet, with a combination of high-quality storage and networking producers' approaches. SoIP offers reliable and effective output productivity and scalable internet protocol storage solutions (Skourletopoulos, Mavromoustakis, Mastorakis, Batalla, & Sahalos, 2017; Whaiduzzaman, Haque, Rejaul Karim Chowdhury, & Gani, 2014). The primary role of the service over the Internet is to make sure to assist the users to convert ambitions into reality or achievements by providing high-quality internet, internet efficiency, and reliable speed (Garg, Versteeg, & Buyya, 2013 &Philip, Rodrigues, Wang, Fong, & Chen, 2021).

Cloud computing is an energy efficiency approach that can manage and control energy consumption growth and is a way of providing cloud computing services at low energy consumption levels, similar to that of a CFL (Compact Fluorescent Light) bulb consuming less energy when compared to the incandescent bulb but still producing the same density of light (Borovick, 2020; Katal et al., 2022)

Moreover, cloud computing provides computational cloud services that extensively leverage the digital computationally and ubiquitous applications that are helping to enable mobile cloud computing. Therefore, this system is considered virtual and computationally capable of calculating and providing reliable results according to the user's wishes (Garg, Versteeg, & Buyya, 2013; Whaiduzzaman, Haque, Rejaul Karim Chowdhury, & Gani, 2014, Aceto et al., 2020).

1.3. Usage OF IOT SCENARIOS

IoT is the latest computational digital platform that can support the information system paradigm also capable of holding different types of operating applications simultaneously. IoT has pervasive characteristics such as being ubiquitous, embedded, and able to provide services different from all other information technology methods used at the technical level or for home office application context. The characteristics of IoT permeate daily human lives (Arntz et al, 2022).

Though IoT architecture remains under the definition process, the IoT concept offers means to collect one or more digital "things or devices", and gathering the things helps provide well-defined communication interfaces. Moreover, sharing data and communicating inside and outside the IoT platforms by adopting extensively designed network gateways is facilitated (Zachariah et al., 2015). In the current technological scenario, IoT usage has increased in different fields to improve healthy lifestyles.

In Europe, the research and innovation program Horizon 2020, identifies the effective categories of societal challenges: demographic, health, well-being, food security, sustainable agriculture, sustainable tourism industry, clean energy, smart and green transport, environment, climate change actions, to use efficient pollution-free raw materials.

The IoT has become the hub of invention, and development for industrial and educational research centres since the IoT concept was introduced in the technological world. The IoT concept provides effective solutions in every field of life that never happened in the ICT sector. The IoT enhances the productivity of products, services, and studies around mature technologies. The IoT terms represent a web of connected things, people, devices, and digital services (Perera, Zaslavsky, Christen, & Georgakopoulos, 2014; Wójcicki et al., 2022). The IoT web (networks) services connect large numbers of smart objects and devices that covey useful, valuable, and reliable information and data and provide high-quality services to consumers using a specific communication protocol. Therefore, every IoT device uses a specific communication protocol and has its specific addressing scheme. Consequently, the smart objects' networking concept refers to the IoT and provides a maximum amount of opportunities for users, producers and services facilitators that can be implemented in various fields (Atzori, Carboni, & Iera, 2014; Connier et al., 2020; Saeed, Alouini, & Al-Naffouri, 2020). Currently, the world has a new method of producing enriched smart applications, and their communication services are connected with smart objects through the Internet of Things of the people (Atzori, Carboni, & Iera, 2014; Tran-Dang et al., 2022)

In the last couple of years, the IoT technology has seen outstanding success as a research area that is expected to continue its journey on opening new horizons of innovations and enabling new digital technologies, such as the new concepts that emerged from IoT technologies, like cloud

computing (Gürdür Broo et al., 2022). Because of the enormous growth of digital technology, agriculture has become essential for economic development. Nowadays, different applications and the latest techniques are helping to promote the development of agriculture (Meola, 2016; Kittichotsatsawat et al., 2021)

Traditional farming faces many problems, such as a lack of farming skills, education, and climate change. Due to industrialisation, the Earth's climate changes very rapidly, causing heavy rainfall, mighty storms, less rainfall, unseasonal rains, and heatwaves. Due to climate change, farmers face significant problems, such as the productivity of their crops and the minor life cycle of plants. To overcome agriculture problems and increase productivity, it is necessary to use novel technologies to reduce hurdles in the agricultural fields. In the present scenario, farmers are leaving their traditional agriculture techniques, and novel technologies such as IoT are emerging. The usage of IoT helps to enhance farmer skills in order to increase production capabilities and monitoring. Autonomy increases the IoT's role in the growth of productivity.

The usage of IoT for industrial production is transforming part of the IoT into a new term called Industrial Internet of Things (IIoT) which will cause a fourth industrial revolution (Pandey et al., 2017). The Industrial Internet of things offers a platform to make visibility about company production operations with the help of the integration of objects, devices, or sensors capable of computing and storage. The IIoT offers a mechanism that transforms business operation methods by giving authentic feedback and dealing with a large amount of data. Moreover, the business achieves have goals due to IIoT operational efficiencies, boosting its productivity, reducing business losses, optimising efficiency, and increasing business profit (Gilchrist, Gilchrist, Bangken, & Thailand, 2016; Wójcicki et al., 2022)

Moreover, the IoT has a vital contribution to home automation. Home automation is delineated as introducing novel technologies within the home environment to offer conforming and safety to its users. Likewise, the IoT leveraged overall technologies due to its specification like examination and execution of home automation. Several wireless technologies are capable of remote data or information transfer, data management, and sensing via WiFi, Bluetooth or cellular technologies. Therefore, home automation design provides a platform to enhance the quality of life, especially for disabled people (Stolojescu-Crisan et al., 2021). It offers an interface for smart house devices through a wired or wireless internet and personal computer and smartphone technologies for supply management and observance.

In health care services, IoT has a significant role in improving the lifestyle of health care services. Technology is helping to overcome the elderly population's problems, such as physical or

psychological problems. Smart Houses, equipped with Zigbee wireless technologies, for example, are an economically affordable solution in global costs, power consumption, and ease of use. The design of smart houses based on Android smartphones is equipped with numerous functions such as detecting falls of Olderadult people, and the system also provides a panic button, ensuring that the olderadult is being monitored from a distance (Tanwar et al., 2022)

Moreover, IoT technologies are reliable to get automatic information about emotional changes, mobility, indoor position, and body physical activities, such as body temperature, heartbeat, and oxygen level in blood. However, the IoT-based system can be deployed at home and controlled from long and short distances through smartphones or smart devices (Mighali, Patrono, Stefanizzi, Rodrigues, & Solic, 2017; Khar & Manju, 2020)

1.4. Definition Of IoT recent era And For Present Study

It is hard to offer an ultimate definition of the IoT concept. IoT has two main components: "Internet" and "Things". The term "Things" encompass sent set of objects, including humans, smart devices, sensors, and other devices designed However, the new definition of IoT gives more importance to autonomy and Ubiquitous networks of Objects. Cisco has been using the IoT concept as the Internet of Everything (IoE) for objects, people, and places to exchange information and services (Lopez Research, 2013). This definition highlights the importance of the inevitable role of identification and service integration.

According to Patel, K. K., & Patel, S. M. (2016), the Internet of things is divided into three parts: the interaction, through the Internet, between people, between people and machines/things and between machines/things. In this way, in IoT, everything is interconnected, whether human or machine/things, for common goals and objectives (Gershenfeld, Kran, & Cohen, 2014).

In fact, either of the definitions mentioned above overgeneralised the IoT concept, reduced its scope, reduced its solution capacity and (mis) represented the IoT as a generic platform. Oversimplifying the definition of IoT in such a manner does not allow helpful contributions to understanding the depth of the IoT concept.

Consequently, the simple definition approach suffers from an extensive drawback. Inside the IoT architecture, novel technologies are running, such as cloud computing, IP (Internet protocol), machine-to-machine learning, embedded devices, or objects. The IoT is the hub of everything. Luckily, a general characteristic exists in several definitions proposed for the IoT. Network connectivity is one of the most comprehensive IoT features, offering interoperability of IoT components, seamless integration, and specific IP address schemes. In this context, connectivity

needs a global infrastructure that offers a platform for the Internet of Things operations (Venkat, 2014). As well as the trait of connectivity, the IoT offers another potential and vital feature that transforms everyday objects into smart objects. These objects have to be intelligent, readable, locatable, recognisable, and have a unique IP address; through these characteristics, it is possible to address them and solve the problem or task set to them.

Furthermore, being possible to connect physical things and virtual objects such as sensors and actuators embedded in physical devices or objects is a defining trait. The IoT sensors can be operated through virtual representation by providing digital information systems that have developed across the physical world. The IoT has an essential and reliable autonomy feature. Autonomy features are created to increase productivity and help populate IoT applications and platforms. As stated in the literature, the characteristics of IoT can control complicated systems through self-governance and self-management (Müller et al., 2021).

Moreover, heterogeneity is one of the core features of IoT applications. The main objective of heterogeneity is to develop the co-existence of all those technologies that are taking part in IoT design and with interconnection platforms selected for the implementation of IoT. Every intelligent object is associated with unique services; these services provide reliable information and data by sensing, identification, and multimedia content that every IoT service associated with a smart object or device (S. D. et al., 2022).

In the literature, stated features and characteristics of IoT could be the main properties that will help be classified as an internet of things. Moreover, the IoT offers various applications that resolve different societal issues. To draw the baseline for the IoT definition in the current technological scenario, it is essential to consider some aspects that will provide essential information about IoT properties. The first is the technological aspect; in the IoT definition, the technical term is not a very novel concept because the technology has been used in IoT for several decades. Recently, researchers have started to merge different existing technology into one platform. This method has made it possible to target millions of digital devices and connect them for communication purposes. The second aspect is the design of IoT services. As mentioned above, the IoT became a technology due to the integration of different technologies; therefore, the design IoT of Applications communicates with humans and other devices such as virtual objects. IoT-based applications also generate different types of data, and these IoT applications store data in their storage and share this data in a shared storage place called cloud storage. In this context, everybody who is authorised can access this data from cloud storage for improvement of education, health, and the environment — the storage quality makes the IoT essential services-oriented architecture model for coming internet products. The final aspect of IoT is final productivity, what IoT produces or provides at the end that makes it essential for

human society. As mentioned above in the literature, IoT has an incredible influence to enhance the social impact among users. The remarkable social impact increases the learning ability that modifies the new ways of education from IoT services.

Moreover, there is some reliable productivity of IoT services, such as smart houses, that fulfil an individual's needs, and smart energy management application that manages the energy in a very efficient way. Indeed, one of the most critical aspects of IoT application is that it enhances health care services at home that improve the well-being of olderadults.

In the present scenario, we need a definition that does not oversimplify the IoT concept but gives all information about the IoT concept. It will cover the heterogeneous, interconnection solution and information sharing on a broader level and explain the design of IoT applications and their worthiness.

In this regard, there is one definition that has been put forward by Atzori, Iera, & Morabito (2017) that covers all potential aspects of IoT: "A conceptual framework that leverages on the availability of heterogeneous devices and interconnection solutions, as well as augmented physical objects providing a shared information base ion global scale, to support the design of applications involving at the same virtual level both people and representation of objects" (Atzori, Iera, & Morabito, 2017).

Comparatively, this is the most applicable definition when compared to the previously presented definitions. This definition provides a broad and complete image of IoT and its characteristics that enhance readers' understanding. In fact, through this definition, readers can learn how IoT applications and services work and what these applications can do for the sake of well-being. Secondly, this definition also predicts how IoT applications will deal with and manage big data and heterogeneous devices in the future. It is estimated that in the future, IoT devices will outnumber the human population and be at around 29 billion, connected devices forecast by 2022, of which around 18 billion will be related to the Internet of Things. 5G will enable organisations to move into a new market and build new revenue streams with radically new business models and use cases (Sheng, Qin, Yao, Wales, & Boualem Benatallah, 2018). When there are more smart devices than people it will be hard to transport big data, or it will be possible to face the slow speed for communication and data loading or uploading.

Moreover, it will be hard for a service provider to store a massive amount of data physically so we can see that IoT devices will be designed to handle the massive amount of data and run as fast as possible to prevent delays. Furthermore, this definition provides information about augmented reality in which things or objects provides information tagged with location, people, and objects. Atzori, Iera, & Morabitos' (2017) definition covers all aspects of IoT usage that not fulfil the needs of the current people but also provides ultimate solutions for IoT application users. In conclusion, IoT

technology is playing an essential role in changing human lifestyles. IoT technology offers very many services that have never been offered by any technology previously. IoT technology is a mixture of different technologies and networks such as sensors, big data, cloud computing, and fog computing, (fog computing is a decentralized computing infrastructure in which data, compute storage and application are located somewhere between the data source and cloud), camera surveillance, heterogeneous devices, remote monitoring from short or long distances, and the most important IoT service, namely a secure environment for its users. Therefore, IoT technology can provide a smart environment and rectify societal challenges such as environmental, medical, healthcare, and educational issues.

IoT has one of the essential aspects that are providing smart healthcare. There are many IoT-based healthcare applications such as in-home healthcare (IHH) systems, personal health care devices (PHD), ZigBee Wireless Technology (ZWT), and Ambient assisted living systems (AAL), Body Sensor Network (BSN) and Biomedical wireless sensors network. The stated IoT application is essential in the medical fields that brought revolutionary changes in old age. These applications are designed to monitor patients and older adults over short or long distances. The main characteristics of these applications are to monitor the older adult or patients through video, GPS, audio, fall detection sensors and monitor their blood pressure, oxygen levels and heartbeat rates etc, without human interference. This type of service is provided to older adults because by having IoT healthcare services, people monitoring the health of older adults people, be they near or far, can be alerted to those people's needs and take appropriate action in order to fulfil the needs of the patient.

In sum, the IoT is a platform that offers various services that ensure the availability of heterogeneous devices, storage of big data, and fast, secure, and reliable communication. All these services make the IoT unique and essential tools for improvement of the lifestyle of people and give them a smart environment (a smart environment is a unified global collaboration which considers the environment as a shared common resource shall complement this effort. Religious practice is a way of life which in turn leads to a smart environment through smart living). (Kumar, 2020) in which they can solve problems hitherto unaddressed.

Conclusions

Nowadays, billions of smart objects and devices work together, sense, share information and communicate through internet protocol networks. These objects or devices are interconnected with each other for data collection and analyses, based on which they can initiate appropriate actions, offering intelligence for decision-making, data management, and planning (Karunanayake et al.,

2016). As previously stated, IoT applications have different important usages and contribute to different fields, which is only possible due to IoT's unique characteristics.

The IoT is still partially a riddle today due to said characteristics, dynamics, moods, and capability to enable new technologies and merge them into its structure. It is hard to offer an ultimate definition of the IoT concept. IoT has two main components: "Internet" and "Things". The term "Things" is used to encompass a different set of objects, including humans, smart devices, sensors, and other devices designed to communicate with other objects without time and place restrictions (Buyya, & Dastjerdi, 2016; Motlagh et al., 2020) The connectivity and sensory capability of objects are fundamental for the IoT atmosphere.

However, the new definition of IoT gives more importance to autonomy and ubiquitous networks of objects. Cisco has been using the IoT concept as the Internet of Everything (IoE) for objects, people, and places to exchange information and services (Lopez Research, 2013&Čolaković & Hadžialić, 2018). This definition highlights the importance of the inevitable role of identification and service integration.

Network connectivity is one of the most comprehensive IoT features that offers interoperability of IoT components, seamless integration, and specific IP address schemes. In this context, connectivity needs a global infrastructure that offers a platform for the Internet of Things operations (Zikria, Yu, Afzal, Rehmani, & Hahm, 2018) After the connectivity, the IoT offers a potential and vital feature that transforms everyday objects into smart objects. These objects are intelligent, readable, locatable, recognisable, and have a unique IP address.

Furthermore, it is possible to connect physical things and virtual objects such as sensors and actuators that can be embedded in physical devices or objects. The IoT sensors can be operated through virtual representation by providing digital information systems that developed over the physical world. The IoT has an essential and reliable autonomy feature, which increases productivity and helps to populate IoT applications and platforms.

Moreover, heterogeneity is one of the core features of IoT applications. The main objective of heterogeneity is to develop the coexistence of all those technologies taking part in IoT design and with interconnection platforms selected for IoT implementation. Every smart object is associated with unique services, and these services provide reliable information and data by sensing, identification, and multimedia content that every IoT services associate with the smart object or device (Souri et al., 2022).

IoT technology plays an essential role in changing human lifestyles. IoT technology offers so many services that have never been offered by any technology before because IoT technology is a

mixture of different technologies and networks, such as sensors, big data, cloud computing, fog computing, camera surveillance, heterogeneous devices, remote monitoring from short or long distance and the most essential service of IoT that is a secure environment for its users. Therefore, IoT technology can provide a smart environment and rectify societal challenges such as environmental, medical, healthcare, educational and cultural heritage preservation.

The IoT is a platform that offers various services, ensuring the availability of heterogeneous devices, storage of big data, and fast, secure, and reliable communication. These services make IoT a unique and essential tool for improving people's lifestyle and gives them a smart environment in which they can solve their educational, environmental, industrial, healthcare, and cultural heritage maintenance.

CHAPTER 2: OLDERADULTS' PHYSICAL, SOCIAL, AND PSYCHOLOGICAL WELL-BEING

Self-reported well-being is becoming the hub of intense discussion in several domains such as economics and public policy. Moreover, the development of well-being has been evolving as a crucial societal aspiration. A report published by the French government and led by Joseph Stiglitz (Vanoli, 2017), claims that the current evaluation procedures for economic performance (i.e. domestic product) are insufficient development indicators. In addition, it advocates that self-reported well-being must also be considered an indicator of social progress that leads to societal development. The Office for National Statistics, a UK public office, raised the national level of regarding the evaluation of well-being level in the Older adult population (Steptoe et al., 2015; O'Connor et al., 2021). Moreover, the Gallup-Health ways Well-Being Index poll, which involved interviewing a thousand individuals per day to grasp the well-being level among the older adult's population had similar findings (Alterman et al., 2019).

Health and well-being are two intertwined factors crucial for an individual's state, especially for older adults. Older adults' individuals are more susceptible to long-lasting diseases; thus, it is essential to establish a proper foundation for both factors. Well-being is becoming a centre of innovative research due to the fragility of older adults. Several studies in the literature introduced various outcome measures for assessing the quality of life (QoL) with respect to the individual's state of health (Pequeno et al., 2020). However, the expected results of self-reported QoL assessment may be affected with older age and are influenced by different factors such as social role, marital status; family relationship status; and outdoor activity intensity.

Numerous academic researchers propose that well-being may be a protective element for older people's health, which reduces the high risk of chronic physical and psychological illnesses and enhances life expectancy (Wettstein et al., 2021; Steptoe et al., 2015). Moreover, investigators argue that well-being can provide a method to measure the quality of physical and mental health in older adults. Furthermore, well-being can serve as a healthcare resource allocation metric. This chapter presents evidence linking well-being with age, mental and physical health, and technology in older adults.

The research under discussion includes data that are spatially explicit, global in extent, and of moderate resolution, as well as the total number of seniors in Portugal. This study, data were gathered from different years and platforms for constructing estimates of the Portuguese Older adult population distribution, suitable for geographical analysis. The demographic data collection of the

Portuguese Older adult population is therefore reliable, of high quality, reasonable, and sourced from raw data, due to the official Portuguese census conducted every ten years. The most recent census that the Portuguese government conducted was in 2021, which was published in the National Institute of Statistics in 2022 (Estatística, 20220). The Older adult population's demographic characteristics have changed drastically since the last census; thus, this study explores the different periods and reliable platforms for newly added data. The National Institute of Statistics offers old, new, and live demographic data (i.e., birth and death per minute.)

Furthermore, this study uses different international database platforms such as INE. Instituto Nacional de Estadístic, Education at a Glance to explore the demographic characteristics of the Portuguese population because Portuguese data platforms do not provide information in English. For instance, the National Institute of Statistics https://www.ine.pt. (Mainly presents data in the Portuguese language, but in rare cases, the National Institute of Statistics offers data in other languages (i.e., English, and other European Languages). It is difficult for a non-Portuguese speaker to understand and interpret data correctly if written in the Portuguese language. Consequently, this study relies primarily on available data in the English language, regardless of the publication time and availability source.

Moreover, the Portuguese database platforms do not provide all characteristics of the Older adult population, such as education level. Thus, this study uses data from Education at a Glance 2019 (OECD, 2019). Education at a Glance platform offers different characteristics of the Portuguese population, but this study will consult education data from this platform.

The structure of this chapter pertains to three sections. The first section of the chapter, proceeding with the introduction, discusses the Portuguese older adults' demographic characteristics, focusing on their life expectancy, household, literacy, and health status. This is followed by a section that discusses the core concept of well-being, the connection between well-being and age, well-being and older adults, and the factors that decrease or increase the level of well-being. Lastly, this section describes how well-being can be used as an approach to develop a digital well-being application for the Older adult population. In conclusion, the last section analyses different well-being scales that can measure the well-being level among the Older adult population.

2. Demographic Characterization of the Portuguese Population

In 2021, Portugal had a population of 10.34 million, including the mainland and two archipelagos of Madeira and the Azores. In the last five years, approximately 12.24% of the population is older than 50 years of age, with an estimated 5.47% women and 6.66% of men. The Portuguese

population has seen a 2.1% decrease between 2011 to 2021 in Portugal according to the 2021 census (Institute, 2021). Due to low fertility and positive development in life expectancy, the Portuguese population has been supplemented by progressive ageing the population. According to *Instituto Nacional de Estatistica*, life expectancy rose by 17.55 and 20.81 years for men and women respectively, between 2015 and 2017. However, between 2016 to 2018, life expectancy increased by 20.77 years for women and 17.58 for men, with an average age increase (for all genders) of 19.61. In Portugal, men have a lower life expectancy than women so that men may live up to 75.90 years and women to their 81.80 years; moreover, with a ratio distribution of 17.90% of people who are more than 64 years old, 15.20% for youngsters aged below 15 years old (Instituto Nacional de Estatística, 2021).

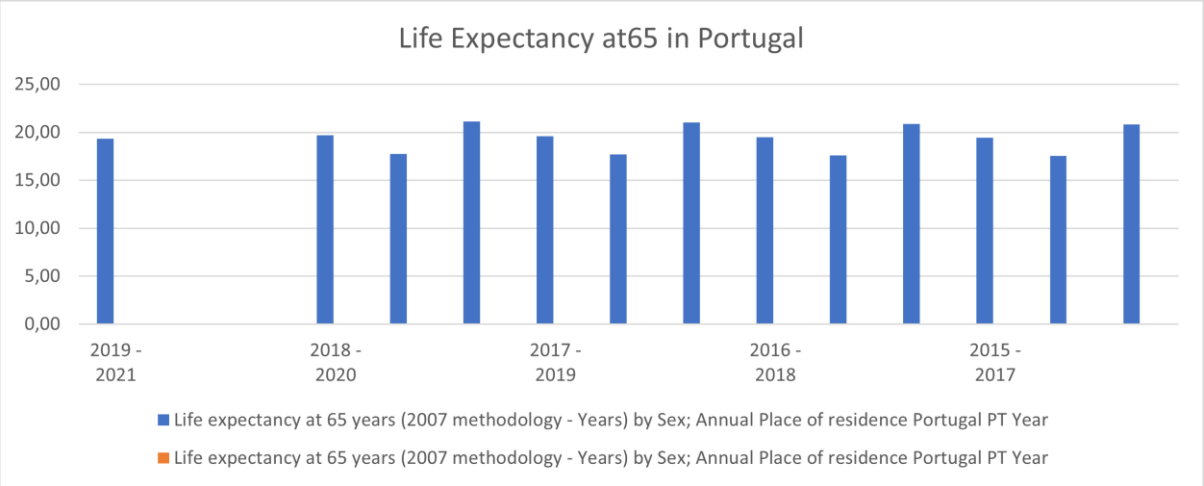
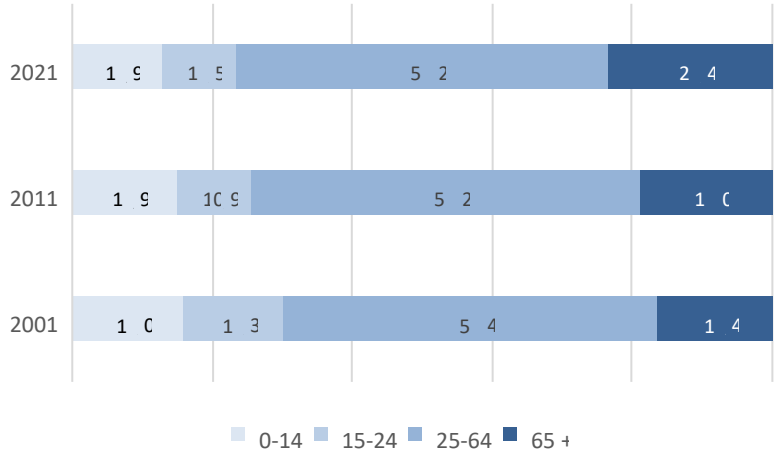


Figure 1 Life expectancy at 65 years in Portugal source (INE.PT, 2021)

The dependency index is an indicator that allows a perception of society's effort on the active population. Between 2011 and 2021. there was a massive decline in all age groups except for the older adult population groups 65 and over. which grew by 20.6%. the groups of young people between 2014 to 2020 had the most significant reduction -15.3%. the decrease of the population aged 15-24 years was -5.1% and -5.7% for the population aged 25-64 years. the double ageing process characteristics by an increase in the older adult population and a reduction in you people has worsened. in 2021, the older adult population represents 23.4 per cent and young people between 0-14 years old just 12.9 (Provisórios, 2021).

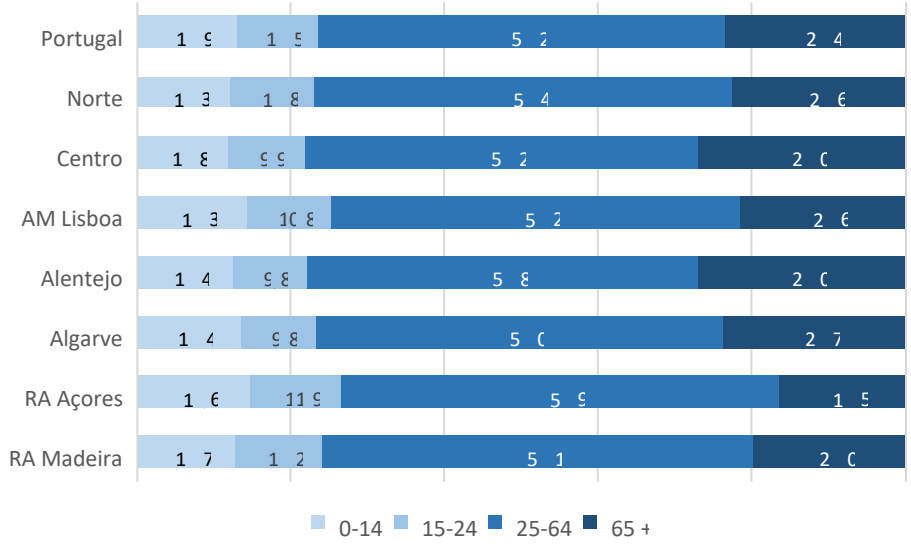
Figure 2 Resident population by age group, 2001-2021 (%)



Source: Statistics Portugal Population and Housing Census (Provisórios, 2021)

Regiao Autonoma dos Acores has the maximum proportion of young people between 0-14 and the population aged 15-24 years is 14.6% and 11.9 in that order and the lowest possible value of the older adults population is 16.5%. on the contrary, central registered the lowest value for young people between 0-14 years is 11.8% and, alongside Alentejo, the most important value for older adults population is 27.0%. Resident population by age group, 2021, NUTS II (%)(Provisórios, 2021)

Figure 3 Resident population by age group, 2021, NUTS II percentage



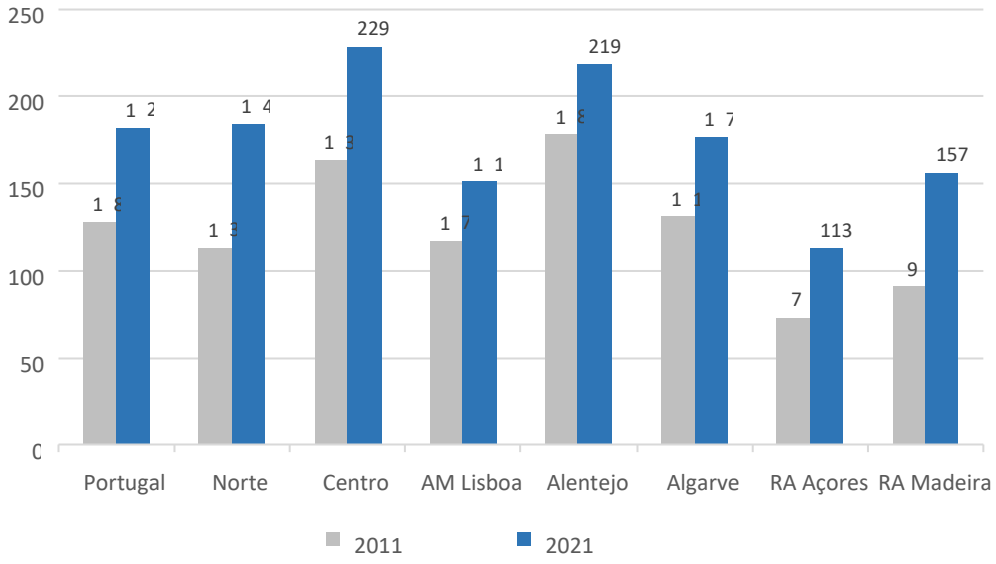
Source: INE, Population and Housing Census

The demographic ageing in Portugal remained to rise with time, highlighting the evident differences in the past decades. According to the 2021 census, provisional results, the population ageing percentage, which compares the aged 65 and over to the population aged 0-14, is 182, for example, 182 older adults per young people. the ratio was 128 in 2011 and 102 in 2001. the reduction

in the ageing ratio is common in all NUTS II regions. In 2021, central and Alentejo regions register the maximum values with 229 older adults per 100 young people. Regiao Autonoma dos Acores Area Metropolitana de Lisboa and Regiao Autonoma de Madeira regions have the lowest possible ratio with 113, 151 and 157 in that order(Provisórios, 202*1*)[1].

Ageing Ratio, 2011-2021, NUTS II

Figure 4 Ageing ration, 2011-2021, NUTS II

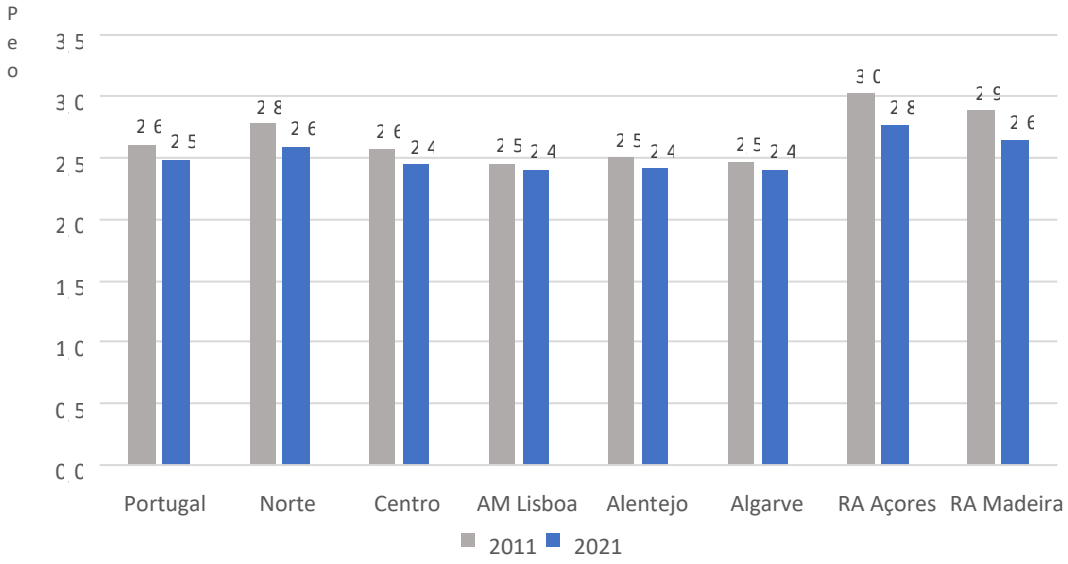


Source: Statistics Portugal Population and Housing Census

The assessment of the Older adult ratio at the municipality level indicates a pervasive contradiction between the interior of the country, the coastline line and central and northern regions focus the older adults

In 2021, there was 4149668 private household and 5476 institutional households in Portugal. compared to 2011, the number of private households and institutional households increased by 2.6% and 13.3%. the huge number of private households has increased in all NUTS II regions, except for the Alentejo region, with a decrease of 307 %. The Average size of a private house in 2.5 people in 2002, which fell by matched to all 2011 / regiao. Autonoma do Acores and Regiao Autonoma da Madeira are the NUTS II regions with the highest average size of private households, with 2.8 and 2.6 persons per household(Provisórios, 202*1*).

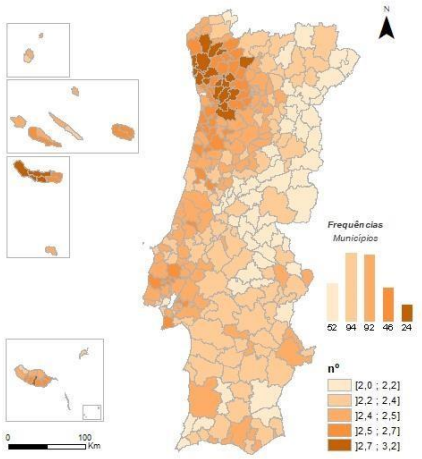
Figure 5 Average size of private households, 2011-2021, NUTS II



Source: StatisticsPortugal, Population and Housing Census

The assessments by Municipality indicate that the median size of Personal Household is higher in several municipalities in Regiao Autonoma dos Acores and on the northern Coastline of the mainland. the Municipalities of Ribeira Grande, and Vila Franca do Campos standout for the largest average size of private households, with a value above three personnel per household. the northern central prior of the country's municipalities hold the lowest figures(Provisórios, 20*21*)[1].

Figure 6Average size of private households, 2011-2021, NUTS II



2.1. Characterization of Literacy of the Portuguese Population

According to education at a Glance 2019 (OECD, 2019), in Portugal, 25% of adults aged between 25-64 years old achieved tertiary education. However, 25% of adults still have lower tertiary education than the OECD standard, nearly 40%, which signifies a considerable development over the past decades. The tertiary education attainment rate, among the younger generation (ages between 25-34), in 2018 was 35%; however, the rate of educational attainment among 55-65 years old was higher than in the year 2008, with 12% to 14% growth. In Portugal, many tertiary students pursue a master's degree level. According to *education at a Glance* (OECD, 2019), in 2017, 33% of all tertiary students in Portugal were registered in a master's degree programme, double the average of 16% of the OECD. Moreover, the percentage of students enrolled in a doctoral programme is more than the OECD average (6%) in Portugal than the average (2%) across OECD countries. According to the OECD (2019), in 2017, nearly 2100 students obtained a doctoral degree from Portuguese universities, of which 55% of them were female students and 23% were international students. In Portugal, the median age of entrants to doctoral degree programmes is 34 years old, considered more than the OECD's standard; moreover, 0.8% of adults have a doctorate (OECD, 2019).

Older adults Health Status in Portugal

In 2021, 50.2 percent of the population assessed their health as good or exceptionally good, down 1.1 percentage points from the previous year (51.3 percent), in contrast to the indicator's long-term upward trend. People with finished secondary or post-secondary education (66.2%) and higher education (74.1%) had the greatest levels of education. 78 percentage of people who had a favourable health status evaluation during 2016 to 2020 the comparison of health status evaluations with at-risk-of-disease assessments.

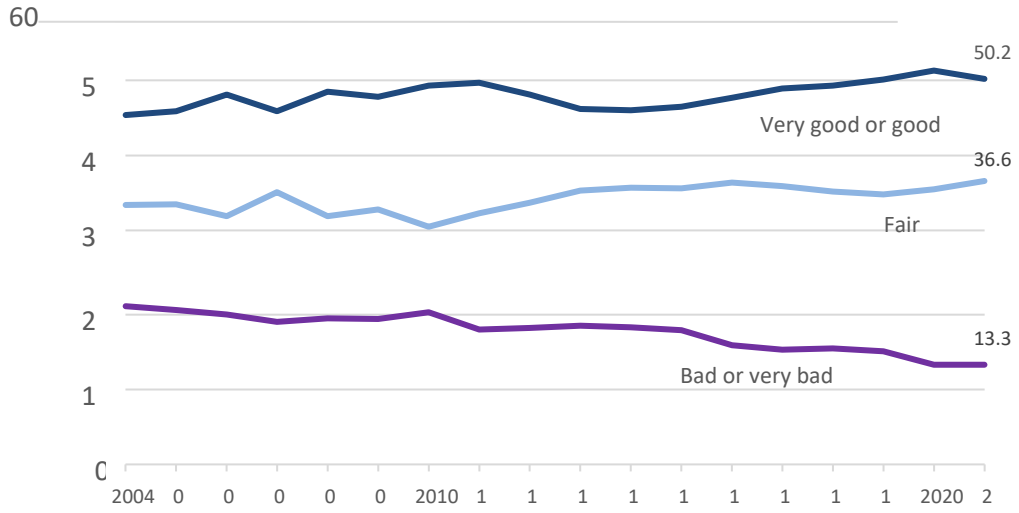
The comparison of health status assessments and at-risk-of-poverty status from 2016 to 2021 confirms the existence of a negative relationship in the case of positive assessments (the proportion of positive health assessments is lower when in poverty), and a positive relationship in the case of other assessments (the proportions of fair, bad, or very bad assessments are higher when in poverty).

Chronic disease or long-term health issues impacted 43.9 percent of the population aged 16 and above in 2021, 0.7 percentage points more than in 2020 and 2.7 percentage points higher than in 2019. In 2021, 34.9 percent of those aged 16 and up reported having some limitations in completing

activities owing to health issues, with 9.6 percent reporting a severe impairment. Both indicators showed a rise in comparison to prior years, reaching their highest amounts since 2016.

According to data obtained in 2021 percent of adults aged 16 and above could not meet their medical care needs, and 13.1 percent could not fulfil their dental care needs. Moreover, a quarter of the population said the COVID-19 epidemic had a detrimental influence on their mental health.

Figure 7 Proportion of the population aged 16 years or olderby self-reported health status, Portugal, 2004-2021(%)

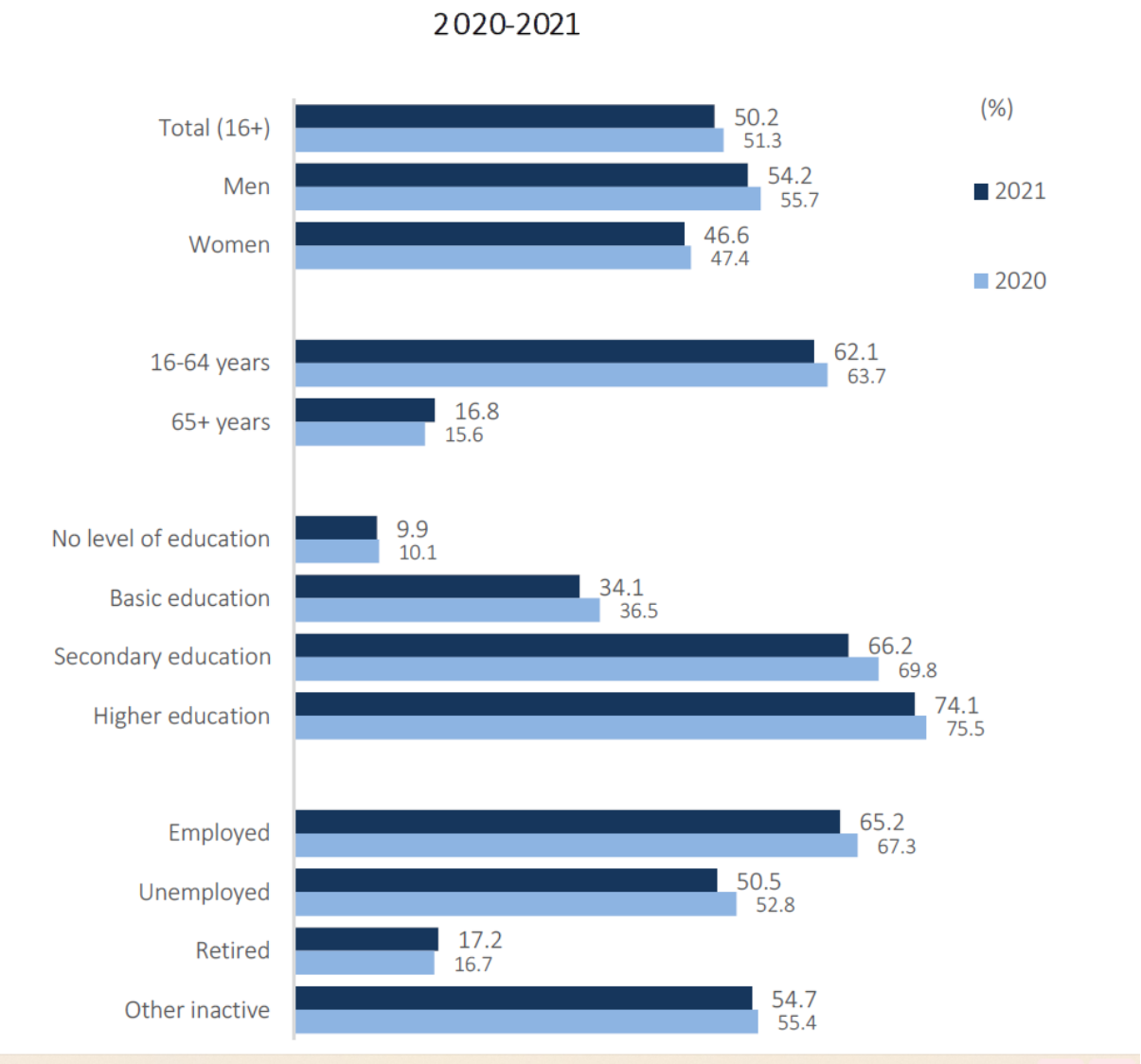


Source: INE, Survey on Living Conditions and Income 2004-2021.

In practically all categories, the proportion of the population who favourably rated their health situation was similar with prior years' survey findings, albeit somewhat lower than the previous year. However, among the senior population (aged 65 and more), the percentage of persons who assessed their health as good or very good increased from 15.6 percent in 2020 to 16.8 percent in 2021. Despite having declined for both men and women, males (54.2 percent in 2021 and 55.7 percent in 2020) remained to be more likely than women (46.6 percent in 2021 and 47.4 percent in 2020) to have a favourable health status evaluation.

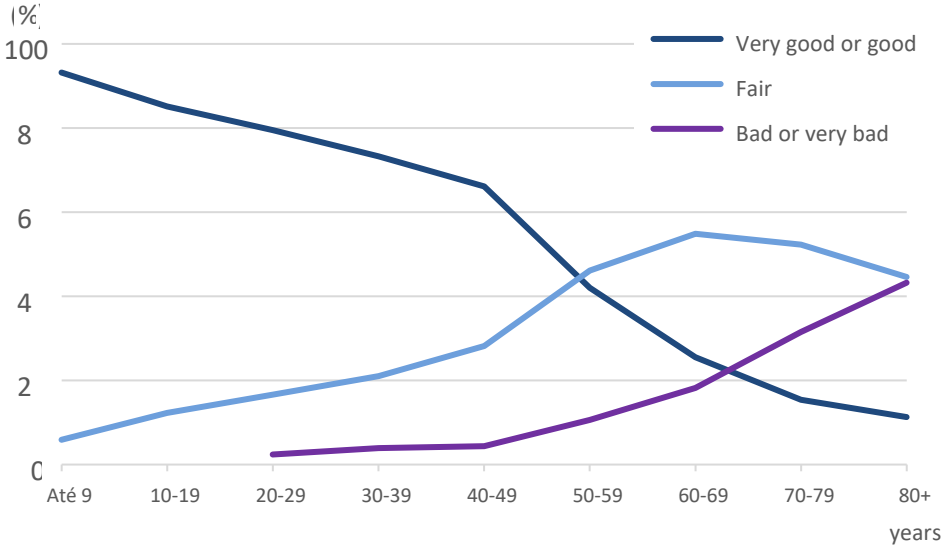
The working population (with 65.2 percent), as well as persons with completed secondary or post-secondary education (with 66.4 percent) and higher education (with 66.4 percent), had the greatest rates of good health status assessments (with 74.1 percent).

Figure 8 Proportion of the population aged 16 years or olderrating their health status as "good or very good



The proportion of persons with favourable evaluations is falling in 2021, from 93.2 percent in the first 10 years of life to 11.3 percent beyond 80 years, with a considerable rise in the severity of variance between 40 and 49 years. In contrast, throughout the first 60 years, the share of persons in good health has increased, while the senior age groups have decreased.

Figure 9 Proportion of the population by self-reported health status and age group, Portugal, 2021

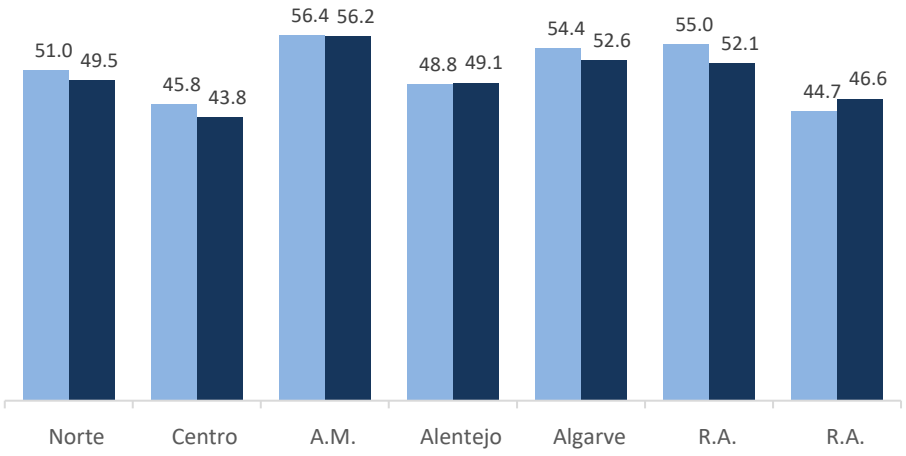


Source: INE, Survey on Income and Living Conditions 2021.

By area, the Region Metropolitan de Lisboa had the greatest proportion of persons aged 16 and over who rated their health as good or excellent (56.2 percent in 2021), a position it had held since the previous year (56.4 percent in 2020). Residents of the Algarve (52.6%) and the Regio Autónoma dos Açores (52.1%) assessed their health as good or very good in 2021, which was higher than the national average (50.2 percent). The population of the Centro area, on the other hand, had the lowest frequency of this indication (43.8 percent) in 2021, a fall of 2.0 percentage points from the previous year (45.8 percent).

In contrast to the falling trend in practically all other areas of the nation, the proportion of the inhabitants of the Regio Autónoma da Madeira who favourably judged their health state grew from 44.7 percent to 46.6 percent between 2020 and 2021.

Figure 10 Proportion of the population aged 16 years or olderrating their health status as "good or very good", NUTS 2, 2020-2021

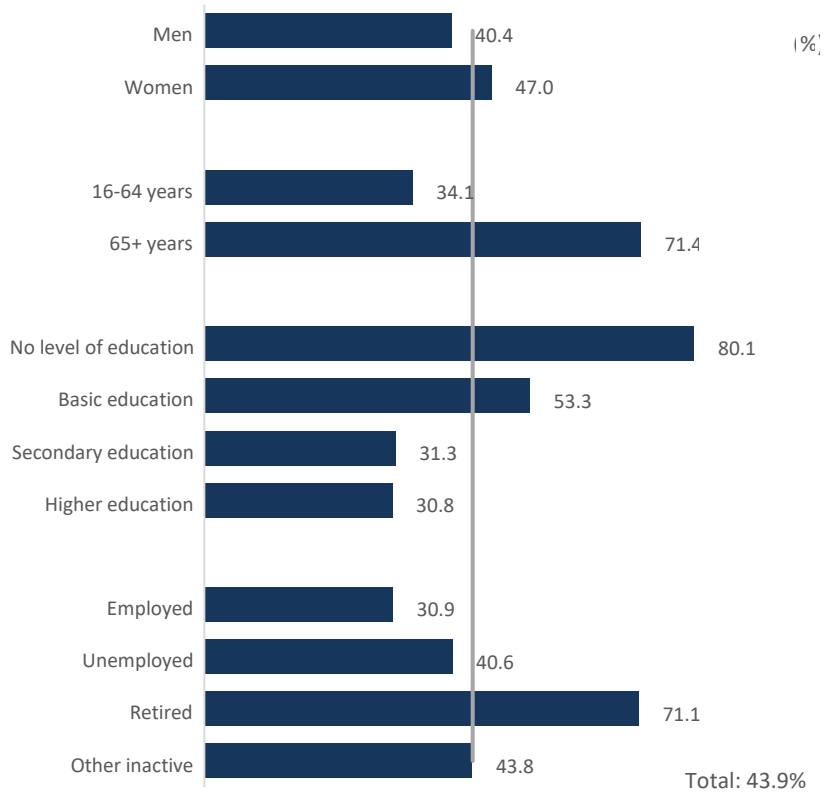


Source: INE, Survey on Income and Living Conditions 2020-2021.

According to the National Institute of Statistics (INE, 2021), in 2021, 43.9 percent of the population aged 16 and up were afflicted by chronic illnesses or long-term health issues (i.e., a health condition that lasts or is likely to last for six months or longer), 0.7 percentage points more than in 2020 and 2.7 percentage points higher than in 2019. This scenario continued to impact more women (47.0 percent) than males (40.4 percent) in 2021, particularly the older adult (71.4 percent), at a percentage 2.1 times that of those under 65 years of age (34.1 percent).

Chronic diseases or long-term health problems affected 80.1 percent of the population without any level of a complete education, a proportion that was much higher than that of people with primary education (53.3 percent) and nearly three times that of those with completed secondary or higher education (both with about 31 percent).

Figure 11 Portugal, 2021, proportion of the population aged 16 or olderwith a chronic condition or long-term health concern

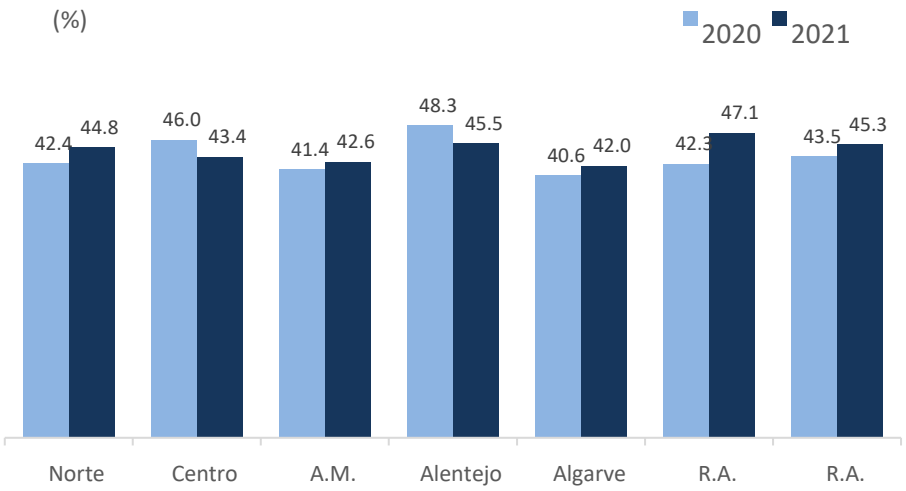


Source: INE, Survey on Income and Living Conditions 2021.

In 2021, the index of chronic morbidity among people aged 16 and above increased for the second year in a row, reaching its highest level in the prior six years in both sexes.

Chronic morbidity was greater in the population of the Regio Autónoma dos Açores (47.1%) in 2021, 4.8 percentage points higher than in 2020 (42.3%), and lower in the population of the Algarve (42.0%) in 2021, 1.8 percentage points lower than in the previous year (40.6 percent).

Figure 12Proportion of the population aged 16 years and over with chronic disease or longstanding health problems, NUTS 2, 2020-2021

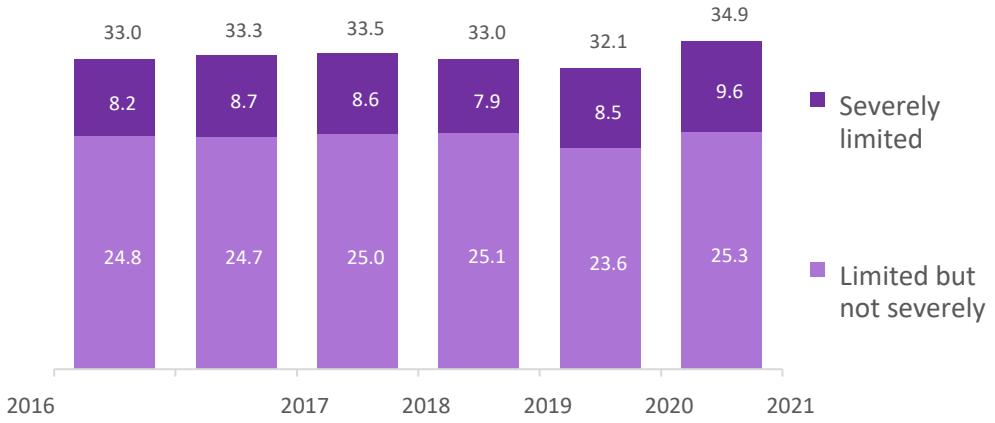


Source: INE, Survey on Income and Living Conditions 2020-2021.

In 2021, 34.9 percent of those aged 16 and up reported having some difficulty doing activities owing to health issues, with 9.6 percent reporting severe limitations. More women (39.0 percent) than men (30.2 percent) reported having some limitations in their daily activities, and the severity of these limitations impacted a larger proportion of women (10.9 percent) than men (8.1 percent). The Older adult (60.8 percent) was more impacted than the group under 65 years old by the presence of certain limitations in their ability to undertake activities owing to health concerns (25.6 percent), 5.6 percent of the population from 16 to 65 years old and 20.8 percent of the population aged 65 years or older have significant limitations. However, as compared to the previous year, the indicator increased the most among the population under 65.

The proportion of persons having some limitations in their ability to undertake activities owing to health difficulties was greater among the retired (59.4%), compared to 33.8 percent of the jobless and 22.4 percent of the employed. These two population groups had large gains in the indicator compared to the prior year (29.6 percent of the unemployed and 18.5 percent of employees in 2020. In comparison to previous years, the presence of activity limits owing to health problems rose in 2021, both in terms of the least severe and the most severe constraints, with the greatest proportions since 2016.

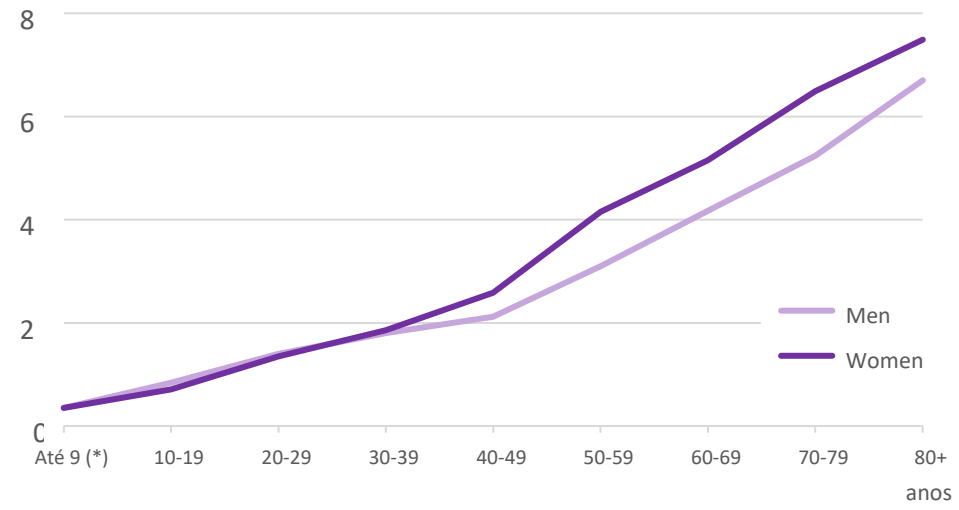
Figure 13 Proportion of the population aged 16 years or olderwith limitation in activities because of health problems by the degree of limitation, Portugal, 2016-2021 (%)



Source: INE, Survey on Income and Living Conditions 2016-2021.

The indicator's data by sex and age group demonstrate that the prevalence of limits owing to long-term health issues increases with age, with greater severity beginning around the age of 40 in the case of women.

Figure 14 Proportion of the population with limitations in activities because of health problems by sex and age group, Portugal, 2021(%)

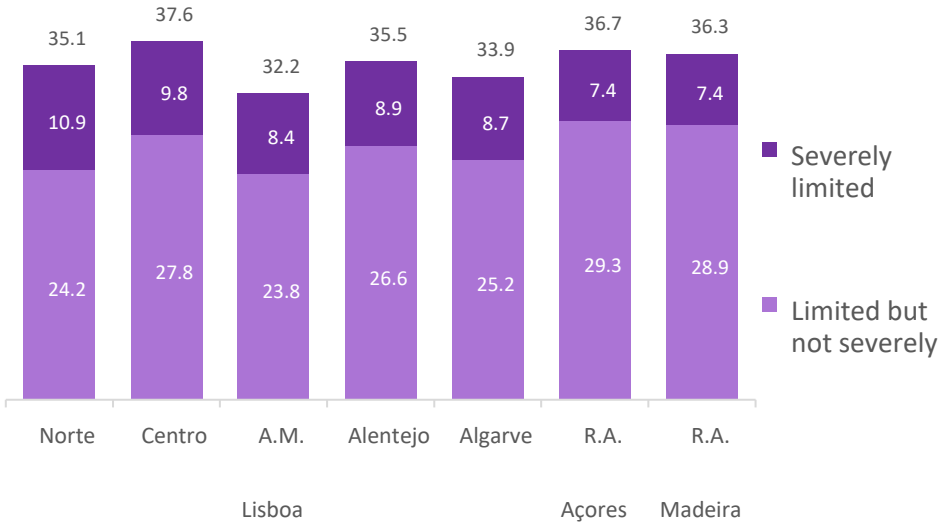


(*) até aos 9 anos o valor refere-se ao total (ambos os sexos)

Source: INE, Survey on Income and Living Conditions 2021.

In 2021, the Centro area had the biggest number of people with some limitations in their ability to undertake activities owing to a health problem (37.6%), but the Norte region had the highest proportion of those with severe limitations (almost 11%).

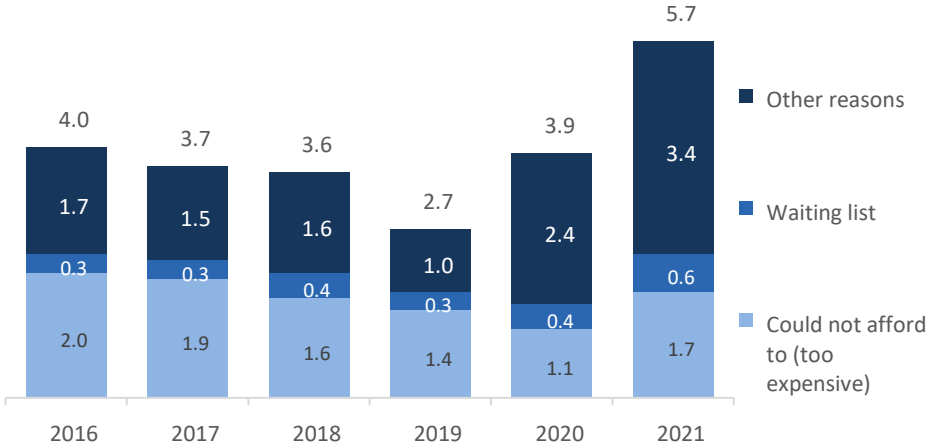
Figure 15 Proportion of the population aged 16 years or olderwith limitation in activities because of health problems by the degree of limitation, NUTS 2, 2021



Source: INE, Survey on Income and Living Conditions 2021.

5.7% facing unmet medical examination or treatment, 1.8 pp more than in 2020 The proportion of people aged 16 years or older who, in the 12 months prior to the interview, could not get a medical consultation when needed reached 5.7% in 2021, the second consecutive yearly increase in the indicator, contrary to the downward trend that has occurred since 2015. In 2021, 30% of the people who reported this situation reported financial difficulties as the main reason (1.6 pp more than in 2020) and about 60% mentioned other reasons, with emphasis on those related to the COVID-19 crisis.

Figure 16 Proportion of the population aged 16 years or olderfacing unmet medical consultation or treatment in the previous 12 months for reasons, Portugal, 2016-2021 *(%)*



Source: INE, Survey on Income and Living Conditions 2021.

Unmet dental care affects 13.1% of the population, up 1.4 percentage points from 2020. The proportion of persons who needed dental treatment in the 12 months before the interview but could not get it was 13.1%, up 1.4 percentage points from 2020 but unchanged from 2019. Financial difficulties were the main reason pointed out for this situation, representing almost 70% of the cases in 2021 (0.9 pp more than in 2020). Of the other reasons (about 32% of the total situations), the

questions related to the COVID 19 pandemic crisis accounted for almost half of the population suffering unmet dental care needs.

2.2. Wellbeing

What is the definition of well-being, or what does it mean to have a happy life? What factors influence, promote, and help to achieve well-being? These questions are currently being raised by many philosophers, professionals, and academic researchers to stimulate discussion on whether well-being is the population's happiness or is a human quality.

The lawmakers are more worried about the operational characteristics of well-being and how these characteristics help them create public policy. However, the public is not concerned about how the public policy addresses the issue; the public is only interested in improving their quality of life. Moreover, it matters how much people are psychologically satisfied with their life because psychological well-being is every individual's concern (Soga et al., 2017; Westwood et al., 2021). Well-being is a concept that has been studied, written, and investigated through the ages by philosophers and scientists. In the last fifty years, well-being has become a focal point for psychologists and scientists, especially those working in the public health sector (Ryff, 2018). Meanwhile, psychologists started investigating personal characteristics associated with well-being and have begun to develop and evaluate systems that help improve the level of personal well-being (Brüggen et al., 2017; Xu et al., 2020). The well-being concept has assisted medical doctors and health practitioners to find a way to enhance psychological well-being at a populational level(Shanafelt & Noseworthy, 2017). Well-being is not merely based on the absence of chronic diseases or illnesses: thus, the concept of well-being covers the psychological, social, and physical aspects of a human being. However, well-being is considered synonymous with happiness and satisfaction (Conti-Ramsden et al., 2016; Guerci et al., 2022). . In medical science, well-being is taken as a tool for positive psychological health (Hammer et al., 2018). Likewise, all researchers investigating well-being agreed that social support is essential for physical and mental well-being, such as an intimate relationship with family and friends.

The concept of well-being can evaluate people's experience and their positivity toward life. The meaning of life positivity can be described in various ways. Some ways link well-being with happiness, which demonstrates an image of an immensely cheerful and joyful individual that most people do not recognize. Researchers have different views on well-being, such as a prolonged state of contentment and a person's wellness that is associated with good physiological and physical health. These views are correct but are incomplete by themselves.

Researchers observed an important development in the well-being field, such as acceptance and recognition of different aspects of well-being; however, well-being aspects cannot entirely be

represented by any method. An individual cannot say that he is feeling well while he is depressed; nevertheless, associating well-being without the presence of depression significantly misleads as to what the public struggles for when they seek to increase and preserve their well-being. Also, well-being is a term that contains a lack of anguish, but it is more than this (Ryerson, 2022; Seligman & Csikszentmihalyi, 2014).

A definition of psychological (mental) well-being offered by "The healthy people 2020": mental well-being includes being satisfied with one's life, balancing positive and negative emotions; accepting oneself; finding purpose and meaning in one's life; seeking personal growth, autonomy, and competence; believing one's life and circumstances are under one's control, and generally, experience optimism" (ODPHP,2016). This definition of well-being is considered a working definition for developing individual well-being; psychological well-being functioning characteristics that can be viewed on a spectrum, as enclosed in the diagnostic and statistical manual of mental disorders (Hidalgo Vicario & Rodríguez Hernández, 2013). Notwithstanding, mental well-being unfolded in a positive direction, beyond the diagnostic and statistical manual of mental disorders with a -5 endpoint of reliable functioning that could include exceptional functions on a different level (Easwaran, 2013). This definition does not remove traumas or stresses of life. According to Selye et al. 1975, "Trauma and stresses are not what happens with you, but how you react to it" (Selye, 1975; Szabo, Tache, & Somogyi, 2012). Some stress can activate with positive emotions and prompt accomplishment and best performance (Szabo et al., 2012; Wach et al., 2020). It is not possible to live a life without stress. Psychological well-being provides a platform to link physical and spiritual well-being. Similarly, there are various methods in which mental well-being interacts with collegial groups. This constellation technique is designed to support and activate psychological well-being (Cooper, C., & Quick, 2017)

2.2.1. Older Adults' Well-being

Well-being Reducing Factors

Several older people enjoy life, but a significant proportion struggle with loneliness, isolation, and mental health problems, such as depression or serious issues that may lead to suicide. Certain older people have a higher risk of poor emotional well-being outcomes than others, and such people are typically very poor, very old, come from a minority ethnic group, isolated, have poor physical health, and most importantly, people who are neglected due to an inactive social or community life. This section assesses trends in older people's well-being, those that affect well-being negatively and positively, and those that work to protect older adults against depression, loneliness, and isolation.

There is far more that policymakers can do to protect and foster a better sense of well-being for Portugal's growing number of older people.

Social Inclusion and Inequalities

The wealth level has risen for nearly everybody, but not equally, and there is evidence of widening income disparities among the top and bottom groups. The Older adult population's wealth and income are more than average. However, in 2019, data revealed more than 600,000 retired people living in poverty than in previous years, possibly indicating a reversal of these trends. People over 75 years old are faring comparatively worse, with lower salaries than those aged 65 to 75. In the United Kingdom, between2020 between and 2040, the Older adult population's household wealth more than doubled and spending 3.5 more on services and goods than in 1971 (Statista, 2018)

From 2020 to 2040, real household disposable income rose around 63%. The salary or income inequality was at its highest in 2020 and 2040. The level of inequality in income, revenue, and wealth is essential in shaping the level of satisfaction, happiness, and well-being among the community, especially in the Older adult community. Large-scale inequality has been discovered to be detrimental to well-being, triggering unhappiness, anxiety, stress and depression (Hoebel et al., 2017).

Health Services Inequalities

The ageing process includes biological changes but also reveals the accumulated effects of individual exposure to external risks. For instance, poor diet affects the ageing process, and it can be further affected by social changes, such as social isolation and loss of family members or close friends (Wagner, Hassanein, & Head, 2010; Nations, 2015). According to the United Nations report, genetic characteristics are anticipated responsible for about 25% of health and functional disparities in old age. Moreover, other determining components include facets of the physical and natural environment (i.e., air, traffic, pollution, and approachability); bad habits such as inactivity and smoking; and individual characteristics like Level of Education, income, and occupation level. Furthermore, these components are often entwined, such that those individual characteristics among the older adult population may hold influence over other health factors (Nations, 2015). Inequalities in health systems and other fields for older adults frequently reflect accumulated disadvantages due to different factors, such as gender, socio-economic status, location, ageist mindsets, practices, and lacking or insufficient laws and policies.

From the perspective of the fast-growing ageing population in society, age-related disparities take great importance. It is expected that from the years 2015 to 2030, the number of people aged 60+ will be around 901 million to 1.4 billion worldwide (United Nations, 2017). In 2010, a multi-country survey disclosed that 63% of respondents find it difficult to access health care services when needed. Older adult confronts several barriers, such as general affordability of the goods and services they need to live, as they generally receive low pensions and are hired on low pay, with decreased family support (HelpAge International, 2011; van Gaans & Dent, 2018).

Health-related facilities are not available worldwide and are a very high cost; therefore, numerous older adults in many parts of the world, more usually those places without socialised healthcare, avoid treatment and preventive health care services or pay health check fees at the expense of other basic daily life needs. Older adults in developing countries often come across health care professionals who are not trained at all or have little experience in age-related health issues(Kydd & Fleming, 2017). Commonly, rural areas are mainly inhabited by older adults, but this is not equivalent to many older adults living in rural areas. Most of the population (young and old) is clustered around cities! Approachability is a further significant barrier to the healthcare system, especially for older adults who are disabled or have limited mobility services, such as in remote areas with poor transportation services and infrastructure (Baer et al., 2016; Lin & Cui, 2021)

Retirement

Few people, after retirement, have opportunities to participate more freely in other social activities and have a leisure time with their friends and family. However, for many people, post-retirement might be challenging due to inevitably longer periods of solitude and inactivity, losing life purposes, and eventually feeling worthlessness. A third of older adults often feel forced to retire, and they often report that they would not like to quit their jobs and be cast aside (Carr et al., 2014). Thus, retirement might result in destabilizing well-being.

Retirement is often accompanied by a significant drop in income with the need to adjust expenses, dislocation, or disposition of properties, adversely impacting well-being. One-third of a life's cycle is spent in retirement; however, as the average life expectancy increases and the work model changes, this fraction of time will increase. The retirement period has already nearly doubled over the last 50 years, from 13 years to almost 22 years (Carr et al., 2014).

Increasing Well-being Factors among older Adults.

To a certain extent, what promotes good psychological and physical well-being among older adults is the converse of some of the elements that undermine it. The fields described above are more meticulously targeted, and design services and policies that support other factors. The following sections describe the main factors that shape and positively enhance older adults' well-being.

2.3. Healthcare Monitoring Services.

The latest developments in medical science, technology, public health, and medicine have increased consciousness about nutrition, personal hygiene, and the environment. It has cemented the way for the growth in life expectancy worldwide over the past decades. However, the growth in life expectancy has also given growth to an increasingly ageing population, so endangering the socio-economic structure of various countries in terms of well-being and expenses related to older adult health care services. For a plan to enhance the older adult well-being level, it is essential to introduce affordable, easy-to-operate health care services. Such health care services include unobtrusive health care services and solutions and smart health care services available in smart homes, which pertain to environmental and wearable medical and modern communication. Smart sensors and information and technologies can remotely provide long and short-distance health monitoring services and effectively enhance older adults' well-being at a low cost (Majumder et al., 2017; Mutanu et al., 2022)

As people age, medical support may increase, which can result in frequent and unexpected medical attention or in-clinic healthcare service. Long-term health care services, such as older adult homes, are costly and are of limited capability. However, the current development of IoT technology can play a crucial role in the growth of older adult well-being and health care systems (Castiglia & Dettori, 2022; Wolf, 2014).

Social and Physical Activities

older adult participation in outdoor activities, such as sports and exercise, improves psychological and physical health by reducing the risk of obesity, diabetes, and cardiovascular diseases. Moreover, outdoor activities reduce mental disorders and improve psychological well-being, such as reducing sleeping disorders, anxiety, and stress, among the older adult population (T. W. H. Chong et al., 2014; Levinger et al., 2022) older adult involvement in outdoor sports is associated with subjective well-being (Zhang, 2019). Regular exercises and sportive activities enhance muscle functions (Djalilova & Davlatov, 2022), increase bone health intensity (Rodríguez-Gómez et al., 2018), prevent metabolic diseases and heart diseases, and reduce fat production in the older adult (Tian D, 2019). World Health

Organization (WHO) describes healthy ageing as the mechanism of maintaining and developing operational ability that enables well-being in the older adult (World Health Organization, 2019). This operational ability is to maintain and build relationships and support the community, which requires engaging in societal and individual level activities. Social participation is the basis of social relations in the community and offers a sense of social identity, fulfilment, and belonging. Cross-sectional studies among older adults concluded positive social relationships with psychological well-being and quality of life and an inverse relationship with symptoms of depression (Nelson, Noonan, Goldberg, & Buchwald, 2013& Litwin, 2011). Social participation has been associated with positive health behaviour among older adults(Berkman et al., 2000). For instance, above-average levels of social participation were reported to be positively associated with consuming at least five daily servings of vegetables and fruits and medium to vigorous physical activity (Samuel et al., 2015). Berkman et al. 2000 (Berkman et al., 2000) suggested that participation in social activities advertised healthy actions and discouraged unhealthy ones; thus, by improving psychological practices through the provision of emotional support from trustworthy social networks (i.e. friends, community, family and neighbours)(Lin & Kishore, 2021; Whiteley, 2015).

2.4. Developing Well-being Technology to Enhance Older Adults' Well-being

Prosperity is a concept that encompasses all human senses, which helps to design well-being products and experiences (Pittman et al., 2019; Thomsen, 2012). The user's experience is a positive point to the well-being of services and products, enhancing the relationship between the user and the producers. Therefore, researchers, designers and producers are developing products that emphasize a positive well-being experience. People improve their satisfaction level through their participation in the product development process. The designers focus on the impact experiences developed by services and products. Thus, to run a process that takes a user's viewpoints into account for the new design of a product or business. In the late 1950s, the well-being concept in the Western world received massive appreciation. The well-being or happiness concept accelerated consumption and Product Design (PD) (Heaton, 2010; Hickel & Kallis, 2020). Product Design is based on the educational process that is essential for its evolution.

Design semantics is a branch of communicative and mimetic characteristics of the developed atmosphere. Design semantics contain numerous assumptions and methods obtained from cognitive science, semiotics, psychological perception, and design history. The researcher examines the qualities of subjects, objects, and space that the consumers can interpret in semantic design. In the semantic design approach, generally, people interact with space and objects related to concepts, ideas, styles activities, and cultures that leave a positive or negative impact on users' behaviour,

emotions, and thinking. The design of the physical environment or surroundings can communicate with people who are living and acting in this cosmos. Through this approach, it is possible to describe the process and quality of the environment. This kind of setting offers reliable attributes interpreted in specific circumstances, such as Older adult healthcare services and being at home(Husebo et al., 2015).

Researchers and producers set homelike quality as their primary goal; they must analyse the characteristics of homelike quality cosmos to develop a well-being environment for older adults. Innovative and novel technologies play a vital role in improving the level of independence and quality of older adults' lives (Wang et al., 2019), especially for those living at home or in health care centres. Considering that, researchers are currently working on a concept called "technology for the Older adults". This concept revealed the notion that technology is capable and effective in improving the quality of Older adult life and health care services (Wang et al., 2019). Thus, it is not easy to make a positive connection between humans and technology (Vaportzis et al., 2017). Olderadult has been considered a group of people less prone to accepting novel technologies; however, they should have a positive behaviour towards technology and use it for health care issues. It is the core duty of researchers, designers, and manufacturers to measure the well-being perception of the Older adult population before designing any technology.

Generally, the design of new technology is based on young people's perceptions, and older adults are dealing with technical operating problems as best they can, as the technology does not consider their physical, psychological, and cognitive aptitudes. Rutherford, Brewster, Golub, Kim, & Roose, (2018) described problems of older adults that they face with technology, such as difficulty understanding digital terms, abbreviations and using a mouse to click on the correct spot. With the growth of age, the Older adult population face many declines in their physical capacity, especially in their sensory capabilities, which slow down their information processing rate. (Rutherford et al., 2018).

Acceptance of novel technologies among older adults is based on the design of the applications representing the older adults' perceptions. Considering the Older adult population's perception and intelligence in designing well-being applications, the outcomes may show minor differences in performances among older adults and younger people. The designers need to use terms older adults are familiar with. For example, technology design should be similar to our real world which represents our daily practices (Wilkinson & Cornish, 2018). Computer interface design, an example of which was presented by Leonardi in which interaction was only possible merely through a mouse and keyboards were substituted by better-known interaction bases, such as clicking,

natural gesture pointing, and touching saw improvements. The older adults' perceptions, previous experiences, habits, and practices can be part of the designing process for well-being applications.

Technological development of well-being applications requires a user-oriented approach (Pauli et al., 2020). Essentially, however, this does not ensure that older adults will adapt to the technology. The user-oriented approach will increase the likelihood of well-being among the Older adult population.

In the design process, the Older adult participants function as evaluators, co-designers or informants and as a primary source for technology development(Fischer et al., 2020). Well-being application highlights various perspectives of Older adults life, such as social, psychological, and biological. However, older adults' knowledge, ideas, experiences, and wishes are essential to provide them with a healthy, happy lifestyle and enhance their adaptation level to new technologies and services.

2.5. Well-being Measurement

Inside the concept of well-being, at least three different methods represent a unique aspect of a population's life experience: hedonic well-being, eudemonic well-being, and life evaluation (Kahneman et al., 1999). Generally, life evaluation links with the population's perception and thoughts about their quality of life, overall satisfaction with life quality and level of happiness. The well-being approach uses a style similar to the Cantril ladder (Cantril, 1965). In Cantril, an individual is asked to put himself on an 11- steps ladder scale to evaluate his well-being level. In the Cantril, *possible life* represents the lowest rung and *great possible life* represents the top-level rung. However, the guidelines are generally ambiguous about how the measurement procedures should take place. Meanwhile, eudemonic well-being emphasizes various goals, meanings and purposes of an individual's life; moreover, the design of the eudemonic questionnaire can explore numerous aspects of an individual's life (Ryff et al., 2004).

Hedonic well-being is associated with everyday moods, for example, sadness, happiness, stress, and anger. The evaluation of feelings is done by asking the person to rate their daily life experience, for example, anger, sadness, and happiness (Kahneman et al., 2004; Steptoe et al., 2015). Notably, negative feelings, such as depression, anger, and sadness, are not merely the opposite of positive indicators of well-being. However, these feelings carry essential information about an individual's emotional state. The hedonic well-being method is not a unipolar approach, but it mixes at most minuscule two inverse dimensions, such as positive and negative dimensions.

Consequently, negative, and positive adjectives are essential for hedonic well-being measurement. There is a crucial difference between different forms of well-being and the necessary cognitive processing level. Emotions can be stated directly, while questions of evaluations possibly demand substantial thinking with a different comparison of individual self-selected parameters or standards.

In what way these three types of methods are appropriate to evaluate human well-being? Financial status, autonomy, and physical health are essential for social growth and psychological well-being or mental health. Few academic researchers have argued that life's assessment questions capture all necessary things that matter, while others identify their importance but without giving any higher status (Martela & Steger, 2016). Usually, researchers measure hedonic well-being by asking the population to think about the last week or month. In the community's inability to recall their emotional state or experience, it is possible to persuade an evaluative, not well-being, feedback. Innovative methods have substantially reduced this challenge, having a distinct population or individuals report about a brief and current period, thus directly discovering emotional conditions without overlapping evaluation. Innovative methods have substantially reduced the challenge of reporting a brief and current period, thus directly discovering emotional conditions without evaluation overlap.

The reporting time frame for such measurements can start from the next moments to longer phases or periods, like a day. Such measurements have improved the reliability of hedonic indices, as various momentary ratings are usually average. Environmental momentary measurement (Kirchner & Shiffman, 2016) whereby persons are arbitrarily encouraged to report their psychological and physical effects. Nonetheless, a study has provided significant results that can be closely reproduced by the reconstruction concept (Dockray, 2008). Thus, Individuals recall events from the previous day and link emotional feelings with them; this procedure has been adopted by the *Gallup-Healthways* Well-Being Index interview (Trindade et al., 2020)

2.5.1. Well-being Measuring Scales.

In the last few decades, many well-being scales and indicators have been developed that contribute to the development of societal policies (Liotta et al., 2020; Smith et al., 2013). These indicators are multi-dimensional, reflecting the impact of atmosphere, economic, and social features on well-being. These indicators can combine different variables, subjective or objective, to regulate the exclusive well-being of a specific population. The aggregating of well-being indicators at various longitudinal scales can create measurement discrepancies and potentially. Although most indicators can measure average well-being at a broader level, few indicators are designed to measure the well-

being of the small community. These two scales also have many advantages and disadvantages. A scale can measure huge populations, offering to track down national progress or cross-country comparison. However, national-level indicators can combine a vast number of individuals. The aggregation mechanism provides essential information about the specific population with a low level of well-being and looking for governmental aid (Andreasson & Birkjær, 2018). These scales neglect community subgroups, such as minorities. National level scales include the Human Development Index, used by the United Nations Development Programme, Happy Planet Index, OECD progressive Life Index and World Values Survey (Fioramonti, 2016; Kubiszewski et al., 2013). At the end of the longitudinal scale, small community well-being measuring scales are getting acceptance in the entire world (Biedenweg et al., 2014). The design of these indicators makes it possible to measure the well-being level in a small community. The characteristics of these indicators assure that the norms or values of the small community should be presented effectively. The essential objective to measure the well-being of small communities is to provide evidence of a faulty level of well-being, requiring governmental aid to enhance well-being. However, these indicators generally measure the well-being level of a small portion of the total population or specific community (VanderWeele, 2019; Vazi et al., 2013). Scale variables describe well-being indicators and how these indicators can be utilized. The well-being scale's design, structure, and composition have different indicators, including economic measures, beyond Gross Domestic Product (GDP) to contain different facets of the market economy; subjective well-being surveys; and weighted composite calculation (Costanza et al).

Many scales available in the literature can measure the well-being of an individual, a small group of people, or the whole nation. Thus, this chapter will discuss the following five well-being scales that contribute to developing well-being technology, product, and application for enhancing the well-being of older adults.

Eudaimonic and Hedonic Well-being Scale.

Eudaimonic and Hedonic well-being scale was designed to measure the entertainment level; instead, it is a high- or low-level concerning product consumption. The eudaimonic and Hedonic well-being scale is defined by Wirth, Hofer, & Schramm et al. (2012). Eudaimonic and Hedonic well-being scales contained two primary aspects, hedonic and eudaimonic. The literal meaning of hedonic is happiness. Kahneman et al. (1999) describe hedonic as the study of what experiences make life pleasant and unpleasant. The experience of pleasure or happiness is subjective and diverse; however, people will experience various types of joy under the same circumstances.

The Eudaimonic scale is proposed by Wirth et al. (2012), with the primary objective of the scale in their study to know the entertainment level after consumption of the product. The eudaimonic

scale is designed to measure some needs satisfaction, such as autonomy, competence, and relatedness.

Table 1 Hedonic and Eudaimonic Well-being Scale from (Wirth et al. 2012,p.418),

1st-Order Factor 2nd-Order Factor	Items
Competence/Personal Growth **Relatedness** **Deeper Reflection** **Activation of Central Values**	1. I have a good feeling because the emotions that I felt during the film positively challenged me. 2. It felt good to expose myself to the theme of the film. 3. I have a good feeling because the film has made me reflect on myself and my life. 1. It felt good to be captivated by the events around [Protagonist(s)] during the film 2. It felt good and right to feel empathy for [Protagonist(s)]. 3. It felt good to feel compassion for [Protagonist(s)] during the film.

Hedonic Entertainment	1. Precisely because the film was so distressing, I had the feeling that the film authentically delivered the central values of life. 2. Altogether, I feel good because [Protagonist(s)] acted responsibly. 3. It makes me feel good to see that [Protagonist(s)] deals (s) with his/her life's trials and difficulties in an exemplary manner. 1. Altogether, I felt well entertained watching the movie. 2. Altogether it was fun watching the movie 3. Altogether, it gave me pleasure to watch the movie.

World Health Organization Five Well-being Scale

The World health organization proposed a scale and designed a questionnaire to assess the well-being of the Older adult population, known as the WHO five well-being scale. This scale contains five-question, as **Table 2** indicates, intended to measure the depression level of a person. Each question contains values of 0 to 5 to indicate the level of depression or well-being (WHO, 1998).

Table 2 WHO five Well-being Scale from https://www.karger.com/Article/Fulltext/376585.

Sr#	Items	All the time	Most of the time	More then half of the time	Less than halftime	Some of the time	At no time
01	I have felt cheerful and in good spirits	05	04	03	02	01	0
02	I have felt calm and relaxed	05	04	03	02	01	0
03	I have felt active and vigorous	05	04	03	02	01	0

04	I woke up feeling fresh and rested	05	04	03	02	01	0
05	My daily life has been filled with things that interest me	05	04	03	02	01	0

SF-36 Mental Health Subscale

The SF 36 mental health scale is designed to improve healthcare services. The scale contains 36 items intended to measure patients' different aspects and parameters, such as physical, social, pain, physical role, emotional, health, energy, and health perception. The SF-36's parameters fall into 0 to 100 values (Brazier et al., 1992), as seen in **Table 3.**

Table 3 Mental Health Subscale from (Brazier et al., 1992)

Area	Dimension	No of question
Function status	Physical functioning Social functioning Role limitation (physical problems) Role limitation (emotional problems)	10 02 04 03
Well-being	Mental health Vitality pain	05 04 02
Overall evaluation	General health perception Health change	05 01
Total		36

The Satisfaction with Life Scale.

Life satisfaction is an inclusive term in which the public expresses their feelings and emotions. Likewise, people can find a positive direction that makes their future brighter (Anand, 2015). Satisfaction with life scale constructed to measure the emotions and feelings of a person, which helps

to drive the people's well-being and good mood. The satisfaction with life scale contains 5-items specially designed to measure individual cognitive decisions about people's life satisfaction (Diener et al., 1985).

Table 4 The Satisfaction with Life Scale from Life Satisfaction | SWLS - Greenspace Mental Health Knowledge Base (greenspacehealth.com)

Sr#	Items
1	In most ways, my life is close to my ideal
2	The conditions of my life are excellent
3	I am satisfied with my life
4	So far, I have gotten the important things I want in life
5	If I could live my life over, I would change almost nothing.

The Perceived Well-being Scale (PWB)

The perceived well-being scale allows for measuring the main elements of a person's physical and psychological well-being. Physical and psychological terms highlight a person's internal consistency and stability (Reker & Wong, 1984).

Table 5 Perceived Well-being Scale (PWB) from (Reker & Wong, 1984)**.**

Sr#	Psychological well-being items
02	No one cares whether I am dear or live
05	I am often bored
07	It is exciting to be alone
08	Sometimes I wish that I never wake up
10	I feel that life is worth living
12	I do not seem to care about what happens to me
Sr #	**Physical well-being items**
01	I don't have many physical complaints
03	I do not think that I have a heart condition
04	I have a good appetite for food
06	I have aches and pains
09	I am in good shape physically
11	I think my health is deteriorating
13	I don't get tired easily
14	I can stand a fair amount of physical strain

The presented study is going to use these scales for measuring physical and psychological well-

being. The reason to choose these five scales is, that these scales' designs and items can measure the two-state of older adults, such as physical and mental well-being. There is one more reason to select these scales which is these scales can measure the happiness (Hedoni) and appreciation(Eudiamonic) levels among older adults, such as the scale presented by Wirth, Hofer, & Schramm (2012)

Moreover, these scales will help to understand the perception of older adults about the social hybrid scenario. for older adult's perception measuring, the study will take these scales and design a questionnaire, this questionnaire will ask various questions to the older adults about their perception of social hybrid scenario and what are tools that enhance their physical and psychological well-being. Therefore, these scales have an essential role in conducting this study and offering a final design of a social hybrid scenario.

In sum, this chapter provided a broader image of the Portuguese older adults' characteristics, for example, older adults' education level, skills, household, average age, and medical facilities. This chapter also provides information about how many and what proportion of people live in cities, villages, the mainland, and islands, what is their way of life or whether they live alone or with family. Moreover, this chapter describes the main factors, such as retirement and the reduction of a social circle, that causes social isolation. On the bases of these factors, the study identifies the five different well-being scales that are designed to measure the well-being of older adults. By using these scales, it is easy to understand the perception of older adults, and later this perception will help to design the final features of the social hybrid model for Portuguese older adults

CHAPTER 03- IOT-BASED SYSTEMS FOR IMPROVING OLDER ADULT WELL-BEING

Older adults do not have easy access to medical services or a person who can take care of them all the time. Older adults need technology that can monitor their health and movement status and other similar metrics via remote control technology over long and short distances. Older adults also need technology that fulfils their social needs and improves their psychological well-being. One technology that can offer these services to enhance older adults' social and physical well-being is called IoT, which is briefly discussed in chapter 01. This chapter's primary goal is to understand the existing IoT healthcare technologies' characteristics and systems and understand social IoT applications. Later it seeks to evaluate if these systems are fulfilling their required demands. The first part of this chapter discusses the IoT systems that help with physical well-being. The second part will discuss social IoT.

This chapter's search has been carried out in the Google scholar tool, Scopus, and IEEE databases, using various search queries; the reason behind different research queries is to find out what existing literature can support the chapter title. This chapter uses the IoT application, SIoT, older adults, and health care applications. The period of this search is flexible because some IoT health care applications were invented a long time ago; therefore, the time slot between 2000 to 2021 was chosen. The selected time slot helps analyse a wide range of IoT and SIoT applications and then choose applications playing vital applications in older adults' lives. The search queries indicated various systems, technologies, and applications effectively working in healthcare services, but we selected only a few because they fulfil this chapter's demands.

3. IoT and Healthcare Applications

In the modern world, people are much too busy due to their jobs or education commitments. For that reason, it is hard for them to take care of their older adults or family members from afar and sometimes even if they live nearby. Generally, older adults do not have easy access to medical services or a person who can take care of them all the time. Digital applications capable of monitoring the older adult population from afar and from shorter distances via remote control technology can be helpful. Internet technology can solve the various health care issues for those patients and older adults who do not have people to take care of them. The solutions came from an IoT concept in which devices relate to each other, and these devices can take care of patients or the older adult population. It is possible to connect different devices and intelligent sensors with the patient's body through IoT technology and wearable devices such as an Apple smartwatch, or Oura ring. These sensors can

collect data and send it to the central server by using the internet where doctors and nurses can access the data from a central server for decision making. Singh et al., 2021)

The developed world knows that a healthy lifestyle is essential to the country's economy. Therefore, developed countries and their healthcare industries invest heavily in the medical field, especially IoT technology and computing. Economically rich countries like the U.K., Italy, China, Japan, as well as the E.U. are actively investing in IoT computing. (Begum & Dixit, 2016). The IoT technologies and applications have brought essential changes in medical fields due to rapid and low-cost medical treatment. It is proven that IoT is an adequate and suitable way to provide medical and healthcare assistance to patients (Shukla & Shukla, 2022). Thus, through IoT technologies, the applications provide many services, such as "identifying the medical sample, medical exam, and storing medical data of a body such as core temperature or heartbeat rate information. The IoT applications offer a mechanism that can measure the physical situation of the body. In this context, the physical information of the body helps for medical consultation via remote control IoT applications and services (Hu et al., 2013; Kadhim et al., 2020).

Recently, the IoT has attained a prominent position in the medical field, especially regarding long-distance healthcare services (Wang, 2022). The IoT applications provide an outstanding digital electronic mechanism by using internet technology. The mechanism is interconnected with a different object for data sharing and communication between objects and humans to objects that enhance the older adult population's healthcare services (Tanwar et al., 2022). There are various healthcare devices available on the market that improve healthcare services, but one device that is more efficient and convenient for users is called the Personal Healthcare Device (PHD). Personal Healthcare Device (PHD) has unique and essential characteristics, such as sensors and data storing of biomedical signals, connected to central healthcare computer servers, due to this, the doctors always get updated data on patients' physical health or older adults (Jamil et al., 2020). The following section briefly describes the IoT-based application that is helping to remove the older adult health-related issues and improve older adult well-being.

3.1. Personal Healthcare Device (PHD)

The IoT applications provide an outstanding digital electronic mechanism via internet technology. The mechanism is interconnected with a different object in data sharing and communication between objects and humans to objects that enhance the older adult population's healthcare service (Tanwar et al., 2022). Health care applications were brought to attention in IoT systems(Evans, 2011; Sajedi et al., 2022) because the internet of things offers numerous functions that provide remote monitoring services; these services are reliable for older adults and patients

(Paganelli et al., 2022; Sebestyen et al., 2014). The PHDs (personal health care devices) are becoming an essential component of remote monitoring applications, especially when healthcare systems on the internet are considered primary health care services. The PHDs (Personal Healthcare Devices) are lightweight and therefore these devices can easily be transported from one place to another; these electronic devices (PHDs) are intelligent, capable of sensing, measurement and taking appropriate actions through users' biomedical signals. It is possible through personal health care devices to monitor the patient's extensive care than ever before in medical history. Due to PHD characteristics, the PHDs are becoming accessible and able to connect their patient's activities with primary health care servers where relevant people such as doctors and healthcare personnel get the relevant data as and when they need it (Jamil et al., 2020).

The design of personal health care devices can monitor and evaluate essential signals such as the psychological parameters of older adults and patients. PHDs use a comprehensive range of appropriate sensors with novel designs that help them to remain functioning even in very harsh and humid environments. Moreover, these sensors can extract information from various sources and locations that may produce additional value. The motion sensors device that is attached to the body of users represents the primary challenge for task monitoring in personal health care environments. The main characteristics of PHCA (Personal Health Care Application) have been divided into categories namely i) things oriented, ii) semantic oriented, iii) app-oriented, and design essential to confirm authentic and reliable digital transmission between the digital application in smart devices and the sensors, developing a personalised digital network among the sensors and for the user's smart device as well as securing the data. For things-oriented design, it is essential to have adaptive nature, real-time monitoring, the ability to immediately convey the message, advanced sensitivity, advanced efficiency, or lower power consumption, and use intelligent procedures to execute the issues effectively. Likewise, semantic-oriented applications build an interactive behavioural environment that is based on the previously acquired data, information, and process unbiased language processing methods to improve the user experience and pervasive computing skills (Gunduz et al., 2022).

Furthermore, there are general characteristics of personal health care devices, including computing, heterogeneous, impulsive interaction across all the components in the network server, location computing, location, dynamic networks that can accommodate various devices or applications as obligatory, and resources controlling the computing elements with higher working efficiency. Personal health devices, also known as "Wearable Health Devices" (WHDs), are emerging technology that enables non-stop ambulatory monitoring of patients or older adults' comprehensive signals throughout daily life activities or in a medical setting, with the benefits of minimising uneasiness and interference with routine life activities(Dias & Cunha, 2018) One of the vital

characteristics is that the personal health devices are lightweight and physically small size. Therefore, it is possible to wear PHD on or in the human body; for instance, wearable devices can be implanted inside, like heart pacemakers, and outside the body, such as watches or bracelets though reduction and integration, are significant issues. Furthermore, personal health devices can have onboard energy supply systems. As stated above, personal health devices are small and lightweight. Therefore, the commercial market for PHD products has increased very rapidly, especially in the medical market. The design of PHDs offers the use of the device for regular medical check-ups such as heartbeat rate, blood pressure, oxygen level in the blood, blood glucose meters, and thermometers. Recently, smart wearable personal health devices have increased in popularity due to their connection with mobile phones and laptop computers. It is predicted that in the future, digital smart PHDs will offer a monitoring platform for e-health applications and will also provide different types of equal access to all e-health services. Therefore, academic researchers have brought novel and various e-health prototype health systems equipped with PHDs such as Live Net, Advanced Care, an alert portable telemedical monitor, Health Gear and My Health (Pawar et al., 2022).

Personal health devices integrate with electronic health systems essential for the developed world in the current technological scenario. In this context, e-health is essential for those countries that have a higher rate of the older adult population, such as Portugal, because Portugal is one of those countries where the older adult population is increasing rapidly, and this rapid growth increases many social, physical, and psychological issues in older adults. Older adults very often live far from their families or live in the remote countryside, so it is hard to receive medical services under critical circumstances. However, with PHD systems, it is possible to avoid this situation by regular remote monitoring services, often anticipating the needs of the patient. Furthermore, PHDs based health care application offers to improve the accessibility and productivity of e-healthcare services in a society.

3.1.1. ZigBee Wireless Technologies

Home automation manufacturers have drawn considerable attention from industrial researchers for more than two decades (Brush et al., 2011; Strengers et al., 2022). The primary attention behind it, is to develop autonomous electrical and electronic home applications. ABI (a market research firm) presented a report indicating that four million home automation applications and systems had been sold in 2013 due to their autonomous features(ABI, 2013). Moreover, ABI predicted that ninety million intelligent home appliances would be deployed in 2017. Many home automation systems have been developed for commercial purposes (de Oliveira et al., 2022) and research activities, but home safety and security have increased in importance among manufacturers and consumers(Ghosh et al., 2022). Despite more than ten years of non-stop research activities at the

academic and industrial level, we have failed to develop home automation as a comprehensive, accessible technology due to many hurdles such as high cost, difficulty in understanding its operating functions, less functionality, safety issues and vendors dependency (Intille, 2020). Despite these problems, the researchers need to configure, install, and manage these systems; in the past, the cost of installation, configuration, and maintenance was very high, and very few people could afford them. The Wireless Home Automation System (WHAS) has recently received considerable attention in the research and commercial community. With the help of novel technologies, WHS applications have reduced their operational costs. Also, WHS provides comfort, safety, security, and communication assistance for older adult remote monitoring. Typically, WHS is equipped with a battery capable of running low-power sensors associated with innovative home applications. These sensors are the main components of the wireless network. These low-cost sensors have made WHAS accessible and affordable for consumers.

Furthermore, sensors remove distance among luxury and mass segmentation of intelligent home automation applications, though WHAS has limitations due to supply chain limitations, mobility, and hostile radio channel clashes. However, various big companies, organisations and research institutes developed different WHAS applications (Rathnayaka et al., 2011) such as air conditioning control, heating and ventilation, home security, appliances control, smart metering and smart irrigation. The primary aim is to develop such applications that enhance security, and safe energy, save time consumption, enhance productivity, improve comfort, enhance lifestyle, and provide a high-quality product at a low price, less maintenance needed and reduction of greenhouse gases in the environment. After introducing low-cost computers, mobile computers, and laptops, the WHAS industry has unexpectedly changed its dynamics. Additionally, the development of advanced software offers an interface for WHAS, which is low cost and proves users with a friendly environment (Riaz et al., 2017).

Currently, WHAS can provide remote monitoring services over long and short distances without wasting time. Their various systems have been introduced in the digital world, such as Instron, Waves, Bluetooth, Wi-Fi, ZigBee and Z-wave (Bluetooth, 2020; Criticalcomms, 2010; WifiVeina, 2020; Zigbee, 2020). The ZigBee Alliance has introduced a very innovative technology called ZigBee (ZigBee 2020). The structure of ZigBee technologies is based on a different standardised set of solutions; these solutions are called layers. Moreover, these layers offer low-cost features such as smooth operation, competence in every environment, lower power consumption, and a high-security environment for users. The ZigBee structure developed on a high level of IEEE 802.15.4 standards describes the functionalities of the Medium Access Control (MAC) and physical layers of WPAN (Wireless Personal Area Network); considering this standard as a framework for ZigBee, the

ZigBee alliance described the upper layers for the ZigBee standard. The ZigBee-based devices are crucial elements of WPAN. These digital devices are broadly described as logical and physical types. The material category types are divided into type subtypes such as Full Function Devices (FFD); another one is Reduction Function Devices (RFD). The core duties of FFD provide the direction for the smooth function of the network. Conversely, RFD does not provide any direction for network routing (Basabi et al., 2021; Tomar, 2011).

The logical types of devices have two sub-categories: a route and end device. The coordinator is a vital subtype of logical apparatus with the primary responsibility to provide a root for a network tree. The coordinator can initiate a digital network tree's extensive formation, which works as a bridge to connect to another network. Unlike ZigBee, end devices have limited functions for better communication with a router and coordinators. Due to the restricted boundaries of end devices, they can sleep for a long time and save energy, effectively helping extend the time of operation. The ZigBee design contained the APS (Application Supports Sublayer), ZDO (ZigBee Devices Object), and UDA (User-Defined Application for user profile). The application supports the sublayer with various services, such as maintaining digital tables that enable communication between different digital devices. The ZigBee used two types of communication modes over its network. The first one is called beacon mode, and the second is the non-beacon mode. The primary responsibilities of beacon modes are to save power so that digital devices wait for them and then are occasionally transferred messages through a coordinator to take care of them.

After completing the message transmission, the coordinators mark a schedule until the next beacon mode is active for these devices. When devices get information about the marked schedule, then devices can go into sleep mode. Unlike the non-beacon devices which do the opposite, the non-beacon devices schedule communication but for the wake function and therefore do not miss any beacon. The non-beacon communication mode is appropriate when designing innovative applications such as fire alarms for smoke because these application devices sleep and wake when any incident happens around them. Through ZigBee technologies, many applications have been developed for different sectors such as education, entertainment, healthcare, well-being, monitoring, and home automation(Nesi & Pantaleo, 2022).

3.1.2. ZigBee Automation Systems

After introducing ZigBee to the market, the developers developed various applications based on ZigBee technologies. The ZigBee application has been divided into four sub-categories such as i) surety, ii) security, iii) intelligent surveillance, iv) energy management, and assistive home services (Gupta & Singh, 2016). ZigBee-based WHAS (Wireless Home Automation System) offers home

security applications (Song & Si, 2017). These applications can monitor the main doors and windows, water flooding, fire smoke, and gas leakage in the home; these applications are designed to operate and be controllable from short and long distances. These applications are equipped with a security alarm and based on MC 13192 ZigBee chip that consumes meagre power and is controlled by a microcontroller chip called MSP430F135. These applications are also accessible through a web interface, and these applications are offered a system that has been equipped with an LCD panel. Likewise, an intelligent system called IHAM (Intelligent Home Automation Systems) is introduced to provide safety and security at home(Chong, 2022; Narayanan & Gayathri, 2013). Their system uses PIC microcontroller technologies combined with ZigBee wireless technology equipped with GSM (Global System for Mobile) network and speech recognition technology. Through voice control technology, intelligent home automation applications control all electric appliances such as lights, fans, and speakers. In ZigBee, intelligent surveillance services monitor daily home activities because these applications can control the environment from a remote location. The intelligent surveillance application is designed to improve the quality of services and communication from one location to another (Gutierrez Pascual, 2012; Sinha & Dhanalakshmi, 2022).

Moreover, the IPS-M (Indoor position system) system is based on the IPS-I structure; this system uses an IPS-G gateway. The primary responsibility of IPS-I devices is to transfer the beacons to the other devices named IPS-M for predicting the estimated distance. Similarly, one project named Digital Living Network alliances (DLNA) was proposed by Kawamoto et al. (2007). This project is designed to register the complaints from home appliances and predict the solution to these complaints. According to Kawamoto, DLNA devices are going to be extensively widespread in the digital world in the very near future. Later, these digital devices started to use intelligent sensors through a digital network. According to Kawamoto, ZigBee technology would be able to rectify the problem and offers a novel solution for networks. The association of DLNA with the ZigBee network is only possible with an appropriate gateway. Therefore, Kawamoto contributed to a design of a gateway that uses an energy-efficient method for regulating intelligent sensors.

Wu & Qin (2008) proposed a wireless intelligent home system. This system is designed for a short-range network, especially for a small home network. This system could be operated and controlled from short and long-distance through a GSM module. The system architecture had three primary elements such as a) a home server based on the GSM module, b) intelligent sensors, and c) intelligent home applications. The system has been verified through small-scale experiments about control capability and remote alarming.

Moreover, Zhang, Zhang, Su, & Wang (2012) proposed a project based on IoT and ZigBee wireless sensor technologies. This system used MCU LM3S9B96 devices; devices use ARM cotext-M3

based digital controller. The proposed system can monitor the temperature, humidity, light of the home and meter readings. ZigBee wireless technologies are equipped with energy management applications; applications are designed to save energy consumed. In this context, Cheng & Hung (2007) proposed power monitoring systems (PMS). This system uses digital signal processing (DPS) and Web page services for communications. Digital signal processing design for computation of real-time power monitoring. The web page application is designed to provide a communication structure between distribution systems over the digital network. Proposed prototype systems are already tested for power management; after the test, it is validated (Anusha, 2018).

Due to ZigBee characteristics, various WHAS applications introduced can assist the older adult population and disabled people. Consequently, Krishna & Nagendram (2012) presented a ZigBee assistive system. This system is based on voice recognition technology that uses ZigBee network technology. This ZigBee application's primary function has recorded the message sent by a specific speech module; these modules are routed to digital electronic devices installed in those houses. The advanced technology is very easy to operate, so there is no need for the user to undergo training. In these systems, users have the opportunity to organise the songs on an S.D. memory card(Obaid et al., 2014). In the existing literature, various prototypes have been developed for remote health care systems. This chapter is based on IoT applications that help promote older adults' physical, psychological, and social well-being. Therefore, this chapter has focused on remote health care systems that are based on ZigBee technology.

Alwan & Prahald Rao (2017) can monitor patients, older adults, handicapped people, and those who need continuous healthcare. These systems' function offers remote electrocardiography (ECG) through smart sensors, a proxy server, a database server, and remote devices that can monitor the patients of older adults from long distances without delay.

In sum, ZigBee wireless technology offers comprehensive technological solutions to overcome older adults' issues. The older adult population is fragile in society and needs more care when compared to the young members of society, but it is hard to take care of all the older adult population due to lack of resources, such as financial problems, the lack of an available workforce and local medical facilities. There is a need to have a system capable of monitoring older adults from short and long distances in this context. Therefore, the ZigBee wireless technology provides a solution to overcome the older adult health care issues because through this technology is possible to monitor older adults and take care of their physical well-being such as monitoring their blood pressure and oxygen level, electrocardiography (ECG) etc. Most importantly it is easy to operate. Additionally, ZigBee wireless technology consumes low power for its operations; low power use makes it unique, making it possible to monitor the older adult population for a long time without any power supply.

3.1.3. Ambient Assisted Living System (AAL)

The novel Ambient Assisted the Living (AAL) idea has been described as a service that has aimed to establish an intelligent environment in the goodwill of older adults(El Murabit, Abtoy, Touhafi, & Tahiri, 2018). Therefore, this study is growing in academic and industrial research sectors; various prototype projects have been conducted to establish AAL applications and offer several intelligent services to older adults or similarly targeted populations. This section will discuss the AAL characters and their contribution to promoting older adults' physical, psychological, and social well-being.

AAL systems have been defined as socio/technical platforms that accommodate AAL services to enhance well-being; generally, the digital network objects are rooted in the AAL architecture (El & Abtoy, 2019). In a digital environment, AAL is hard to address because it has a complex structure. The main elements of this complexity are the crucial heterogeneity of the end-consumer community and their physical restriction. However, the development and designing of AAL applications need extensive respect for various components, characteristics and customs (Blackman et al., 2016).

Still, there are many challenges to implementing an AAL-based environment because it still needs to discover functionalities, novel ways, needs, and habits that differ from one stakeholder to another. Furthermore, generally, consumers are not aware of how to use and be comfortable engaging with hardware and software and have less patience with technical problems (El Murabet, Abtoy, Touhafi, & Tahiri, 2018). The specific environmental challenges are core issues nowadays; these environments can be workplaces, hospitals, and homes. Due to the characteristics of AAL, many targeted environments can be integrated into AAL systems, but all applications would not have such types of ability to be integrated into AAL systems.

The emergence of effective competencies in ambient assistive living (AAL) systems needs reliable knowledge from different sectors, including medicine, cognitive psychology, computer science and neuroscience. These knowledge fields have extreme importance in Artificial Intelligence (A.I.) and have helped develop a system in which devices can recognise, process, interpret, and understand human emotions (Picard, 2000Jenny; Kennedy, 2022), leading to the vast number of algorithms, research and approaches in AAL fields. There is a question mark about affective systems connected with their reliable affective qualities; to put it simply- what kind of infrastructure and emotional procedures do such systems need that will help to promote the well-being of people? This answer to this question comes from Pudāne & Lavendelis's (2017) research. This research indicated that affective processes had shown, namely, emotion generation, emotion expression and emotion

mapping in healthy behaviour. This study also discussed that not all AAL-based needs all these processes to develop an AAL system.

AAL is a term that means to live in a technological environment. AAL technology is sensitive and adaptable for users and intelligent objects. This technology's core features are to provide a positive response, take appropriate actions of people or objects, and provide various innovative services to overcome the user's problems. Moreover, AAL technology offers an individual autonomous environment through digital support to improve the user's self-determination. Furthermore, the AAL application has a significant contribution to meeting demographic challenges and opening new doors for opportunities. Likewise, the design of the AAL application supports the healthcare sector (Smarter, 2020). Behind the scenes, the AAL concept is the paradigm of the internet of things. The internet of things offers various platforms for developers to design such devices that can connect the different digital devices, technologies and systems on one platform to achieve common goals like health monitoring (Lemus-Zúñiga et al., 2022; Dudakiya et al., 2016).In the current technological scenario, the way of data, collection, and analysis procedures has been changing due to the rapid growth of IoT devices in our society, such as fitness trackers and wearable digital biometric sensors (Angelini, Carrino, Khaled, Riva-Mossman, & Mugellini, 2016; Passos et al., 2021). Therefore, many IoT technology producers create IoT applications for daily life monitoring such as location monitoring, step counting, and dietary activities. For example, smartwatches and wristbands are designed to monitor health and fitness levels.

Also, intelligent cell phones equipped with an electrocardiogram (ECG) provide data and health conditions by analysing heart-related data (Satija, Ramkumar, & Manikandan, 2017). Similarly, there is a smart brain sensing headband designed to monitor brain activities. After analysing the brain activities, the headband conveys this information to smart devices such as computers, tablets, and cell phones via wireless mediums like Wi-Fi and Bluetooth (Lim et al., 2012). Wearable devices have brought revolutionary changes and greatly improved human beings' lifestyles (Li, Shen, Abdalla, Yu, & Ding, 2017). Considering this, AAL-based health care monitoring systems can track and supervise the consumers' health and fitness levels. Moreover, these applications have supplementary features designed to offer real-time communication from one device to other devices for enabling data that must be communicated and examined through health care applications. Due to the credibility, effectiveness, reliability, and low cost of IoT-based AAL applications have attained a prominent position in health care in modern societies.

The worldwide human population numbers are increasing significantly due to the latest technologies in the health care and medical fields. Also, older adults' numbers increase who need more care and medical facilities than youngsters. It is hard to fulfil all medical, psychological, and

physical demands and needs of older adults due to a lack of human resources, and the cost of health care is increasing dramatically. As well as all these problems, many developed countries are spending billions of dollars on healthcare sectors to improve the quality of life by monitoring blood pressure, body temperature, heart rate, and daily activities (Passos et al., 2021). The bed blocking by older adults(Lei, Bai, Hong, & Liu, 2022). This is a term in which older adult patients are medically ready to go home but stayed in a medical facility such as a hospital or clinic instead of going home because at home there are no healthcare services available outside the hospital.

Currently, in many developing countries hospitals physical monitor older adult patients only at the hospital. For this to happen, a patient needs to come physically to a clinic or hospital for his or her medical check-up, whether he or can walk or not. Moreover, doctors and clinicians need to physically maintain medical data for future use (Dudakiya et al., 2016). This is hard not only for the fragile older adult population to visit the hospital in person but also for doctors to maintain effective physical medical data of patients.

However, now this situation is changing in both developed countries and developing ones too. The reason behind it is the recipe of multiple technologies like intelligent mobile phone applications and intelligent sensors and wearable devices which have made it possible to promote the well-being of older adults via remote monitoring methods. In the context of older adult-related issues, it is necessary to develop a platform that will offer different opportunities to monitor older adults' health status at home and office without any human intervention. These types of novel technologies will offer to transfer the medical data to the hospital where doctors or the relevant person will have access to the data for medical purposes, letting the older adults patients stay at home and even get healthcare services at home(Palumbo et al., 2014). AAL technology has innovative characteristics; therefore, various industrial and academic researchers have started several projects based on AAL technology, such as the My Heart project (Luprano, Sola, Dasen, Koller, & Chetelat, 2016). The My Heart project has the main objective of an earlier diagnosis of heart-related problems, warning the patients and sharing data with doctors about patients' heart-related issues. After getting a warning from the devices, patients and doctors can take precautionary measures to reduce heart-related problems. Similarly, there is the Heart Cycle project (Luprano et al., 2013) a proposed project which has the objective to offer a very comprehensive disease control mechanism that can stop heart failure and managing chronic heart disease. Moreover, more innovative projects recently proposed enhancing health care services such as the Continua Health Alliance (Palumbo et al., 2014). The project offers a telehealth ecosystem: various products, devices, and patients associated with each for the one purpose of health care. Likewise, the project Aware (Alsina-Pagès, Navarro, Alías, & Hervás, 2017) proposes an intelligent system that is based on several sensors, video surveillance and

ultrasonic sensors that are designed to help the older adult population in their homes who have chronic disease or with serious illness, for example, CASAS project; this project offers an intelligent environment that helps to monitor dementia patients from a long or short distance(P. & D.J., 2009). Unlike the project DOMUS (Mégret et al., 2010), the design of this project is based on behavioural recognition software, especial for those patients and older adults who are suffering from Alzheimer's disease (Alsina-Pagès, Navarro, Alías, & Hervás, 2017).

3.1.3. WBSN (Wearable Body Sensor Network) Health Care System

Wearable Body Sensor Networks (WBSN) in health care platforms and applications are made to monitor patient health data and offer data evaluation. Presently, various wireless healthcare studies and projects have been proposed to continue older adults or patient tracking services in an ambulatory, open environment, and in-clinic. This section of the chapter describes the characteristics of WBSN and a few popular research projects about digital health care systems using body sensor networks.

This section describes a few popular research projects about the healthcare systems using body sensor networks and describes how a Wireless Body Sensors Network offers autonomous systems designed to monitor a patient's daily activities. It consists of novel intelligent sensors connections that do not hinder daily patient activities and are useful in detecting underlying symptoms of chronic diseases such as heart attack, diabetes and asthma, and it also warns the patients in case of emergency conditions (Alkhayyat, Thabit, Al-Mayali, & Abbasi, 2019).

The sensor nodes in the Wireless Body Sensors Network use extraordinarily little power and therefore, these applications serve in environments as diverse as entertainment, consumer electronics, sports training, and special forces such as military, bomb diffusers, astronaut monitoring, and firefighters. Through WBSN the medical professional can monitor movement, activities, and essential body signals from any remote location via internet technology. Consequently, this technology (WBSN) is money-saving technology, increasing its reliability, quality of services, fault assurance and security. Due to this quality, the demand for WBSN applications is increasing rapidly, but this technology also has limitations such as less digital memory capacity, battery power, and Fluctuating bandwidth. Therefore, WBSN cannot fulfil all customers' demands (Alkhayyat, Thabit, Al-Mayali, & Abbasi, 2019).

Characteristics of WBSN.

Characteristics of WBSN sensor nodes offer various features that make WBSN suitable for use in an enormous number of developing applications and digital platforms. A few characteristics of WBSN are described in the following sections

Energy-efficient: The WBSN architecture is designed in a way that empowers the sensors to consume less energy. The power management system is used to manage the power resources optimally so that nodes remain active for a longer time, and network working time capacity increases (Alshaheen, 2018).

Heterogeneous: WBSN uses sensors that have heterogeneous capability; therefore, every sensor has its functions, such as some sensors able to detect temperature level, blood pressure and so on. Every sensor used in WBSN has its storage capability, energy consumption and computation capacity(Qiu, Wang, & Zhao, 2017).

Cost-effective: WBSN sensor lifetime is longer than other sensors due to their characteristics, and fewer sensor nodes are needed in network development and replacement when they get damaged. Due to its reliability and durability, there is a lesser or lower cost of developing a WBSN network (Alshaheen, 2018).

Advantages of WBSN: WBSN is a better approach than previous approaches due to its unique characteristics of being used for older adult or patient monitoring. There are some essential advantages as described fellow.

Wireless technology: WBSN is a technology that is equipped with wireless technology. Before introducing WBSN to the market, the doctors, nurses, and health care professionals used traditional approaches for health monitoring that used a great deal of wires, thus making the entire monitoring system awkward. Due to the massive number of wires, the system took up more space, making it difficult to operate. However, WBSN uses a wireless communication method with no wires (Interconnected & Networks, 2019).

User-friendly and Energy-efficient Technology:

The WBSN is a technology that uses a user-friendly and energy-efficient method. Traditional approaches were not effective regarding power consumption and mobility, but now novel approaches are emerging into sensors technology that has already led us to user-friendly body temperature techniques, body tracking, blood pressure, and other essential human body vital signals. These readings are available on different devices such as the mobile app, laptops, and Personal Digital Assistant (PDA), where users can get data at any time and store them for later usage (Dias & Cunha, 2018)

3.1.4. BWSN (Biomedical Wireless Sensor Network).

Advances in digital technology offer miniaturisation and integration of intelligent radio interfaces, sensors, and embedded microcontrollers in a specific microcontroller; Microfabrication and WSN provide a new generation of WSN applicable for many digital platforms. One of the most important and exciting fields of digital applications is that of health management services. Therefore, information technology manufacturing corporations are aware of the demand for WSN in health care applications, so they are extensively focusing on designing e-health solutions, such as "Life Shirts" and Ewatches for example. Consequently, WSN (Wireless Sensors Network) platforms and applications play an influential role in commercial health solutions in hospitals, institutes, and public research facilities (Alshaheen, 2018; Hofman et al., 2022).

Key Function of BWSN

Biomedical Wireless Sensor Networks have very many potential functions that analyse different medical tests of the human body. There are the following medical tests that BWSN can examine and detect effectively.

a) Glucose level examination: The design of biomedical sensors offers measurement of glucose levels in the human body and provides a reliable, accurate and fewer intrusive evaluation of glucose levels (Bahareh Javid, Faranak Fotouhi- Ghazvini, 2018; (Hofman et al., 2022).

b) Cancer detection: Currently, there is irrefutable proof of how patients can prevent worse outcomes because of cancer, and that is by detecting it in earlier stages. Various scientific studies have shown that cancer cells contain and exude nitric oxide that disturbs the blood in the area near a cancer cell (Juneja, Kendre, & Patkar, 2016).

c) Asthma early warning: Digital sensors can detect the allergens in the air, generate a warning message, and convey it to the patient's doctors or healthcare workers. These sensors can gather data from national monitoring air quality platforms (Hofman et al., 2022). Avoiding medical accidents, approximately ninety-eight thousand people die every year due to medical errors. These errors take place in hospitals because of medical accidents caused by human mistakes. The Nightingale project uses wearable environmental intelligent sensors in a network to cut down medical accidents.

d) Health rate monitoring and cardiovascular diseases: Smart sensors can be placed individually on a patient, allowing a medical doctor to obtain the patient's vital information and prepare a treatment plan while monitoring the patient's physical health. The practice of health rate nursing is aimed at protecting various lives. Intelligent applications offer monitoring to firefighters in their

homes, clearly difficult, working environments and analyses their heart rate, hence determining their ability for working in such poor conditions. The use of chest straps with electrodes can save many firefighters' lives since the electrodes can operate in a moist condition in contact with the chest. Similarly, intelligent applications can be accomplished using specific wristwatches whose effectiveness can only be observed when triggered automatically if any significant adverse circumstances arise. These wristwatches calculate the user's heart rate and blood pressure using the very novel method called an oscillometer. It is essential to note that no certified practical application can be used while at a job, which presents a substantial challenge (Bayoumy et al., 2021).

e) Depression and Alzheimer's: in these situations, it is possible to detect the abnormal situation within an older adult population. For example, falling detection can alert family members, neighbours, medical doctors, and hospitals about the current older adult's physical situation. It can operate with accelerometers to identify the older adult or patient physical movements with the help of a ZigBee protocol and GSM (Global System for Mobile communication) that offer real-time data or information. Furthermore, it can use RFID (Radio-frequency Identification) technology to control older adults or patients' inputs and outputs; sound sensors can detect motion and request assistance; light sensors can check the opening of a refrigerator door to monitor how often a patient gets food (Cui et al., 2019).

Usage of BWSN in Medical Applications.

WSN applications, including sensors and positioning systems such as GPS, can be used in almost all health areas (Farahsari et al., 2022). For example, wireless data communication is a bidirectional radio frequency communication that permits each node to send information and accurate data to a base station, even if patients are not inside its direct radio frequency reach (Freitas & Azevedo, 2016; Farahsari et al., 2022).

Aminian and his team developed a prototype of healthcare systems for hospitals, which is a ubiquitous healthcare system model. This model is to place non-invasive wireless smart sensors on a patient's body to develop a wireless network that can communicate the patient's health status with the central communication station connected to monitoring systems. However, the relay nodes do not need a frequency band and communicate the data over a short-range frequency module (RFM). It is essential to note reserved medical bands exit, such as medical implant communication service (MICS). These bands offer 10 meters range in diameter and operate in a 402 to 405 MHz frequency band used for patient body area network applications because of their minimal power transmission (Aminian, 2013).

Another study was developed by Tolentino and his team (Tolentino, Kim, Park, & Park, 2011). The Tolentino study presents ubiquitous health systems' novel design to monitor typical physiological

or chronic diseases of older adults. The main difference is that it is designed to supervise the older adult population living alone and in remote areas without having enough physical health, technical and medical support to monitor patients in a hospital environment. By incorporating the wireless sensors network (WSN), Ad hoc is combined with existing medical practices and technology in real-time remote monitoring to alert medical doctors and staff to the patient's health status or to provide the medication with the help of wireless information and data to a central station that is connected to a server on ad hoc networking using IEEE 802.15.4 or LR-WPANs (Tolentino, Kim, Park, & Park, 2011).

The European Commission developed the WealIT project as an integrated project to research "Wearable Computing Devices" as an innovative technology dealing with advanced computer systems embedded with clothing. One of the potential characteristics of this project is the immediate availability of older adult medical information at any time that can decrease the costs of medical analysis, the power to perform medical analysis daily according to the situations of patients and in severe cases could finally save a patient's life (Andres, Eduardo, & Javier, 2011).

An established company named eHit provides high-tech digital services to healthcare at a long or short distance. It is one of the leading health gateway technologies, a platform that connects to a mobile server and devices. The mobile device has essential features of collecting essential data from intelligent sensors and transmitting it to the central server to receive the information and forward it to be processed. However, the eHit company has more innovative products in its portfolio, including the patient care device Gateway, which has similar features to the health Gateway but permits monitoring in the hospital without a mobile device, using the LAN, a module connecting sensors without having a Bluetooth connection. (Leroux, 2013).

3.2. Social IoT Applications.

IoT (Internet of things) describes the interconnectedness of various devices with ubiquitous accessibility to a constructed-in intelligence. Things are already reshaping the way we interact with devices and provide us with novel networking and socialising capabilities through intermediate devices and will soon convert our lives into a hyper-linked cyber-physical social environment (Malekshahi Rad, Rahmani, Sahafi, & Nasih Qader, 2020). The potential devices contain heterogeneous IoT intelligent devices such as smartphones with distinct connectivity and interfacing demands and service quality requirements (Yaqoob, Ibrar, 2017) within the context of the social internet of things, which is a specialised subset of IoT, the heterogeneous services link up and work together and socialise and collaborate to accomplish various specific goals. This kind of social communication required teamwork between the IoT devices, which is the essence of social IoT.

However, it cannot be truly understood unless built-in help is given inside the operating systems, devices firmware and other related software running on these IoT machines (Ahmed & Rehmani, 2017).

In this context, this section discusses the existing social internet of things (SIoT) systems and their contribution field of healthcare and gerontology that improves older adults' physical and psychological well-being.

Project name: Tablet Senior Inclusive-Scenic

Conducted by: Sioslife (2018)
Target population: older adults

Website:https://sioslife.com/seninc/?gclid=CjwKCAiAiMLBRAAEiwAuWVggjlAUhu7zcLjxl2GWvHm2y9TDUwcCLhKqFfj1XgNjyAJkOiwcnx7dhoCqR8QAvD_BwE

A Detailed Description of the Project

The siosLIFE older adult-friendly software application is designed for those who do not come into contact with such technology. The application offers a simple and user-friend interface in which older adults can take photos and share them with family members and on social media platforms. Likewise, older adults can make a call in two touches, audio, or video, with family members and community members. The application also offers "Serious games for cognitive training". The siosLIFE application also provides features in which older adults have a wide range of music and films section, promoting opportunities for their well-being. Lastly, older adults can press the SOS button; when they press the system, emergency services such as firefighters or medical emergency services are alerted to their situation of need. The offered application is available for android, iOS, and desktop devices.

Project name: SHAPES

Conducted by: Commission (2020)
Target population: Older adults

Website; https://cordis.europa.eu/project/id/857159.

A Detailed Description of the Project

The offered systems aim to develop the first European open ecosystem enabling the large-scale placement of a comprehensive range of digital solutions for older adults who are facing temporary or permanent disabilities; the system builds an interoperable platform mixing an intelligent digital solution to gather and analyze older individual's health environment and lifestyle information, recognized their requirements, and provide a solution that could support the individual data protection and trust. Shapes projects develop interoperable systems mixing novel digital solutions to gather and examine the older adult health environment and lifestyle data, recognises the needs of more senior adult, and provides a modified resolution that supports individual data safety.

Scalability, Consistency, and Interoperability Shapes platforms can enhance the efficiency of health care service, older adult lifestyle, ease the burden on older adult family and services providers.

Project name: Elliq

Conducted by: Elliq, (2021)
Target population: Older adults

Website. Healthy Living Made Simple: Join ElliQ's Free Insiders Program

A Detailed Description of the Project

The ElliQ is a voice-controlled tabletop type of assistant that promotes a healthier, active way of life. ElliQ is created explicitly with older adults in mind to help recommend numerous activities, and entertainment, and to help users manage and enhance their health and well-being. Days at home are made much easier Elliq around, as he or she attends to them throughout the day. There are the following features that Elliq can perform.

i. Health reminder
ii. Music streaming
iii. Curated video
iv. Wellness
v. Morning motivations
vi. News, sports, and weather
vii. Cognitive games
viii. Calendar appointments
ix. Interesting facts

Project name Clevermind App

Conducted by; Palumbo (2013)
Dated: 2009

Targeted population: older adults

Website: https://www.kickstarter.com/projects/1957572863/clevermind**.**

A Detailed Description of the Project

The Clevermind is an application based on the voice control app, which stimulates older adult cognitive abilities and people with Alzheimer's or Dementia. This application has a robot that will greet users when users log on. The opening screen shows the users about weather, date, and calendar. Users choose to play video games, read the news, use the internet for chatting with family and friends, trivia games, listen to music, and watch numerous movies, books and audiobooks and pictures. Within the offered categories, the user can select activities; these activities will take the

older adults to the internet site such as news features will give users options of NBS, CNN and Fox News, USA Today and more.

Key characteristics

I. Cognitive assessment training tracking and reporting
II. Speech recognition and interaction module: My intelligent Robotic Assistant (MYRIA)
III. Carefully designed for older adults and people with mental disabilities
IV. Big buttons, large fonts, and an intuitive interface
V. Multi-function schedule, derived from the native iOS calendar
VI. Simplified experience for social connection like Facebook
VII. The ability to quickly contact for help

Project Name: HABITAT: an IoT solution for independent older adults

Conducted by: Borelli et al. (2019
Target population: older adults
Website: **https://www.mdpi.com/1424-8220/19/5/1258.**

A Detailed Description of the Project

The HABITAT project aims to develop an intelligent, IoT-based environment for the older adult population. In this study, the technology constraints address the model and recognize several intelligent objects and their daily lives. In this context, the main objective is to develop an IoT-based social system that offers various intelligent devices' interoperability. This project set four smart devices named **1)** indoor localisation system **2)** smart chair, **3)** Belt environment for movement information and **4** SEPA (Single Euro Payments Area). These four devices are designed to help the older adults in their own houses and an older adult's health care centre. The fours devices can reduce older adults' health care expenses and enhance their social and physical quality of life.

Project Name: SOCIALIZE

Conducted by: Miori & Russo, (2017)
Target population: Older adults
Website: **https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8016215.**

A Detailed Description of the Project

The study offers an IoT-based model called "SOCIALIZE" for social networking, leading to the social internet of things. The prosed model will provide an innovative solution to support and enhance the quality of an older adult's life via information and communication technology (ICT) tools. The SOCIALIZE ambient assisted living) (AAL) the primary goal is to develop a reference platform for older adults by utilising novel technological solutions to make more accessible their everyday activities. The primary objectives of SOCIALIZE are to collect the atmospheric data from the older adult's body and

transfer this data to the medical staff or caregivers. THE SOCIALIZE projects developed an intelligent system devoted explicitly to the demands and needs of older adults to expedite their participation in social life. This study has developed a service called “Older Adults” to monitor services that are incorporated into SOCIALIZE system. These services' primary tasks are to increase and enhance the physical activities of residents, gather data, and evaluate physical and atmospheric factors from the numerous hi-tech heterogeneous devices and allow them to work together and communicate data—then finally, the data only accessed by the doctors, caregivers.

Table 6 Summary of Characteristics of selected IoT & SIoT systems

Internet of things (IoT) health care application (For older adults)									
Name of systems	**Physical Data monitor**	**Psychological well-being**	**Physical well-being**	**Social interaction with family or friends**	**Outdoor and indoor physical activities**	**Long-distance health monitor**	**Remove social isolation**	**Privacy control by users**	**Enhance the autonomy of the Older adults**
Personal healthcare device (PHD)	✓	✗	✓	✗	✗	✓	✗	✗	✗
ZigBee wireless technologies	✓	✗	✓	✗	✗	✓	✗	✗	✗
Ambient assisted living system (AAL)	✓	✗	✓	✗	✗	✓	✗	✗	✓
WBSN (Wearable Body sensor network) Heath care system	✓	✗	✓	✗	✗	✓	✗	✗	✗
BWSN (Biomedical wireless sensor network.	✓	✗	✓	✗	✗	✓	✗	✗	✗
Social internet of things applications (For older adults)									
Tablet Senior Inclusive-Scenic	✗	✓	✗	✓	✗	✗	✓	✗	✓
Smart and Healthy ageing through people Engaging in Supportive systems	✗	✗	✓	✓	✓	✓	✓	✓	✓
Healthy Living Made Simple: Join ElliQ's Free Insiders Program	✗	✓	✗	✗	✗	✓	✓	✗	✓
Clevermind app	✓	✓	✗	✓	✗	✗	✓	✗	✓
HABITAT: IoT solutions for independent older adults	✓	✓	✓	✓	✗	✓	✓	✗	✓
SOCIALISE	✓	✓	✓	✗	✗	✗	✗	✗	✓

3.3. Discussion

The chapter has two main parts. The first part describes the Passive health care services solution for older adults like Personal Healthcare Device (PHD), ZigBee wireless technologies, Ambient Assisted Living system (AAL), WBSN (Wearable Body Sensor Network) health care system, and BWSN (Biomedical Wireless Sensor Network. These IoT-based applications are designed to collect the physical data of older adults over short and long distances. These applications are smart enough to work autonomously and make intelligent decisions that improve older adults' physical lives. These applications can be installed in older adults living places or embedded in or on older adult bodies. However, these applications' primary function is to monitor older adults' physical data and pass this information to the doctors or caregivers, but these applications cannot interact with older adults to let them know what is happening inside their bodies. Mover, the older adult does not have any control over these devices because accessing the information from these devices needs permission given only by doctors, caregivers, and family members which consequently makes the older adults depend on devices and other people. These applications do not offer social services that encourage older adults to participate in social activities and enhance their psychological well-being.

The second part of this chapter is based on another aspect of IoT: the social internet of things (SIoT) represents intentional communication. The objectives of the above social internet of things (intentional communication) paradigm are to keep people and things separate; to permit objects to have their social network; to permit humans to impose guidelines to defend their secrecy or privacy. Intelligent objects are not making difference because they are just physical data, but social IoT applications make huge differences because social IoT devices connect objects with humans and humans with social interaction objects to enhance the social interaction level among the users. This kind of interaction allows older adults to remove their isolation and improve their social circle.

When IoT applications are providing support in physical and social participating opportunities, then where is a loophole? Why are these applications not promoting older adults' physical and psychological well-being? Why these existing IoT applications are not fulfilling the demands of older adults? The reason is that the current IoT applications offer the solutions to the problems of older adults separately, for instance, one IoT application only offers the physical well-being solution. In these applications, an older adult has no power to access physical data. In this application, older adults are dependent on medical personnel or caregivers because only they have special permission to access older adult data. However, these applications are designed for physical well-being and do not engage older adults in social activities. It is therefore unlikely that social IoT-based applications

offer social interaction between older adults and objects, or older adults to younger people. There are significantly fewer chances that SIoT applications provide physical data monitoring services to older adults because they are based on social ecosystem mechanisms. Nevertheless, older adults need both physical and social services for their physical and social well-being.

Older adults are a vulnerable group in society due to their decreased health conditions. For this reason, they are often dependent on care services and entering a long-term care institution is also a difficult challenge for them. In institutional care, numerous factors affect the self-determination and autonomy of older adult residents. Autonomy in long-term care is an essential aspect of the lives of older adults. Older adults are a vulnerable population in our societies due to their fragile health conditions.

For this reason, they are often dependent on others, such as health care services. Such dependency affects older adults' physical and psychological well-being very badly. Therefore, we need a platform that offers passive and intentional communication at the same time in which older adults will have the opportunity to spend an autonomously, physically, and psychologically healthy life. Older adults' autonomy and connection with their social groups could preserve their abilities such as decision-making and relation-building, empowering their physical and psychological well-being.

However, all those applications mentioned above, and their characteristics are not enough to fulfil older adults' demands. These applications' design does not consider older adults' needs and does not care about the actual user, people such as volunteers, nurses, and family members.

As mentioned above, all IoT and SIoT applications do not offer passive and intentional communication on a single application. However, these applications offer passive and intentional communication services separately. Personal Healthcare Device (PHD), ZigBee wireless technologies, Ambient assisted living system (AAL), BSN (Wearable Body Sensor Network), Heath care system and BWSN (Biomedical Wireless Sensor Network Systems are offering passive communication but with restricted mood. The restricted mode means this system only authorised people, such as physicians or caregivers, have access. Older adults do not have privacy control over these applications. To use these applications, older adults always depend on their doctors, caregivers, or family members. As mentioned in table:01 that these all IoT applications are only designed to monitor the data from a short or long-distance and promote their small amount of autonomy such as controlling lights etc.

Likewise, the SIoT Tablet Senior Inclusive-Scenic, SHAPES, Elliq, Clevermind app**,** HABITAT, and SOCIALIZE offer intentional communication in which these applications enhance social interaction autonomy privacy, outdoor activities, removing social isolation, and improving physical and psychological well-being. These applications do not consider older adults' social interaction demands,

such as not fulfilling older adults' social preferences, and not creating ease in using applications interface with the prohibitive cost and complex procedures of social media usage. The existing applications are not good enough at promoting the well-being of the older adult community, and it needs to be done more in that older adults have more opportunities, especially for passive and intentional communications together on one platform. Most older adults need somebody who should be near to them for physical health monitoring such as doctors, caregivers and family members that directly affect their freedom of choice where older adults are unable to make their own physical and psychological decisions that affect not only their physical well-being but also their psychological well-being.

Furthermore, older adults also need a platform to promote their physical well-being via social interaction, social participation, and participation can be physical or virtual. Above all, the mentioned applications and their characteristics are not capable of fulfilling the older adults' needs in terms of promoting their physical, psychological, and social well-being. Therefore, there is an extensive need to propose a model that fulfils older adults' passive and intentional communication demands. After analysing IoT application and SIoT application characteristics, this study proposes a "Social hybrid scenario" (see chapter 5). The proposed model's goal is to build a social IoT Hybrid scenario to promote the physical, psychological, and social well-being of older adults. The proposed model helps the older adult population to spend healthy and enhance their physical and psychological activities. The proposed model is used to prevent or decrease social isolation among the retired or aged population and their health-related mental and physical health issues. The scenarios of the proposed model can be presented as follows: this study offers a model of the prototype that is contained two pervasive scenarios such as (I) Passive communication and ii) hybrid social communication.

3.3.1. Passive Communication

For health care, passive communication design directly connects doctors, friends, and family members of older adults. For passive communication, the older adults will have an intelligent bracelet embedded with intelligent sensors measuring data such as a pedometer, GPS, body temperature, blood glucose, fall detection and blood pressure. These sensors will communicate data with doctors, friends, and family members through the Android or IOS mobile app.

Doctors

The prototype's design offers the doctors an opportunity to access the older adults' physical health data and act according to the data information. Doctors receive data on the older adult's

people's temperature, blood glucose, blood pressure, geolocation, and how much the older adults walk per day. Once the doctors receive the data, they analyse data; if doctors observe anything unusual, such as high blood pressure, blood sugar, body temperature, and not doing the daily walking per doctors' advice (such as per day step) they can act. Through GPS, doctors can see the older adults' exact location (older adults in the house outside the house, moving or static). Doctors can call the older adults and let the older adults know about his unusual physical data and get information, and whether he is taking medicine or not; doctors advised him to follow the instruction and take medication and do excise. If doctors cannot contact the older adults, they can call the more senior adult family members or close friends and request them to visit the older adults physically and get physical information about older adults' health.

Family members

The proposed model enables older adult family members to take care of their older adults more easily from short and long distances. For this, family members connect with the older adult through a mobile application and monitor the older adults' daily activities in real-time, such as their daily steps and their exact location of the older adult person. The family members can call the doctors, older adults, or emergency services in an emergency scenario.

3.3.2. Social Communication

The second scenario of the proposed social hybrid scenario is social communication. The design of this social hybrid scenario can enhance the psychological well-being of older adults and outdoor activities. In this social hybrid scenario, older adults can interact socially. Therefore, the proposed model prototype has a social interaction capability. Older adults can participate in social discussions, upload their images, and participate in outdoor social activities that enhance their physical conditioning and mental health. The proposed social hybrid scenario model contained the following two layers

Online Social Communications

For online social interaction, the proposed model prototype offers local and international social interaction groups. These groups provide older adults with a variety of people, such as older adults or youngsters to engage with. Every group has subgroups such as if somebody is interested in science and technology, and a person can enter into science and technology group for example, or if somebody wants to interact with people who like politics, he can join the politics and current affairs group.

Face-to-Face Communication

The model design encourages older adults to do and participate in outdoor activities. Therefore, in the app application, there is an option for Face-to-Face Communication (FFC). FFC components will allow the user to find out about social activities nearest to their town, city, state, or country. Once the older adults select the training according to their wish, the older adults can read the description of the activity theme and where and when this activity will happen. After reading the activity description, they can participate in social activities and interact face to face with peers and friends. This activity will enhance not only their social circle but also strengthen their psychological and physical well-being.

CHAPTER 04- RESEARCH METHODOLOGY AND PRACTICES

Our study proposes to reflect on an interactive social hybrid model consisting of two structuring layers called passive and intentional communications layers. Adaptability is the user's ability to determine the system model functionalities himself; transfer of technology design process to the users, giving him the freedom to live their life autonomously in a physical and social context. The social IoT Hybrid scenario model's design offers an ideal tool and conditions for the adaptation process. The model's design offers older adults more significant control over the physical disposition of the space and, simultaneously, they perform social, and physical activities and feel safe due to passive communication tools. It aims to study the impact of the conceptual study model on the communication process between older adults, doctors, and family members that constitute the social and healthcare sphere.

The study seeks to reflect on various research methodologies, tools, and techniques that use the internet of things (IoT) theory to utilise modern technologies for older adults' well-being. The study proposes a methodology in which first we sketched a social hybrid scenario model (see chapter 5) and its characteristics that consist of IoT, passive and intention communication theories. Later, the model is validated through an online survey including a questionnaire sent to the senior local Portuguese university by email.

4.1. Research Method

In scientific research, there is a general term called methodology, or research techniques, in which the researcher seeks knowledge to improve existing knowledge (Bryman, 2012). The research methodology is an investigation framework in which a group of procedures or standards helps select effective techniques for developing an experimental validation process.

This study's methodological approach uses deductive research methods (Pochiraju & Seshadri, 2019), which helps to validate our conceptual model approach. Miles and Huberman (1994) discussed the research composition as a conceptual framework that illustrates the narrative in the conceptual model. Still, often in graphical format, the key factors that construct the variable are studied and presumed relation between them. Of course, whether this relationship exists is one of the features of the study. Miles and Huberman conceived this conceptual framework as the sequence of scholarly bins containing key actions and events(Miles & Huberman, 1994)

Simulation conceptual model illustration is essential in conceptual development projects because it communicates between participants, users, and domain experts. There is a point in simulation projects when the conceptual modelling process occurs inside the specific stakeholder's mind. The thinking process involves reflection on constructing the problems and sketching a conceptual model that helps the manufacturers, producers, and academic and industrial researchers solve the issues. Moreover, the different stakeholders may have a unique perspective on the system; their reasons may include understanding the system's features, previous experiences, and personal goals.

The conceptual model representation for this context behaves as a communicative model in which communication involves various stakeholders; a standard representation that all stakeholders can recognise is essential (Maroun, 2020; Nance, 1994). Indeed, effective communication between stakeholders is essential for a good conceptual model's success, making the need for good conceptual model representation even more essential (Robinson, 2015). The study brings to the process of conceptualisation, design, and validation of the social IoT hybrid system's characteristics, perceptions, and desires of the older adults, aiming to incorporate elements of hypothetical model validation methodology.

Regarding the research method, the model validation assessment defines the degree to which a model an exact image of the actual users from the model's intended uses. This information is used to decide whether the model has potential features that users can accept and use in the real world (Thacker et al., 2018). This study uses a soft system methodology to validate the social hybrid scenario. "The Soft System Methodology is a cycle learning system that uses models of human activities to explore with actors in the actual-world problem situation, their perception of that situation and their readiness to decide upon purposeful action which accommodates different actor's perception, judgement and values (Richardson, 2016)."

In the present study, a quantitative approach has been adopted to collect data and analyse and interpret the perception of older adults on their social and psychological well-being. in this sense, a questionnaire has been developed and used for the online survey. it is possible to verify the flow of construction of questionnaires by online surveys based on general and specific objectives which are defined for the investigation. The flow of questions was adjusted to discourses found and adapted up to the responses of participants in this sense that it is possible to select the right option from the questionnaire and provide as much information as possible. With regards to collecting the data, a completely online data collection was planned. Therefore, the data collection and online survey were carried out between March 4th to March 29th of 2022. For the online survey, the first email was sent to senior Universities on 7th March 2022 and a reminder email was sent on 21st March 2022 to get

more participants, as many as the study can. The reminder email worked perfectly, and the study got more participants which enhances its authenticity level. The study defines the following phases to execute the model validation methodology.

4.1.1. Research Methodology Phases

Phases	Instruments or techniques
Phase1 Identify the problem & describe the objectives	**Literature Reviews**
Phase 2 Define features of the hypothetical social hybrid scenario	
Phase 3 Proposed and validate the model	**Online Survey (quantitative analyses)**
Phase 4 Evaluate validation results	**Online Survey Data**
Phase 5 Communicate results	**Statical Data**

4.1.2. Analysis model

The analysis model is valuable to elucidate the main ideas and concepts presented in the research question (Quivy & Campenhoudt, 2005).

Concept	Dimensions	Indicators	Scales
Social IoT hybrid scenario	IoT interaction (passive) Social interaction (intentional)	The connection between devices/objects the connection between devices/objects and humans Connection between humans	Strong or weak by Likert scale Strong or weak by Likert scale
Passive communication	Biometric indicators Physical activity Geolocation Connection between objects	Heartbeats Oxygen in the blood Numbers of steps Geographical positioning Positioning relative to objects with sensors	Per Minute Low or high Per day Per hour per day
Intentional communication	Social interaction Publication of information Shared activities Participation in civic activities	Number of meetings with friends and family (face-to-face or/and online) Number of publications on online social networks	Per week, or per month

		Number of activities carried out jointly with other persons Number of activities carried out in the local community	High level or low level by Likert scale
Well-being	Physical Psychological Social	Results in the well-being scales	High level or low level by Likert scale
Older adults	Age Genre Relational situation Family typology	= or >60 years Female Male Other Married / Divorced / Other	Good or bad health Educated of uneducated Married / Divorced / Other

		Live alone / live with a partner / live with family / other	Live alone / live with partner / live with family / Other

4.1.3. Sample

Thus, to define the sample of the proposed study, procedures related to the demographic composition of 411 senior Portuguese Universities were considered. These 398 universities are in eighteen different districts of mainland Portugal. The remaining 13 senior universities are situated on two different Portuguese islands, namely Azores and Madeira. A total of 179 participants have participated in the sample, 64.2% or 115, are female and 35.8% are 64 males. Regarding the age group who participated in the sample, 11.7% are aged between 55 – 59 years, 14.5% are aged between 60 - 64 years, 22.3% are aged between 65 - 69 years, 30.7% are 70 - 74 years, 16.8% are aged between 75 - 79 years, 3.4% are 80 - 84 years and 0.6% (one participant only) is aged between 85 - 89 years. Regarding the education level of participants in the sample, 19.0% have 1st cycle of basic education (4th class), 2.2% have 2nd cycle of basic education (6th year), 10.1% have a 3rd cycle of basic education (9th year), 22.3% have finished secondary education (12th year), 36. % have graduated with a bachelor's degree, 6.7% have a master's degree, and 2.8% have a doctorate.

4.1.4. Planning and Execution of Methodology

Study Object

The main intention to conduct this study is to validate the IoT (Internet of things) social hybrid scenario model that can promote the physical, psychological, and more general well-being of older adults. In this model, older adults can communicate with other people about engaging topics or activities or applications for well-being enhancement. In this way, the research has studied objects: the IoT, SIoT technology, and the physical, psychological, and social well-being of older adults.

Target Population

Commonly, the target population in qualitative research is key when the research population is significant. The study portrays the research objectives, assumptions, and backgrounds that can dictate the selected community's material and concentration in qualitative research (Asiamah, Mensah, & Oteng-Abayie, 2017). The study's target population will be individuals, and older adults aged more than 50 years. In general, the people who are retired from their jobs have physical, psychological, and social issues. Gradually, their social circle becomes smaller and smaller, impacting their psychological immune system and making them fragile within the community. Due to this reason, this study selected more than 50 years old or more as the target population.

4.1.5. Study Instruments

Defensible inferences to be made based on the data, and research tools used (such as questionnaires, interview schedules and observation schedules) must be internally valid and reliable (Gray. E, 2013). An instrument's validity must be designed in a unique way to simplify the analysis of sample data. The primary tool used to collect data from older adults; is the IoT social hybrid scenario validation questionnaire.

Questionnaire.

The research questionnaire provides the purpose of gathering data or information about people's behaviour, attitudes, knowledge, and faith or beliefs (Jones, Baxter, & Khanduja, 2013). The chosen Likert scale helps to formulate a questionnaire. In this context, the older adult population asks to perceive how the IoT-based model's passive and social features can enhance their well-being. Likewise, a theory assessment of opinions and perceptions newly published in the nursing literature recommended that these are multidimensional, individualised and subjective (Tsimane & Downing, 2020). Both structured and psychological status have a mental and communication component and represent an individual's perception of a phenomenon. A reasonable distinction between attitudes and perception includes an extra affective element which is bipolar and acts as the individual's psychological response to the phenomenon(Puspitasari, Garnisa, Sinuraya, & Witriani, 2020). The study decided to develop a questionnaire with Likert scales help to evaluate older adults' perceptions because Likert-type scales are among the most generally used psychometric scales for evaluating self-reported attitudes and perceptions about any model. It is a one-dimensional scaling methodology based on traditional measurement philosophy, which uses a single stimulus and a single response form. Likert scales are created from operations of the empirical referent of latent constructed (van Alphen, Halfens, Hasman, & Imbos, 1994), habitually established by scale developers. Generally, the Likert scale is based on five ordinal responses, and this study also uses five ordinal response categories: strongly disagree, disagree, neutral, agree, and strongly agree.

The study designed a questionnaire that contained 45 questions and five major parts. The first part of the questionnaire has 7 questions that required a declaration of informed consent, age, education, employment, household, and a list of smart devices that an older adult is using. The second part questionnaire has 14 questions designed to model social interaction with family and friends. The third part of the questionnaire has 11 questions about the medical follow-up of the model. The fourth part contains 8 questions 'Your opinion about the system's advantages and disadvantages about model design. The fifth part of the questionnaire has 12 questions about 'Your predisposition to use or not use a system of this nature the model'.

Part 1. Personal information

1. Declaration of informed consent
2. Gender
03 Age
04. Level of education
5. Employment status
6. Whom do you live with?
7. From the list below, please select the technologies you have for personal use

Part 2. Social interaction with family and friends

8. I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends
9. I agree with the connection of my social networks (Facebook...) to the system.
10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)
11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon).
12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family.
13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.
14. If you'd like, let us know what you think of additional ways the system can promote interaction with family and friends:",

Part 3. Medical follow-up

15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)
16. Knowing that my doctor receives a report with data regarding my health is reassuring.
17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).
18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).
19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity.
20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments.
21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).
22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)
23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.
24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.
25. If you wish, let us know what you think of additional ways the system can promote interaction with your doctor and/or follow-up healthcare teams

Statistics: Part 4. Your opinion about the system's advantages and disadvantages

26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing, and participating in activities, etc.).

27. I am reassured by the fact that the system securely restricts access to my personal data.
28. It reassures me to be able to customize privacy levels, defining who can see my data and shares.
29. I like to be able to define how each friend and family member can communicate with me through the system.
30. I consider it essential to be able to disable some system features whenever you want.
31. I am concerned that other people may unduly gain access to my personal data recorded in the system.
32. I am concerned that the system constantly monitors my social interactions and health data.
33. If you wish, describe other advantages and disadvantages that you think may exist in the system

Part 5. Your predisposition to use or not use a system of this nature

34. I would use the system because it would help improve my physical well-being.
35. I would use the system because it would help improve my psychological well-being.
36. I would use the system because it would help improve my social well-being.
37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.
38. I would use the system to have a more assiduous and direct interaction with my family and friends.
39. I give privilege to face-to-face contacts and, therefore, I would not use the system.
40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.
41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.
43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.
44. I'm not a skilled user of technology, so I wouldn't use the system.
45. If desired, describe other reasons for using or not using such a system

Questionnaire validation.

The questionnaire was validated by three senior researchers from the University of Aveiro and five respondents from different parts of Portugal. This process led to the reformulation of some aspects, namely: changing the nomenclature of a level of the scale (from 'No opinion formed' to 'Neither agree nor disagree,' to be more in line with the lexicon of the remaining items).

Online Survey Procedures

The survey approach is a widespread means of measuring people's opinion of a topic, for example, people's perception and stated use of eHealth and social services. Nevertheless, surveying as a scientific methodology is often misconducted. Moreover, while a survey is easy to perform, confirming that it is of high-level quality is much tougher to achieve. Often the words questionnaire and survey are the same in an operational context.

However, here we are firmly communicating that the survey is a research method where individual opinions are gathered from a sample of subjects and examine the study population's characteristics. On the other hand, the survey is one of the data collection techniques applied in the

survey method, where subjects are asked to answer a predefined set of questions. Physical well-being literature is replete with survey studies done in different physical well-being health settings on a range of topics. For instance, the apparent satisfaction of EHR (Electronic Health Record) systems by an ophthalmologist in the USA (Chianese, Piccialli, & Valente, 2015; Tsai, Lai, Chiang, & Yang, 2014), and the stated effect of EMR approval in primary care in Canada (Trudel et al., 2017). The quality of physical and psychological well-being related to eHealth survey studies can be highly variable depending on how they are constructed, performed, evaluated, and registered. It is important to spot their different categories of survey findings that vary from exploratory to predictive, involving one or more topics and physical and psychological eHealth systems over the allotted period. There are also numerous published recommendations on how survey studies should be reported, designed, and appraised—expanding survey studies used by many organisations such as health organisations to determine patients, public and provider perceptions about eHealth applications that improve the users' lives and well-being. Consequently, the forms of survey studies and their procedural considerations should be of great interest to those engaged with eHealth evaluation.

This study uses the descriptive survey method. The descriptive survey method asks questions to obtain respondents' perception and their association with a social hybrid scenario model. The perception can be the behaviour, attitudes and reported interaction of participants with eHealth, medical facilities, and social services. Association describes correlation among specific responded physical characteristics and the system such as passive and social communication experience. The survey design is quantitative and includes descriptive numbers such as the frequency distribution of Likert scale responses from applicants.

An example is a survey that changes the end-user satisfaction with computerised provider order entry (CPOE) over time in rigorous care (Hoonakker et al., 2013). The presented study get data through the survey, that participants answered online. To facilitate the understanding of the model, the participants were invited to watch an animated video before starting the answer[1] and prototype Figma App[2] to report their feedback.

The Animation video describes the main functions, characteristics, and scenarios of the proposed model in motion graphics format, but Figma prototype features allow a user to explore the different scenarios and interact with the proposed design. Figma prototypes are a fabulous way to preview interaction and user flows. Though, Figma prototype people can understand, how the

[1] https://youtu.be/kLuvZJP-uck.

[2] https://www.figma.com/proto/gcoX09Xuqn4AQKFrX5PwVe/Prototyping-in-Figma?node-id=0%3A2&scaling=scale-down&page-id=0%3A1&starting-point-node-id=0%3A2&show-proto-sidebar=1.

proposed model application looks like for example what colour, font size, icon and what Figma application gives response if they click on different icon and button. The Figma prototype also let them know how they can interact with family and doctors and what kind of physical and social activities they can perform through the proposed model. For more information regarding the Figma prototype app please follow the link https://www.figma.com/proto/gcoX09Xuqn4AQKFrX5PwVe/Prototyping-in-Figma?node-id=0%3A2&scaling=scale-down&page-id=0%3A1&starting-point-node-id=0%3A2&show-proto-sidebar=1.

Survey Conducted Location

The study conducted an online survey targeting Portuguese senior citizen universities. Therefore, the research team contacted http://www.rutis.pt/intro/home which is a national database platform for senior universities in Portugal. The Rutis platform provided 411 senior universities' email addresses and contact numbers of 398 universities from 18 mainland Portuguese districts and the remaining 13 universities from 2 different islands such as Açores and Madeira.

Planning of Survey.

Thus, the Planning of an empirical survey to validate the social hybrid scenario model and note the perception of older adults about the proposed model. The study designed a questionnaire in which participants answered the questions and show their perception of how the social hybrid scenario model's characteristics can enhance their well-being.

To present an effective and clear message of the proposed model, the study decided to produce an animated video and a Figma prototype. Figma prototype app/video served as support for seniors to understand the system and answer the questionnaire survey in an informed way. An app that elaborates on different aspects of the passive and social aspects of the proposed model. This video tells participants, how the proposed model helps them to enhance older adults' s physical and psychological well-being.

This study designed and investigated the Portuguese senior citizen population. Therefore, the research team contacted the Portuguese senior citizen universities—the team got all seniors university's contacts numbers, email, and social media (Facebook, WhatsApp, and Twitter) from http://rutis.pt/intro/home. The study wrote an email in the Portuguese language about survey motives and goals, given a survey link in the email and requests senior Universities to share the survey with their senior student to participate in online survey.

Data Collection and Analyses

As above mentioned, this study uses a questionnaire as a tool to collect the data. The questionnaire contains various questions about features of the social hybrid scenario model. These features can improve the well-being level of older adults. Thus, to measure the well-being level of older adults, the study uses the Likert scale method that contains the five number highest well-being levels one is the lowest well-being. After conducting the questionnaire, the study analysed and decided to use the descriptive quantities research method to interpret and analyse the collected data. the study does a map and graphical data presentation of questionnaire results through SPSS software.

Conclusion

The whole chapter is based on a fundamental methodological approach that can lead to the nature of study objects and answer the raised questions. The presented theoretical and methodological framework defines the study position from a methodological and empirical implementation perspective. The second stage highlighted different stages and phases to develop a social hybrid scenarios model with a method implementation of empirical study in real-life life of the older adults. Furthermore, this chapter presented a conceptual model of a social hybrid scenario, and the objective is to present the model to describe the phenomenon of usage and adaptability of IoT to enhance passive and social communication. Later, the study will develop final social hybrid scenarios and create an analysis frame based on the set of factors and variables that indicate the level of well-being in participants that analyse and evaluate the empirical study

CHAPTER 05- The Social Hybrid Scenario Model

The main objective is to validate the IoT and SIoT-based model that helps to understand the characteristics of novel technologies which help to promote older adults' physical, psychological, and social well-being. Moreover, the model provides an understanding of IoT sensors' role in older adults' daily life activities and improves the older adults' lifestyle by applying innovative technology. The main objective of this chapter is to sketch and describe the functional requirements, interface design, and passive and intentional scenarios. These scenarios indicate the image of the social hybrid model, which means what older adults do inside the model's environments and what opportunities older adults must promote their psychological and physical well-being. In this context, a proposed social hybrid scenario model has two primary communication components: passive and intentional communication. These two components can provide an environment in which older adults can interact with health care workers, doctors, family members and friends. In hypothetical models, all passive scenarios are designed in a health care interaction context in which older adults feel more protected, autonomous, and confident because 24 hours and seven days a week, people can take care of them through mobile and smart IoT applications. 24/7 surveillance increases the credibility of a social hybrid scenario and its worth among the older adult population and producers. Likewise, all intentional scenarios are designed to enhance the social interaction among older adults, which is essential for enhancing social circle and mental health.

The model's sketch contains these passive and intentional layers (Fig 17 A layer passive, and B layer intentional) that depict the social hybrid scenario's primary character and how combining passive and intentional layers offers an environment where older adults spend their healthy autonomous lives. If you look at Fig17, two layers are mentioned. On the left side is a layer, which represents the passive layer. The passive layers can predict, notify, suggest, make appointments, memories sharing, and live and real-time health data for its management and allowing the patients to call their doctors and family members. The B side of the model offers an intention communication service in which older adults can make invitations: invite people to outdoor and indoor activities, make audio/ video calls, show: multimedia comments, participate in city tours, hiking, and cultural activities: watch movies with friends and family members, play: outdoor and indoor games and log on to online classes and workshops.

However, the systems offer health care and social communications platforms; systems must use Wi-Fi internet, cellular data internet, or IoT clouds service. Unlike family members and medical doctors, they need to install the system on their mobile phones and monitor older adults' physical

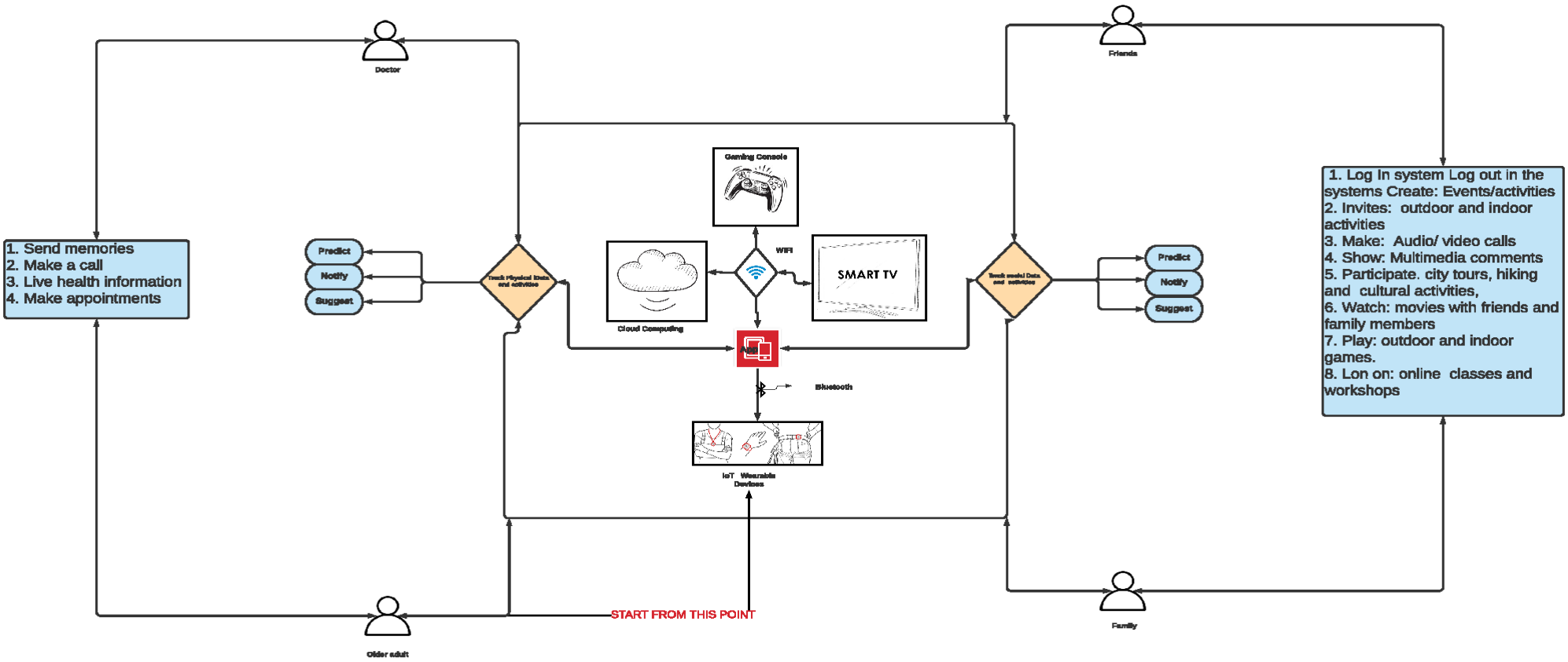
data. The system provides live data on older adults' physical health, in which doctors can analyse the older adults' physical data and suggest how to improve their physical well-being. Likewise, the older adults' family members will take care of older adults' daily activities, such as how many steps he walks per day and their geolocation, but in a critical situation, they will also receive the notification in the same manner and while doctors receive it in cases such as heart attack and fall detection.

For passive communication, the system gathers data from passive devices (medical or intelligent bracelets), analyses that information, and sends it to the medical doctors, healthcare personnel and family members to analyse and to allow these people to take precautionary measures to avoid worst-case scenarios. For example, when an older adult falls immediately, this information passes to doctors; as a precaution, doctors call the family members or an ambulance to avoid the worst-case scenario, in which the older adult is hurt and in pain for instance. Initiating social hybrid scenario services, the older adults wear a passive device (smart bracelet, smart clothing necklace etc.) on their body, connected to the system (installed on an Android phone) via Bluetooth technology. The passive devices are embedded with different sensors such as bio-signals, heart rate, and weight sensors. The intelligent passive devices will gather physical data of older adult bodies like body temperature, blood pressure, heartbeat, glucose level in the body, geolocation of older adults, monitoring the physical activities, and preventing of falls by detection and communicating this information to the family members and doctors via an Android application.

The system helps convert digital data into visual communication tools such as graphs and shares this information with the relevant authority. This chapter depicts a broader image of the model through narration and sketching the different scenarios of the model.

The chapter tells the reader what the initial user interface is looks like and what are the characteristics of the model can promote well-being among the older adults

Figure 17 Diagram of Social Hybride Scenario model



5.1. Requirement

- Maximum priority
- Medium priority
- Lower priority

5.1.1. Functional requirements

- To Register as older adults, family or friends and older adults
- To Login
- To Retrieve a password (in case of a forgotten password)
- To Pair a smart IoT bracelet with an Android application such as a mobile, tablet, or TV
- To Send Messages
- To make Audio calls
- To make Video calls
- To Monitor physical health data of older adults such as body temperature, heartbeat, footsteps etc
- To Make an appointment with Dr, the laboratory, and pharmacy
- To share videos, images, or graphical materials
- To Invite friends for outdoor activities

- To accept an invitation from the friends
- To play video games online for brainstorming with friends
- To Participate in online classes such as dance, food, gym, and painting classes
- To make Call SOS services (by Dr) in emergency scenarios
- To make the call to the patients and family members by the doctors
- To Play outdoor IoT location-based games with friends and family
- To provide a Health prediction after evaluation of older adults with weekly or monthly data
- To send a Warning or alert notification to the doctors about an older adult's health in an emergency call by systems
- To send a friend request
- To Add friends, family members or doctors
- To control Privacy
- To Share geolocation with friends and family members
- To create events

5.1.2. Technical requirement

- The IoT system software is designed in a way that it can be run on all Android and iOS applications and is compatible with the all-new version of Android and iOS devices
- The IoT system offers to monitor the physical health data of older adults through smart sensors
- Older adults should have an intelligent bracelet that can connect to the Android application via Bluetooth
- The system allows the Dr and family to monitor the older adult's physical health via the Android application
- The system allows the generation of alert messages when older adults are in a dangerous scenario
- The system enables the services of the call between Dr, family members, friends, and older adults

- The system enables social interaction between older adults and other people by offering indoor and outdoor activities
- The system allows older adults to invite people to different social activities, whether in or outside the house.
- The system predicts future physical health complications by analysing health data.
- The system enables the geolocation of older adults via GPS technology, family members and Dr can see the live location of older adults with the permission of older adults
- The system allows older adults to make appointments with doctors and visit them physically
- The application should have a social component where users can promote their achievements, generate content, and associate them with the application's functionalities

5.1.3. Investigation

This study develops ideas that serve to answer and identify the best way to achieve the defined objectives. This primary study objective is to sketch and validate an IoT-based social hybrid scenario with the study title "A social IoT Hybrid scenario to promote the physical, psychological, and social well-being of older adults". In the final design of the model, it is concluded, based on the sample of the study's target audience, that there is a predisposition to integrate technology to enhance older adults' physical and psychological well-being.

5.1.4. Designs

Users and fellow chart of user's task social hybrid scenario

To test the functions of a social hybrid scenario, we define the following primary users who can initiate the function of a social hybrid scenario.

i. An older adult

ii. A family member or friend of an older adult

iii. A medical doctor for older adults

Download and Installation of Systems

All three users (older adults, family members and medical doctors) need to download the Android and iOS application of the social hybrid scenario from the google play store or provided website. However, older adults must purchase smart IoT passive devices from offered platforms (medical stores or other platforms). After purchasing smart IoT passive devices, the older adults need to install them on their bodies by wearing them or positioning them in their surroundings, turn on them, and connect with an Android application via Bluetooth.

After the installation process, the first page of the application will be the login page. We have three user types, so the registration page will allow the following to log into the system. When older adults select the registration as an older adult, the following window opens the first screen, which shows two options, log in and registration. The login is for existing users in which users need to provide an email and password for login. The registration option is for new users, in which users need to register themselves by clicking the registration button that leads users to the next page. To initiate the registration process, users need to provide their email address, select the desired password, and then hit the next button option, which leads users to the next page, where they will have three following options for the user to register themselves as:

i. As an older adult

ii. As a doctor

iii. As a family member or friends

5.1.4.1. Registration as an Older Adults

After completing registration, the system leads the user to the new screen called the home screen. The home screen provides different information to the user; for example, top of the home screen, the user can see the user's picture, name, age, location, blood oxygen and heart rate. Thus, right beneath this information, the user can see the list of notification information such as health, social and physical activities-related notifications.

Moreover, beneath the notification information, there are fifteen activities options available for using physical and social activities such as 1) health data, 2) video consultation, 3) appointment, 4) online activities, 5) physical activities, 6)notification, 7) suggestion, 8) create events, 9) connects devices, 10) privacy setting, 11) camera, 12) call, 13)friends, 14) list of hospital and 15) list of pharmacy (see fig ....) The bottom of the screen is based on the home screen icon, which leads to the home screen, research icon, research page, and messages lead to the messages page icon.

Firstly, users need to connect their smart devices with the services app through Bluetooth for it to work and communicate properly. Thus, the user must click on the devices connected option and search their devices for connection with the study's model. However, older adults need to turn on the IoT application power by hitting the power button before connecting with the model. After establishing the connection between the Android application and the passive device, the service starts giving live data from the designated IoT device on the one model app.

Secondly, the user needs to establish security layers and secure their private information and data before adding people to their friend list, whether they be family members, family doctors, or friends. The friend request is associated with privacy layers; when somebody selects one of these

people for adding or sending a friend request, the new window pops up and asks the older adults which personal information want to share with either their doctor (Dr), family members, friends, or publicly. Once older adults set and select the privacy options, they hit the "send request" button. After adding the people to the older adult friend list, older adults can interact with Dr, family members, and friends through text chatting, audio, and video calls.

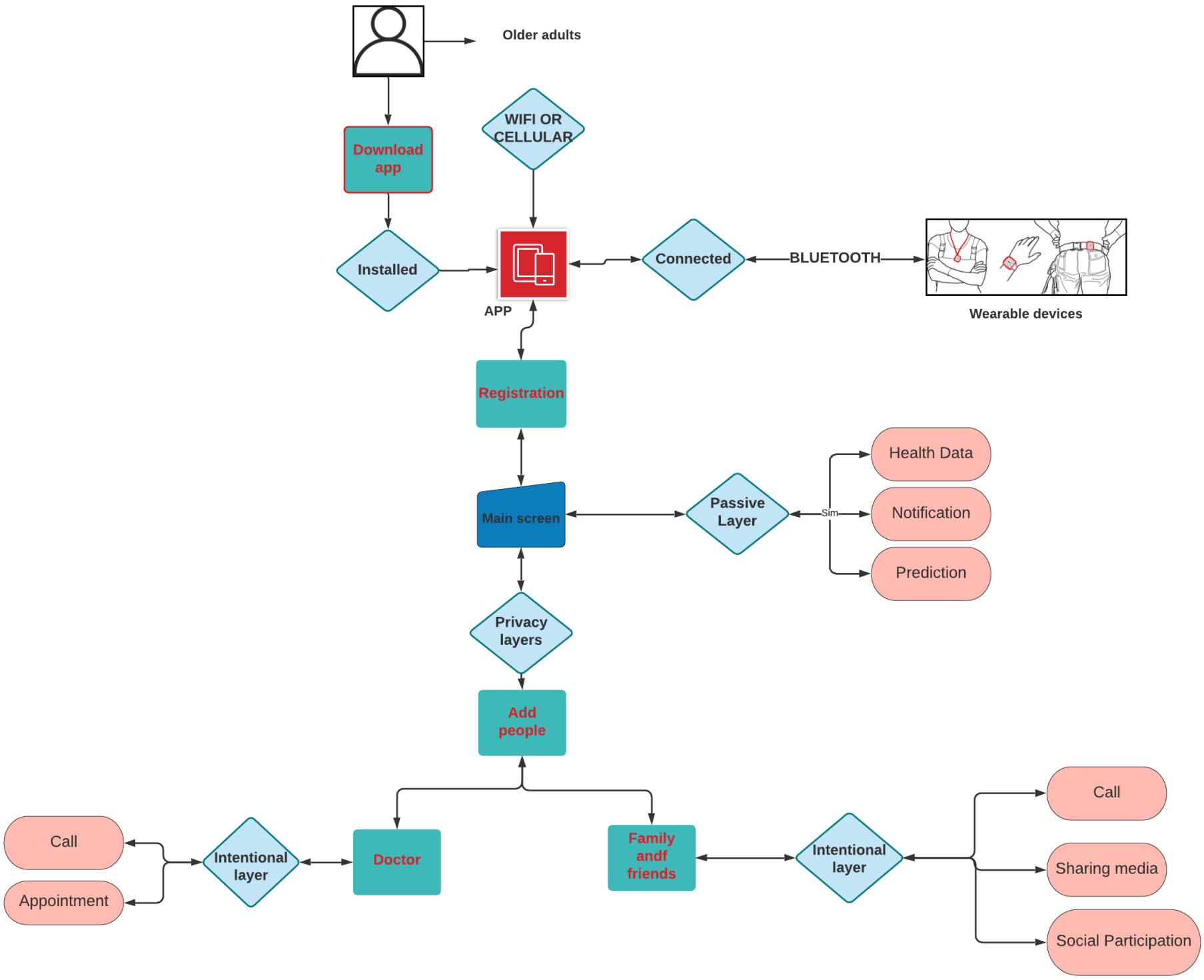
Make an appointment with Dr, the laboratories, and the pharmacy

After a certain age, it is hard for older adults to visit doctors, laboratories, and pharmacies. Additionally, older adults often must stand and wait hours and hours for their turn which make their life more difficult and fragile. Therefore, we decided to offer a platform where older adults make appointments with doctors, laboratories, and pharmacies. Patients or older adults do not need to visit the doctor's laboratories and pharmacies. However, doctors' laboratories and pharmacies will come to older adults' defined locations and provide all essential services and medical treatment, except that medical treatment and services cannot be performed at an older adult’s location due to a lack of tools, equipment, and logistics.

When a doctor examines older adults and does medical exams, they will add the exam information to the older adult’s profile, and this information automatically will go to the nearest designated laboratory. When the laboratory receives the exam notification, they will send a message to the older adults to tell him or them what time and day older adult wants their services for performing the essential exams. If they cannot perform some CT scans or MRI exams, they will offer to pick up and drop services, ferrying the older adult to this less-than-portable medical equipment.

Similarly, with pharmacies, when a Dr adds medicine to the older adult’s profile with the suggestion, the pharmacies will receive a notification of what medicine older adults need and for how many days. The pharmacies will send back a message to the older adults in which they will tell them when they are coming with medicine and with the cost of medicine.

Figure 19 Older adultsas user layer



Groups

Window seven is designed to interact with people face-to-face or online. Older adults select an option, and a small window will open for all people to discuss, sharing videos, audio messages, and images with each and for knowledge enhancement and social interaction. Furthermore, this window also gives an option called "outdoor activities". After selecting outdoor activities, the small window will open, giving information about location activities such as music programs, art shows, social gatherings, religious gatherings, or political gatherings near the older adults. The older adults also show their interest by clicking a button representing that they will attend the event.

Indoor and Outdoor Activities

Local and international groups offer comprehensive activities to enhance physical and psychological well-being by promoting social interaction between users. The interaction can be indoors and outdoors. Following indoor and outdoor activities are explained extensively.

i. Gesture Control Video Games

In gesture control video games, older adults will place the bracelet on their wrists. Such interfaces are intuitive, as we can see with the popularity of the legacy video game system, the Nintendo Wii, which allowed users to interact in games by using gestures while holding motion-sensitive controllers. One older adult will click on indoor activities, there will be a video games option, once older adults click on it, the following window will explain how to play these video games with the bracelet; this game can be a racing car. In the car video games, the older adults will have to move their hands in a different direction such as left, and right then a car will move left and right accordingly and pass different obstacles. Secondly, painting games with gesture control bracelets will also be available. In the video games option, there will be a hand painting video game option. When older adults click on this option, they will have a small window explaining how to play this game with a smart bracelet. After reading the video games, the older adults start drawing the painting, colouring them by hand gestures, and completing the level.

ii. Brainstorming Games

In this type of game, older adults will have to play crosswords games with their friends. Older adults need to complete missing parts of folk phrases or words and get points in this game. These

points older adults can share on social media platforms. The main objective of this kind of game is to enhance mental activities and boost the brain's working capacity.

iii. Online Dancing Classes

Once older adults click on this section, a window will open and ask people to join trainers or participants. For example, if the person chooses to be a trainer, he will train online and teach about dance or gym, for instance, all other people who participated as participants. When the trainer starts training, the notification will go to the participant in which the participant needs to accept or reject the notification. If they will accept, immediately a window opens that will show the trainer, who will be giving training tips. After watching the training in their window, participants will follow the trainer's guidelines and follow him or her as they will do for a gym or dance.

iv. Folk Teller and Singing Activities

When older adults click on folk tellers and singer activities, a small window will pop up in which the older adult will have to select one option from two options: 1st is as participant and 2nd is as singer or folk teller. If the older adults select singers and folk tellers, they must sing live songs for participants or narrate folk stories or local history. The participants will listen and pass their comments and question about the songs, folktales, and stories. These comments and questions will be received by the story narrator or singer, who will answer them.

v. Video and Audio Call.

Through the features, older adults can make video or audio calls with their family members, friends, and others in local and international groups.

vi. Sharing

Through these characteristics, people can make videos, images, or painting through offered applications and share them with their friends. this feature provides live video recording, editing, and sharing with their peers or friends.

vii Gym Central:

Gym central is a fitness-based characteristic of the social hybrid scenario, which has aimed to keep older adults independent physically, psychologically, and socially active. Through this feature, older adults will have trainees in a virtual environment that offers

personalized. The training and feedback are personalized, and social means older adults can participate and interact with other older adults and group exercise classes even if they have different physical and mental abilities.

Smart home convenience for older adults

The intelligent home convenience concept is one in which older adults can benefit from home automation technologies. Smart devices can help older adults in terms of making their life simple and autonomous. Therefore, current, and modern home automation technologies offer many benefits to our older adult community. In a social hybrid scenario, we will put smart sensors in a different part of the house to communicate with the bracelet and Android application. Through IoT applications, older people can control room temperature, and lights, close the main door or room door, control window curtains, and water the plant without physical moving. Regarding personal security needs, motion sensors will tell older adults about an intruder and automatically call the police or loved ones in a perceived time of need

Outdoor Activities

Going outside in the fresh air is a wonderful way for older adults to spend time with other older adults by doing interesting and health-giving outdoors activities to promote their physical and psychological well-being. Going outside encourages light exercise and promotes socializing, which are essential and integral parts of a healthy older lifestyle. There are many great outdoor activities for older adults to do that are easy for caregivers to arrange. Therefore, the system offered provides an opportunity to go outside and enhance the healthy living style of older adults. In international and local groups, older adults will have an option called outdoor activities. When older adults click on it, they will have the following option for selection and show interest in participating in these activities by clicking “I am going to participate.”

i. Gardening

Gardening is considered one of the most popular activities among older adults. This is a reliable way for older adults to stay active and improve maintain power and flexibility. There, the system offers to older adults to do gardening; for this, when people click on the gardening option, a new window will open in which different people are offering gardening jobs for older adults with groups. When older adults show interest in participating in gardening activities and click on the option interested, they will have the time, date, and location for gardening activities. They will also see how many other people will participate in this activity.

ii. City Tours.

A great way to stay active is through the walk, whether long hikes or a quick jaunt around the neighbourhood, which helps maintain cardio fitness as a part of the senior lifestyle. In this context, the system offers an activity called walks. When older adults click on this, they will have a new window, in which older adults can create a walking tour of this or already created a walking tour of the city or village. When older adults click on "Interested", they will have a time walk tour map and how much distance will cover.

iii. Outdoor Entertainment

Many local and international organizations will put on small outdoor theatre and music events to enhance older adults' happiness levels. This system offers an option in which older adults will click on this option and read all events times, dates, and locations, both locally or international, that are going to happen near or far from the older adult's location. They can note the time, date, and location for participation.

iv. Outdoor Crafts Events

Outdoor activities for older adults can include art. Outdoor crafts shows are filled with fun scenery, live activities, and great opportunities to see some engaging art, and older adults can produce their art by participating in these activities. The system offers people to participate in the crafts events by clicking on "Outdoor crafts events". After clicking, they will time, avenue, and dates. By participating in these events, older adults can show their crafts skills and increase their social contacts by interacting with other participants.

V. Location-Based Games

The main objective behind the location-based game is to tackle several crucial topics related to the ageing community. This activity will explore social inclusion issues in the older adult community and the education of older adults in digital technology, especially in mobile technologies and their learning motivation. Secondly, older adults have an activity in which tools combine historical knowledge with intelligent tablets and interaction in mixed-age teams of two players. The study method is to stimulate cooperation and interaction between old and young team partners: on the one hand, the older team member will use the smart device with the indirect assistance of the younger team member; on the other hand, the senior member should be more aware with the historical locations and cultural background of the games.

Invitation to Outdoor Activities.

Going outside with friends or family members helps to enhance the physical and psychological well-being level more than going with strangers or alone. Therefore, the offered system enables an invitation feature in which older adults can invite friends or family members to join them in outdoor activities. Likewise, when older adults select "walk" and plan to participate in group or individual walks, the system will invite their family members or friends for a walk. For the invitation, it is essential; that the older adults send an invitation request to their friends and family members for specific activities. When a friend or family member accepts the invitation, then they can schedule the date, time, and route of the walk.

Privacy Control Panel in the Older Adult Window

In this panel, the older adults will have options that control their private information, and they will have freedom of what information needs to share with their Dr, family members, friends, and others. Therefore, when older adults will receive friend requests, or add contact requests from someone such as a doctor, family members and friends, before accepting the request a window pops up which mentions what information older adults want to share with the person who is requesting it. For example, if older adults want to share body temperature, fall detection, heart rate, and glucose level but an older adult does not want to share their geolocation with a person then they can select the option of what to share and what not to share. Later, if an older adult wants to share more information about his physical health activities, he can click the button. The system will give them full autonomy and privacy, to control their privacy and physical data information as much as they can.

5.1.4.2. Registration as a Family Doctor

After installing the doctor's Android phone application, the doctor needs to provide the following information to initiate his activity on the offered system.

i) Name

ii) Email address

iii) Phone number

After completing registration, the system leads the doctor to the new screen called the home screen. The home screen provides different information to the user; for example, on top of the home screen, the doctor’s name, picture, specialization, and address of the hospital where he works. Thus, the doctor can see the list of notification information about a patient’s critical health information right beneath this information.

Beneath the notification information, the medical doctors will have five options to interact with patients and their family members such as 1) a list of patients, 2) adding patients, 3) appointments 4) privacy, and 5) notifications.

After these six options, a map indicates to the doctor the patient's live location that gives information about what patients are doing and their exact location. However, if the patients activate the privacy on-location option, the doctor cannot see the live location of older adults or patients. The bottom of the doctor's home screen has a search option and messages icon to search and generate the message to the patients.

i. Notification

Once the doctor hits this option it will lead him to a window where he can see various notifications in chronological order, like 1,2,3,4 and 5. In front of these numbers, captions such as "1" will have life threats when the doctor sees these notifications and ha can react according to their level of threat. Once the doctor clicks off the threats, he can see the following screen which will provide information related to the current patient's situation. If a doctor thinks the patient's physical health is not good and has life threats, he will call the emergency services or call his family members who are already added to his contact details.

ii. Patients Add

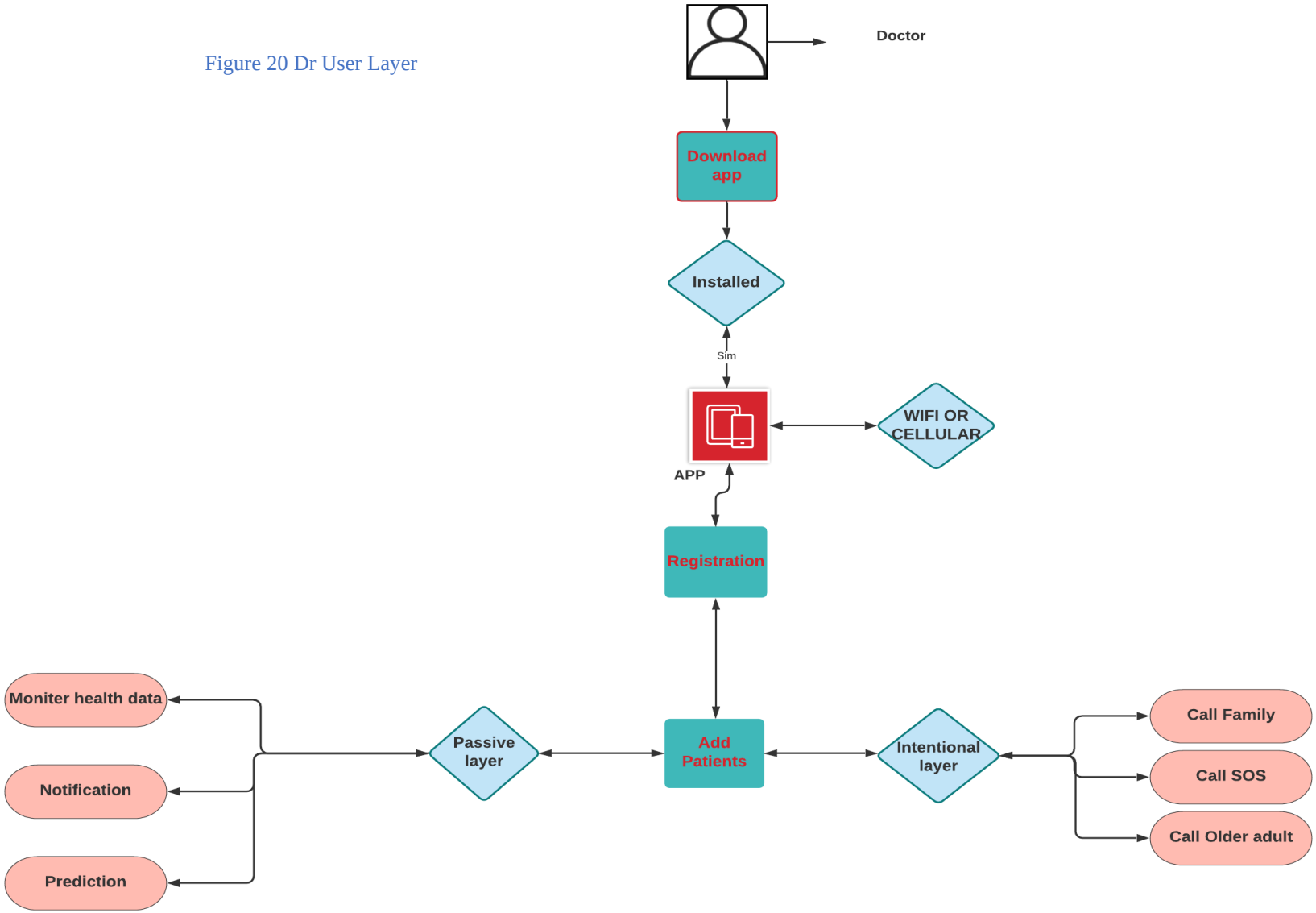
The second option of the primary doctor screen will add patients to his profile. Once the doctor hits the add patient option, this button will lead him to the next window that will demand that he fill in the following information for older adults into the information.

i. Name
ii. Age
iii. Medical number
iv. Phone number
v. Email address
vi. Family member's contact numbers

The 3rd option will be a profile of patients. Here there will be a list of all patients with their names or medical numbers. When the doctor clicks on the name of the medical number of patients, it will lead him to a profile of a patient in which the doctor can see live data streaming of the older adult's physical health, such as his or her body temperature, blood pressure, glucose levels, heartbeat, how many steps he or she walks per day, and what is his or her current location.

Secondly, if the doctor feels something abnormal in sensors data, then, there is an option on older adults' profiles to make calls or send a message to the older adults and family members to let them know what the current situation is and how they will take precautionary measure to avoid the worst-case scenario.

Figure 20 Dr User Layer



5.1.4.3. Registration as a Family Member

When family members finish installing an Android application, they must provide the following information to finish their registration with the system.

i) Name

ii) Contact details, such as their mobile telephone number

iii) Email address

After completing registration, the system leads the family members to the new screen called the home screen. The home screen provides different information to the user, for example, the top of the home screen, the family member's name, pictures, relations, and locations. Beneath this information, family members have two basic options such as:

1) add people and 2) notification. Once they add the people, they also show mothers, fathers, and friends on the home screen. After these, a map indicates to the family the current live location of their mother, father and friends that give information about what family members are doing and the exact location. However, if the older adults activate the privacy on-location option, the family cannot see the live location of older adults or patients. The bottom of the family members' home screen has a search option and messages icon to search and generate the message to the patients.

Add Family Members

After providing basic information, the family member needs to press the next window, which leads family members to the next screen to find an option called "Add Patients". When family members press this add patient button, then they will provide the following information.

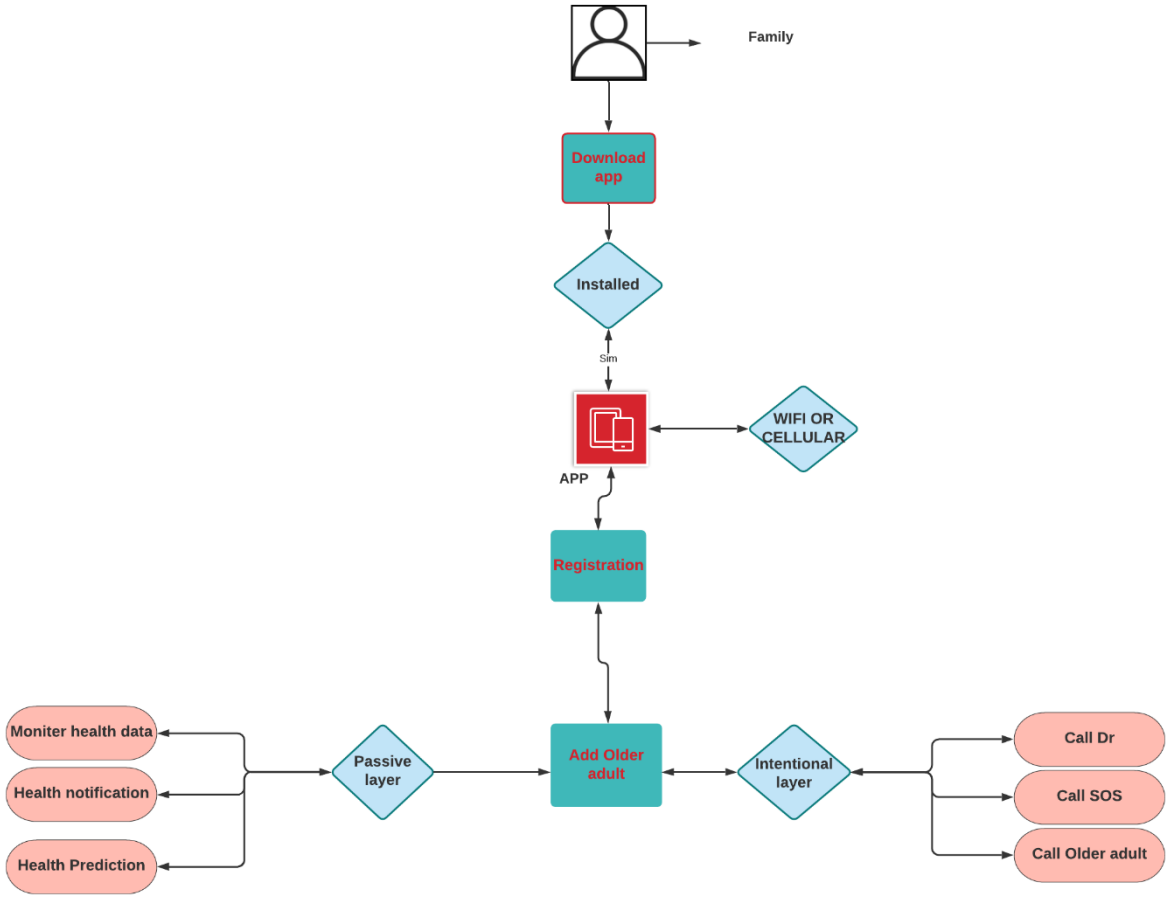
i. Email

ii. Phone

iii. Relationship

Once he sends the add request, he or she will wait for acceptance of add request; otherwise, the "Next" button will not activate to lead the family member next screen. After accepting the request by the older adults, the "Next" button will activate, and family members will visit the next screen. The next screen is the main window where he can see geolocation, daily activities such as how much he walks per day, body temperature, blood pressure, and glucose level. If family members observe anything abnormal in the physical health data, then he can call the older adults and check if they older adults are okay or not; if the older adult is not okay, then he can call the doctors from the same window and consult with the doctor about the present health condition.

Figure 21 Family user layer



5.2. The Flow of the App and User Tasks

To perform the specific tasks and operate the application effectively, it is essential to have a user-friendly visual representation of a prototype in a social hybrid scenario. The visual representation of the application leads us to understand how to navigate one page to others or offers and perform the different tasks by giving a flowing visual representation of the application. The following flow charts represent the three different users and their tasks in the offered applications.

5.2.1. Sketches Interface layout

We propose the initial version of the visual layout of offered interfaces of the social hybrid scenario, and it is essential to propose a primary but practical layout of an application that represents the offered requirements of the system. This study is going to use an Android smartphone named Asus Zenfone, with a 1080x 2160 screen resolution. **T**his phone was chosen as it is a medium specification budget phone and quite normal, and therefore a useful, and replicable pilot device.

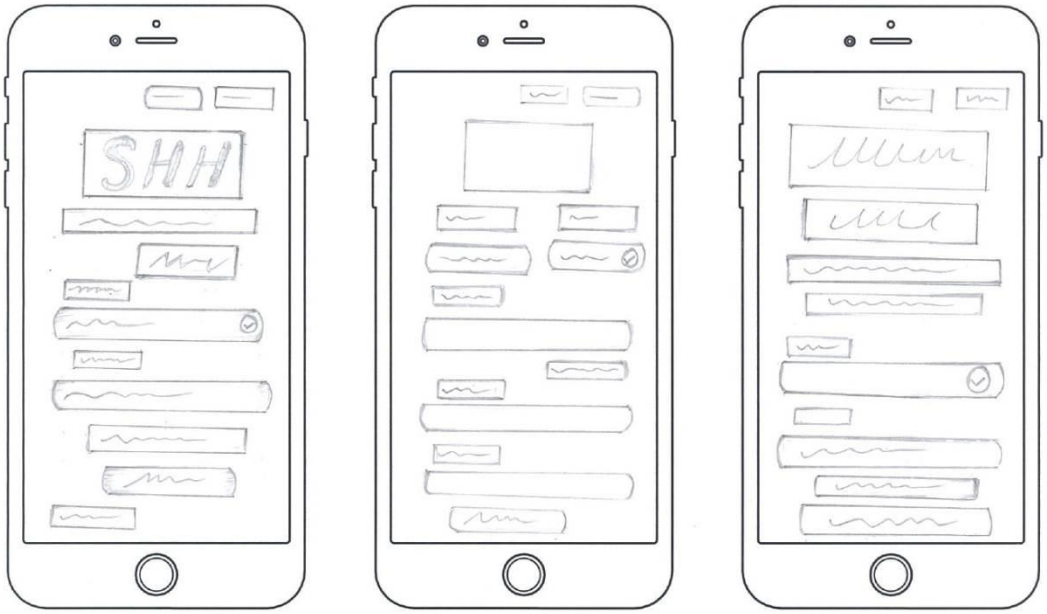


Figure 22 Registration or login`s interface

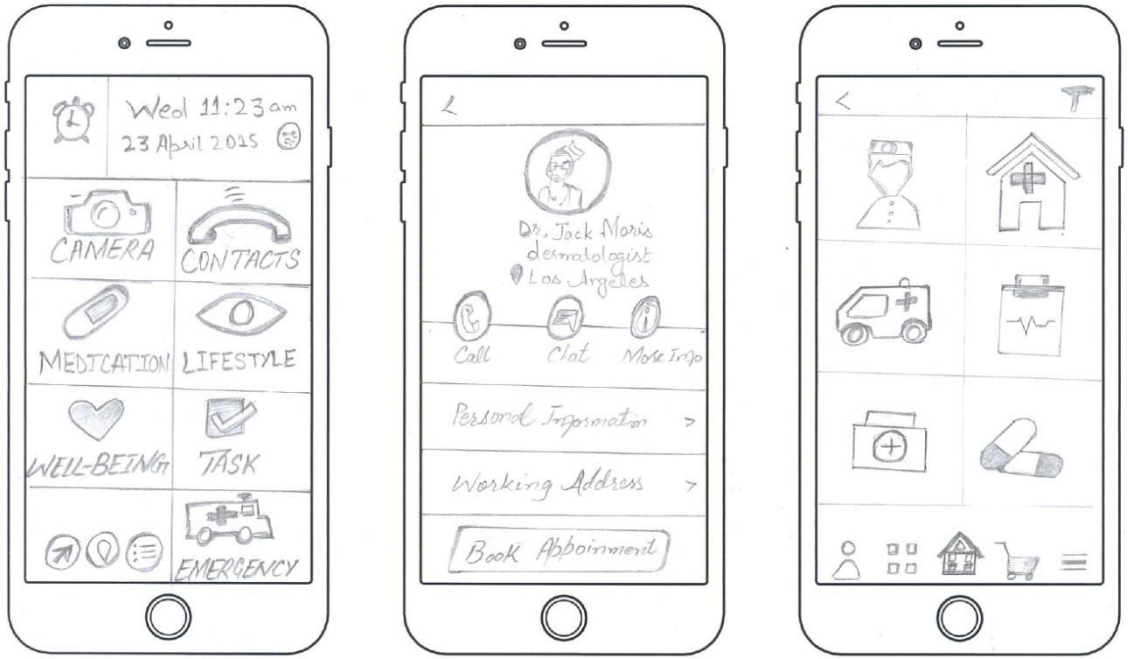


Figure 23 Olderadult app operating interface

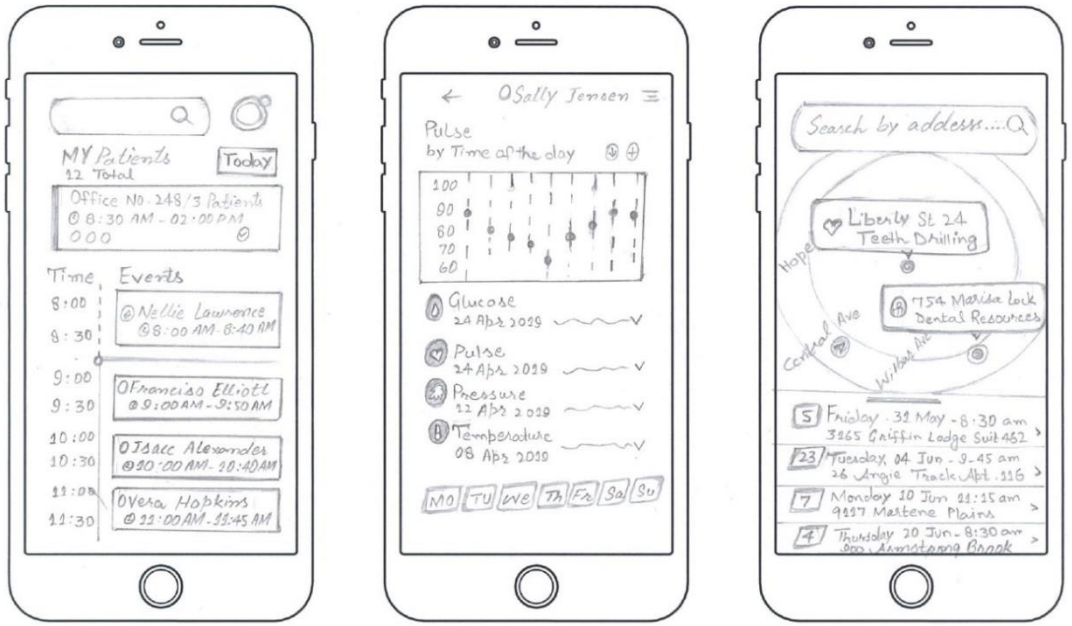


Figure 24 Dr`s operating interface

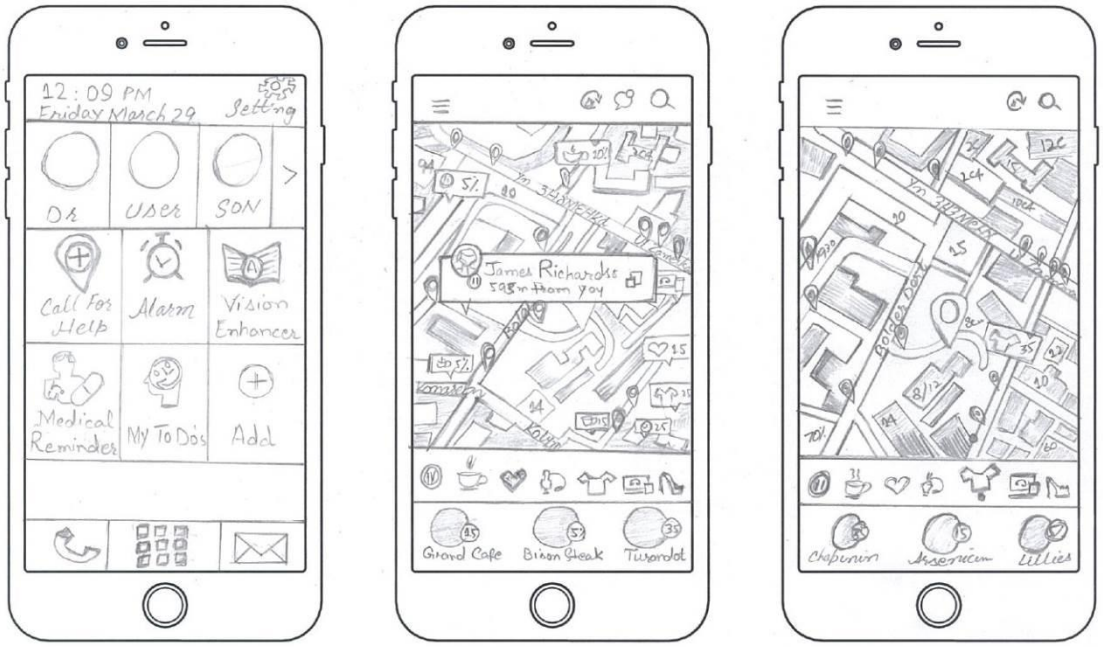


Figure 25 Social Communication interface

The above layout interfaces show how different users can perform various tasks by following the graphical navigation of layouts. First, all users need to register themselves to login into the system. There is a registration button when users click the registration button, and this click leads users next screen in which users have three user options such as older adults, Dr, and family members. The users need to decide who they are and then click on one user.

5.3. Technical Procedures for Prototype Development

5.3.1. Networking Phases

This phase is responsible for gathering data from the perception phase and broadcasting and transmitting the gathered data from lower to upper. At this phase, the Arduino plays a role as the gate of application that incorporates intelligent sensors and devices through fog computing; the fog computing can visualize the information, and performance, process the data and pass the information to the cloud.

5.3.2. Perception Phase

The perception phase of this layer will develop small, low cost and practical tools that are adept at processing and offering health care effectively via an effective communication protocol. Various sensors will deploy on the smart bracelet for enhancing the monitoring services and can be used for transmitting information about GPS location, body temperature, fall detection, glucose, and heart rate sensors with the help of Arduino Bluetooth H-05 that will connect with the Android application for example, if the body temperature of an older adult increases, that sensors will send an alert to his medical doctor and let him know that the older adult's body is behaving abnormally. These smart IoT sensors will be attached to a programmable small computer, called Arduino Nano, that studies the main building component and was chosen due it's to its efficiency, low cost, and customization. The Arduino is equipped with smart sensors with smart, intelligent characteristics, which have a unique IP address that makes it unique and recognizable over the network for connected devices.

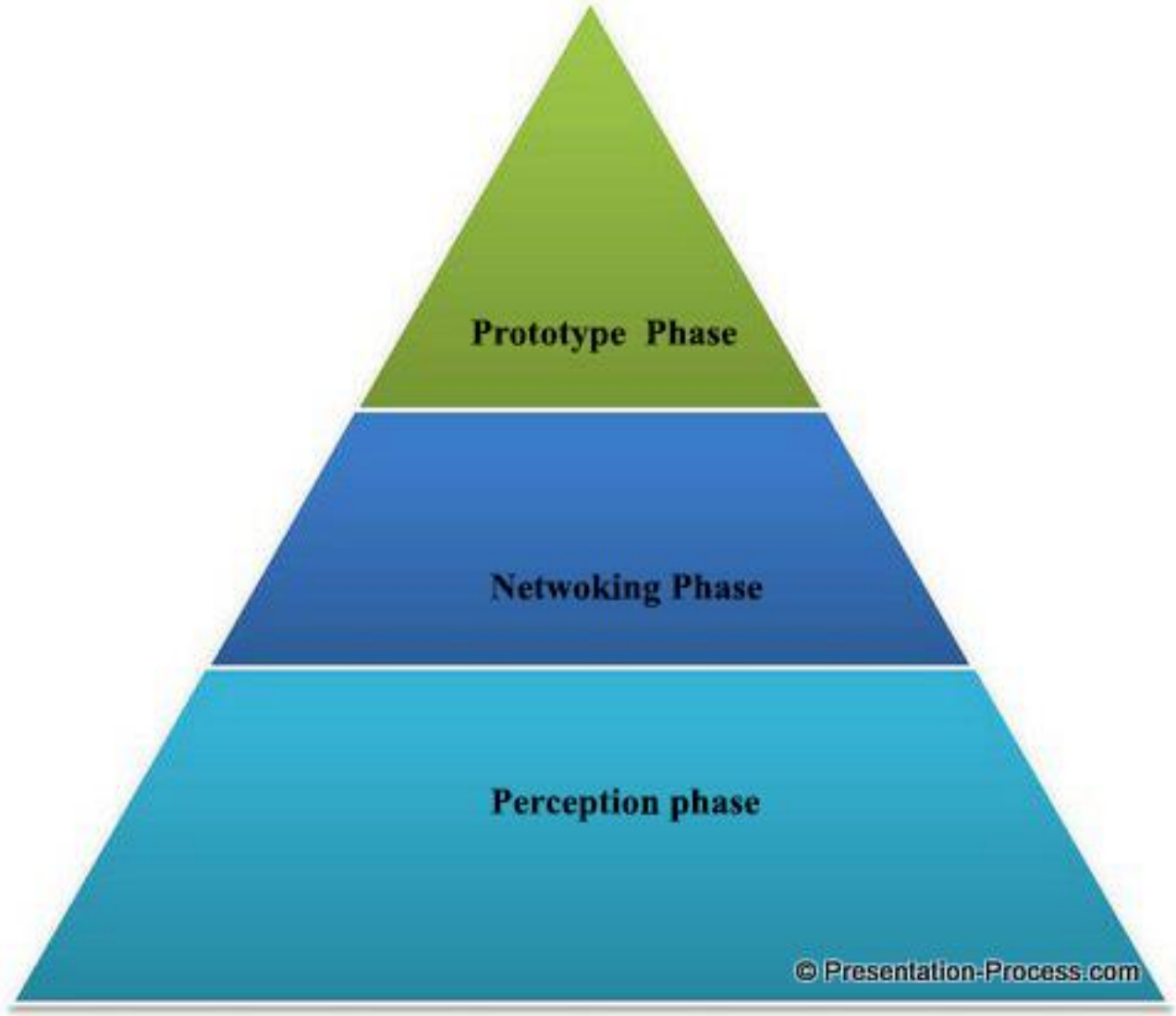


Figure 26 **system phasehttps://www.presentation-process.com/Prototype Application Phase.**

5.3.3. Prototype Application Phase.

The system phases can analyse the data, store it, make it intelligent and communicate with end-users. The system phases can gather data from the live streaming or the storage cloud. Furthermore, these phases sort down the data and dig out other helpful information for patients and doctors. The phases propose an intelligent environment for health care and social interaction solutions based on smart, precise, adequate information and automatic makes applicable decisions.

Required Tools

i. Hardware

First, we need various hardware for two different platforms, but they will communicate with each other. First platforms android application. We need a mobile phone and one computer for Android application development and programming to develop an Android application. Secondly, we need to develop a passive device that would be a smart bracelet. For the smart bracelet, we need the following sensors and hardware.

a. Arduino board
b. HC-05 Bluetooth
c. Sensors: Blood pressure (BP), body temperature (BT), Blood Glucose (BG), fall detection (FD), heart rate (HR), Geo-Location (GL)
d. GPS
e. 3D printed bracelet

ii. **Software**

a. Android Studio
b. Arduino programming editor
c. Adobe Photoshop
d. Cinema 4D
e. Adobe XD
f. Programming; Java, C++, HTML, and JavaScript

After arranging all hardware and sensors, we later need to draw circuits, place all sensors on the Arduino board, and complete the circuits.

Designing

Through the design phases, we will design the android application adobe XD because Adobe XD the software can design the layout of the mobile application, adobe XD, and we give visual identity mean how the app will look and communicate from one page to another page. Furthermore, we need a 3D bracelet; we need to design the 3D sketch for 3D printing. For a 3D sketch of the bracelet, we will use Cinema4; later, we will use any 3d printer and print 3D Bracelet.

5.3.4. Development and Implementation.

The implementation stage involves transforming the software technical data package into one more fabricated, integrated, and tested software and hardware configuration item for software and hardware acceptance testing. The main activities of hardware and soft implementation include the:

i. Fabrication of software and hardware units to satisfy structural unit specifications.
ii. Assembly, integration and testing of software and hardware components into a software and hardware configuration item.

iii. Prototyping challenging software components to resolve implementation risk or establish a fabrication proof of concept.

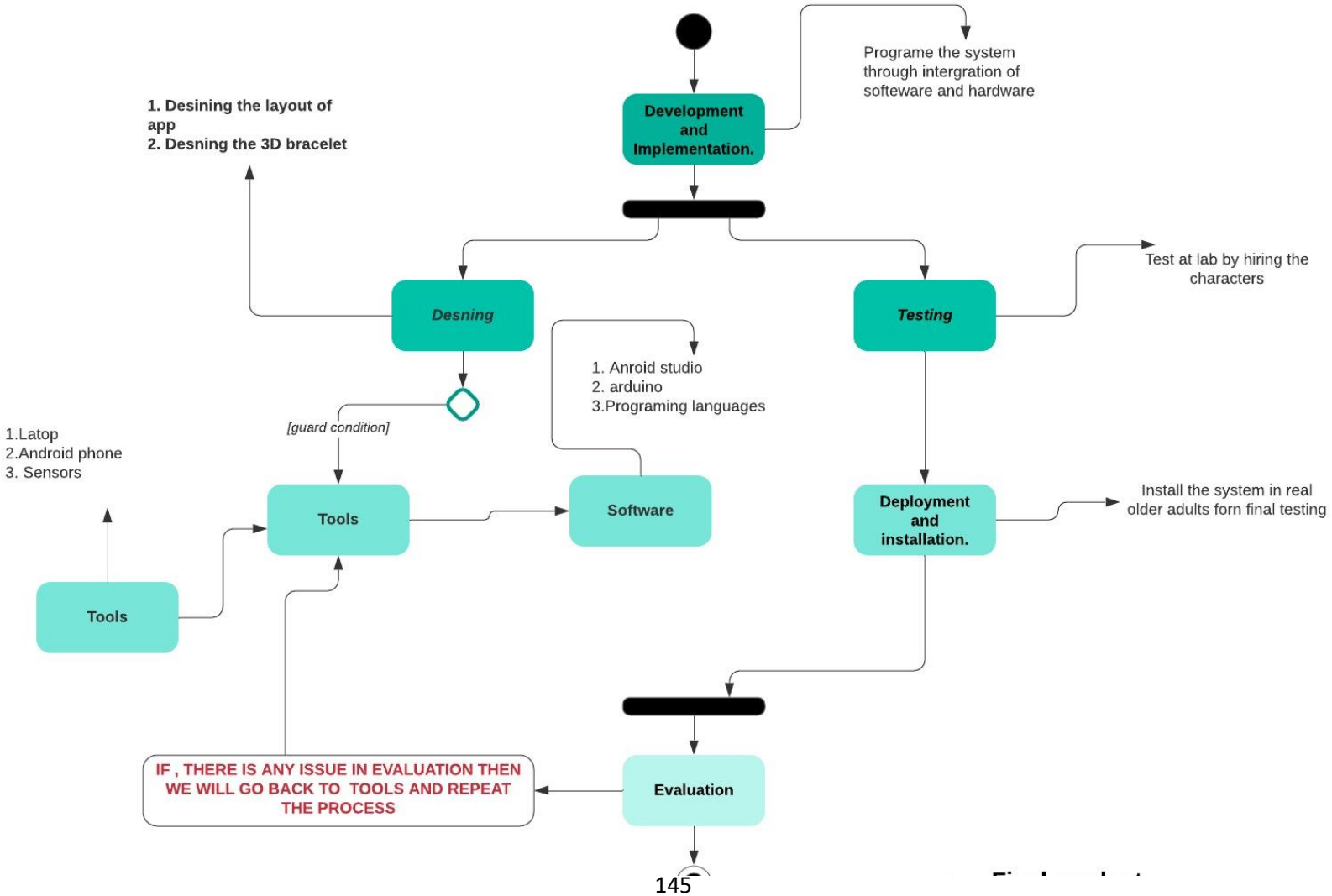
Testing

After developing the Android application and the smart bracelet, the next level tests the application at a laboratory or a small level. The test level will make understand the integration of software and hardware application. Therefore, first, we will hire three people pretending these are actual characters like one will be a doctor, the second will be an older adult, and the last will be family members. After hiring, please explain how this application or system will work later to give them a test application. If we observe any technical issues, we will resolve issues and move to the next level.

5.3.5. Deployment and Installation.

After testing and rectifying the issues observed during the testing session, we will deploy and install the social hybrid scenario in real work. To deploy a social hybrid scenario in the real world, we will be needed older adults living far from the city, and they do not have any medical Centres nearby; fewer people are there to take care of them. Once we find these people, they will install Android applications on their mobile and put the bracelet on their wrist, as well as install the same application on their families, friends,' and doctors' Android phones.

System Architecture



CHAPTER 06- Empirical Results and Discussion

6. Statistical Methods

6.1. Descriptive Statistics

In terms of descriptive statistics for the characterization variables, the tables and graphs are presented to illustrate the frequency distribution of observed values. The quantitative and Likert scale variables were analyzed using the categories presented, calculating some relevant descriptive statistical data, addressed by Guimarães and Sarsfield Cabral (2010) as the mean (M) values (on a scale from 1 to 5, a value greater than 3 is higher than the scale middle point), the standard deviation (SD) representing the absolute dispersion, the variation coefficient (VC) representing the relative dispersion and minimum (Min) and maximum (Max) values.

6.1.1. Scale Reliability

The internal consistency (reliability) analysis allows for studying the properties of measurement scales and their items, according to DeVellis (1991). Cronbach's alpha (Cronbach, 1951) is the most widely used model of internal consistency in the social sciences, measuring how a set of variables represent a certain dimension (Hill & Hill, 2002). A coefficient of internal consistency of 0.80 or more is regarded as adequate for most applications, and a value between 0.60 and 0.80 is acceptable, as referred, for example, by Muñiz (2003), Muñiz et al. (2005) and Nunnally (1978).

6.1.2. Pearson Correlation Coefficients

This association analysis is explained by Maroco (2011, p. 22-26) to study the relationship between quantitative variables, as the ones obtained from scales, using the Pearson correlation coefficient, which is a measure of linear association and varies between -1 and 1. The closer you are to the extreme values, the greater the association between variables.

6.2. Descriptive Analysis

The total sample contains 187 subjects, but eight responses were collected as a pre-test, without the personal data, so they are eliminated from the analysis, remaining 179 valid answers, were collected from March 4th to March 29th of 2022.

.

6.2.1. Declaration of informed consent

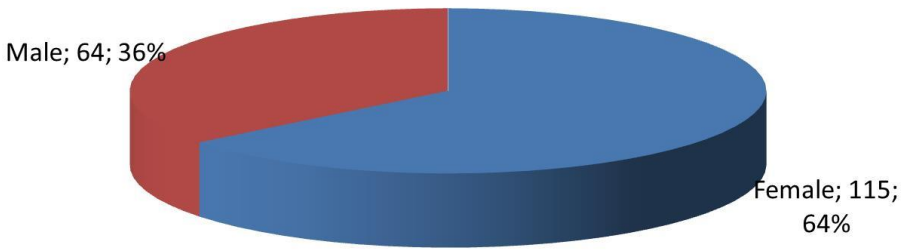
All the participants answered, “I declare that I have read and understood the information above and agree to participate in this study, allowing the use of the data I provide, voluntarily, trusting that it will only be used for this research and the guarantees of confidentiality and anonymity gave to me by the researchers.”

6.2.2. Personal data

Table 7 Frequencies: 2. Gender

	N	%
Female	115	64,2
Male	64	35,8
Total	179	100,0

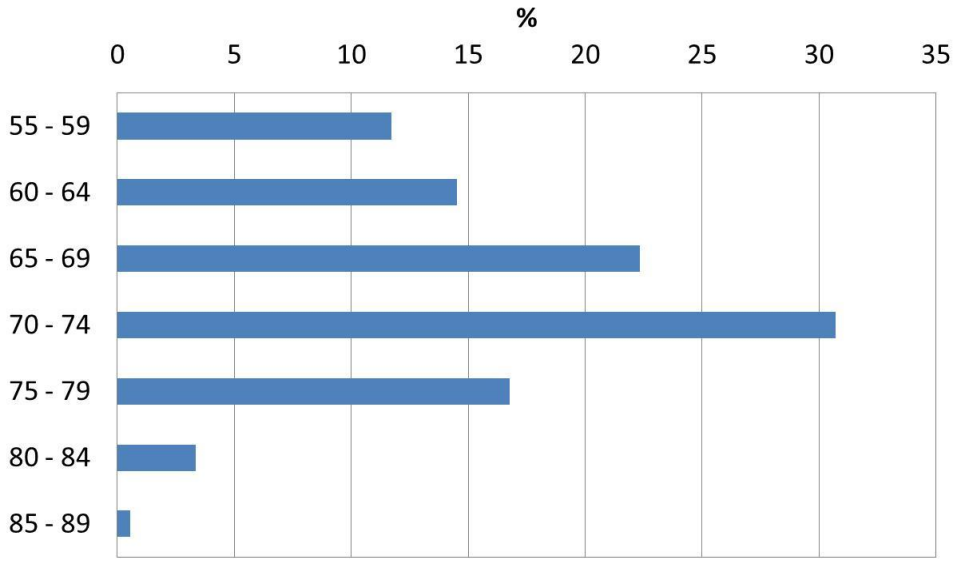
Figure 27 Frequencies : 2. Gender



In the sample, 64,2% are males and 35,8% are females.

Table 8 Frequencies: 3. Age

Figure 28 Frequencies: 3. Age



	N	%
55 - 59	21	11,7
60 - 64	26	14,5
65 - 69	40	22,3
70 - 74	55	30,7
75 - 79	30	16,8
80 - 84	6	3,4
85 - 89	1	,6
Total	179	100,0

In the sample, 11,7% have 55 – 59 years, 14,5% have 60 - 64 years, 22,3% have 65 - 69 years, 30,7% have 70 - 74 years, 16,8% have 75 - 79 years, 3,4% have 80 - 84 years and 0,6% (one element) has 85 - 89 years.

Table 9 Frequencies: 4. Level of education (completed)

	N	%
1st cycle of basic education (4th class)	34	19,0
2nd cycle of basic education (6th year)	4	2,2
3rd cycle of basic education (9th year)	18	10,1
Secondary Education (12th year)	40	22,3
Graduation	66	36,9
Master's degree	12	6,7
Doctorate	5	2,8
Total	179	100,0

Figure 29 Frequencies: 4. Level of education (completed)

In the sample, 19,0% have 1st cycle of basic education (4th class), 2,2% have 2nd cycle of basic education (6th year), 10,1% have 3rd cycle of basic education (9th year), 22,3% have Secondary Education (12th year), 36,9% have Graduation, 6,7% have Master's degree and 2,8% have Doctorate.

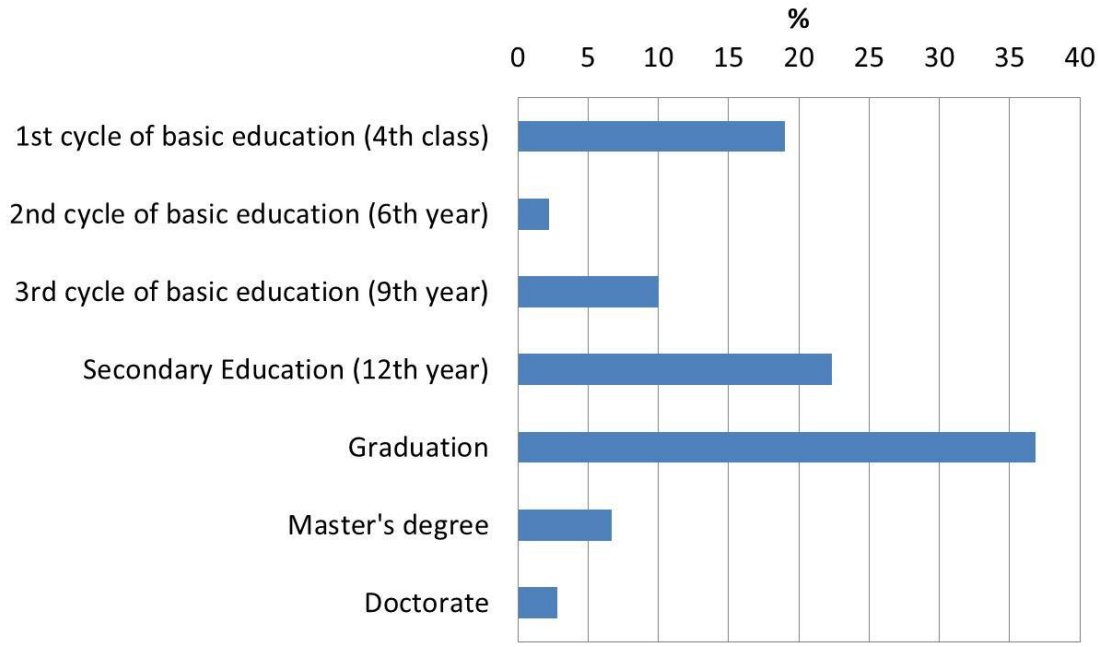
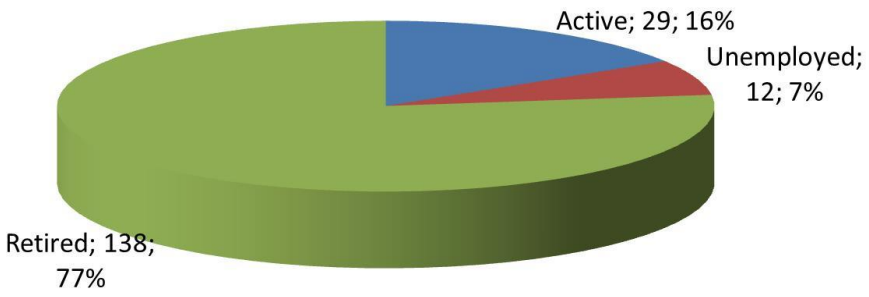


Table 10 Frequencies: 5. Employment status

	N	%
Active	29	16,2
Unemployed	12	6,7
Retired	138	77,1
Total	179	100,0

Figure 30 Frequencies Chart: 5. Employment status

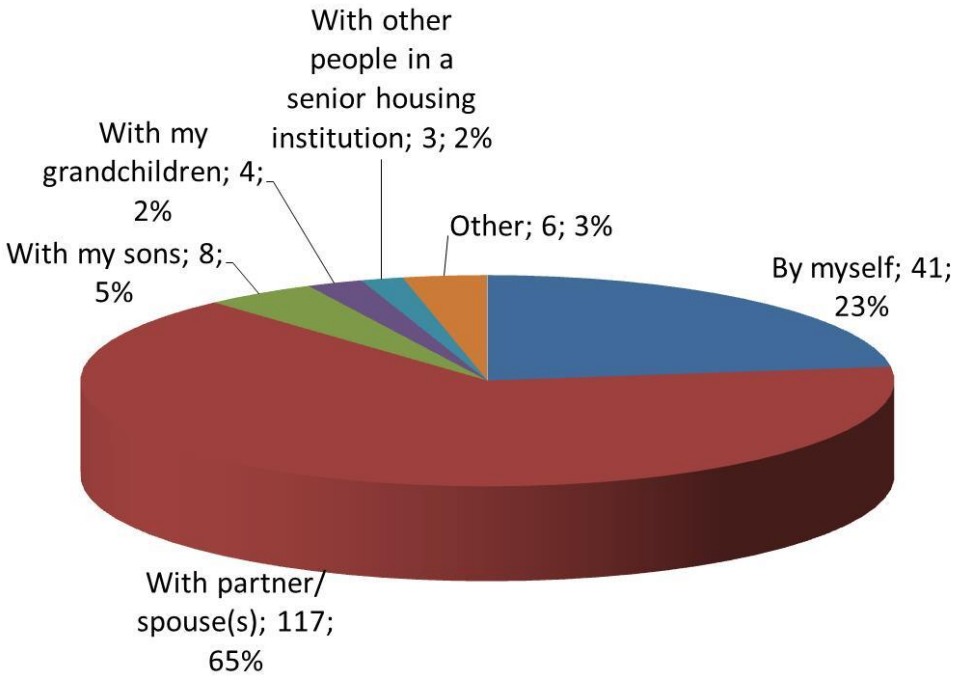


In the sample, 16,2% are Active, 6,7% are Unemployed and 77,1% are Retired.

Table 11 Frequencies: 6. Whom do you live with?

	N	%
By myself	41	22,9
With partner/spouse(s)	117	65,4
With my sons	8	4,5
With my grandchildren	4	2,2
With other people in a senior housing institution	3	1,7
Other	6	3,4
Total	179	100,0

Figure 31 Frequencies: 6. Who do you live with?

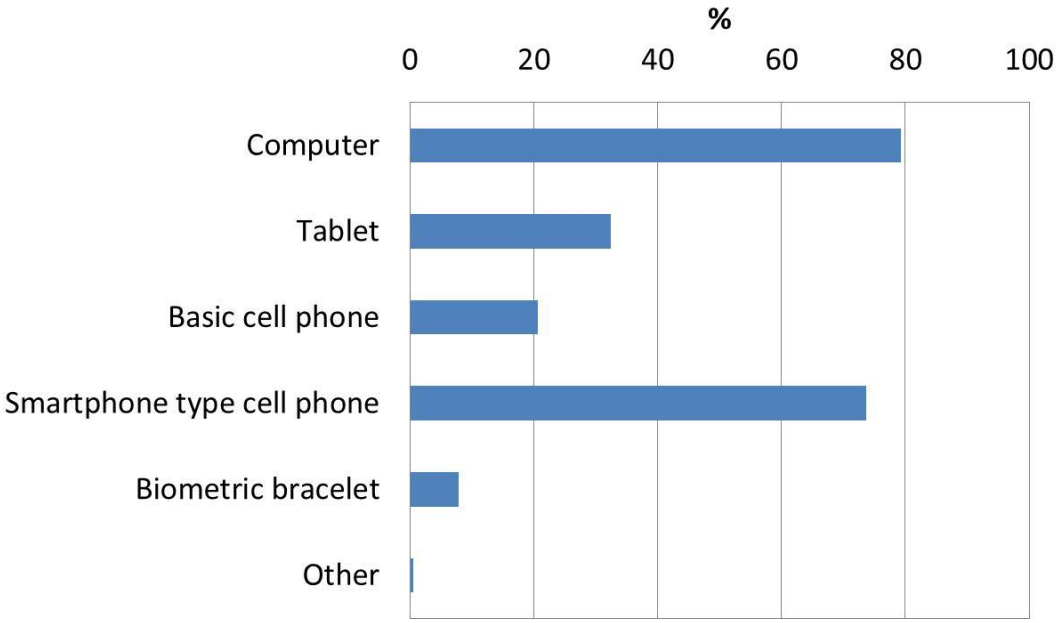


In the sample, 65,4% live with a partner/spouse(s), 22,9% answered that live by myself, 4,5% live with sons, 2,2% live with grandchildren, 1,7% live with other people in a senior housing institution and 3,4% live with Other, specifying “With the parents” (2 elements), “Husband and youngest daughter”, “Mother and brothers”, “With goddaughter” and “With husband and father” (one element each).

Table 12 of frequencies: 7. From the list below, please select the technologies you have for personal use

	No		Yes	
	N	%	N	%
Computer	37	20,7%	142	79,3%
Tablet	121	67,6%	58	32,4%
Basic cell phone	142	79,3%	37	20,7%
Smartphone-type cell phone	47	26,3%	132	73,7%
Biometric bracelet	165	92,2%	14	7,8%
Other	178	99,4%	1	,6%

Figure 32 Frequencies: 7. From the list below, please select the technologies you have for personal



In the sample, regarding the technologies for personal use, 79,3% have Computer, 73,7% have a Smartphone type cell phone, 32,4% have Tablet, 20,7% have a Basic cell phone, 7,8% have a Biometric bracelet and 0,6% (one element) has Other, specifying Smartwatch.

Table 13 Table of frequencies: Personal data

		N	%
2. Gender	Female	115	64,2
	Male	64	35,8
3. Age	55 - 59	21	11,7
	60 - 64	26	14,5
	65 - 69	40	22,3
	70 - 74	55	30,7
	75 - 79	30	16,8
	80 - 84	6	3,4
	85 - 89	1	,6
4. Level of education (completed)	1st cycle of basic education (4th class)	34	19,0
	2nd cycle of basic education (6th year)	4	2,2
	3rd cycle of basic education (9th year)	18	10,1
	Secondary Education (12th year)	40	22,3
	Graduation	66	36,9
	Master's degree	12	6,7
	Doctorate	5	2,8
5. Employment status	Active	29	16,2
	Unemployed	12	6,7
	Retired	138	77,1
6. Who do you live with?	By myself	41	22,9
	With partner/spouse(s)	117	65,4
	With my sons	8	4,5
	With my grandchildren	4	2,2

	With other people in a senior housing institution	3	1,7
	Other	6	3,4
7. From the list, please select the technologies you have for personal use	Computer	142	79,3%
	Tablet	58	32,4%
	Basic cell phone	37	20,7%
	Smartphone-type cell phone	132	73,7%
	Biometric bracelet	14	7,8%
	Other	1	,6%
Total		179	100,0

6.3. Part 1. Social interaction with family and friends

Table 14 frequencies: Part 1. Social interaction with family and friends

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
8 . I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends	2	1,1%	1	,6%	12	6,7%	56	31,3%	101	56,4%	7	3,9%
9. I agree with the connection of my social networks (Facebook...) to the system.	9	5,0%	18	10,1%	36	20,1%	75	41,9%	31	17,3%	10	5,6%
10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)	4	2,2%	12	6,7%	33	18,4%	81	45,3%	32	17,9%	17	9,5%
11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon).	3	1,7%	4	2,2%	18	10,1%	96	53,6%	46	25,7%	12	6,7%
12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family.	5	2,8%	7	3,9%	26	14,5%	85	47,5%	40	22,3%	16	8,9%
13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.	6	3,4%	15	8,4%	59	33,0%	64	35,8%	20	11,2%	15	8,4%

1- Totally disagree; 2- Disagree; 3- No opinion of disagreeing or agree; 4- Agree; 5- Totally agree; 9- Does not apply to my case

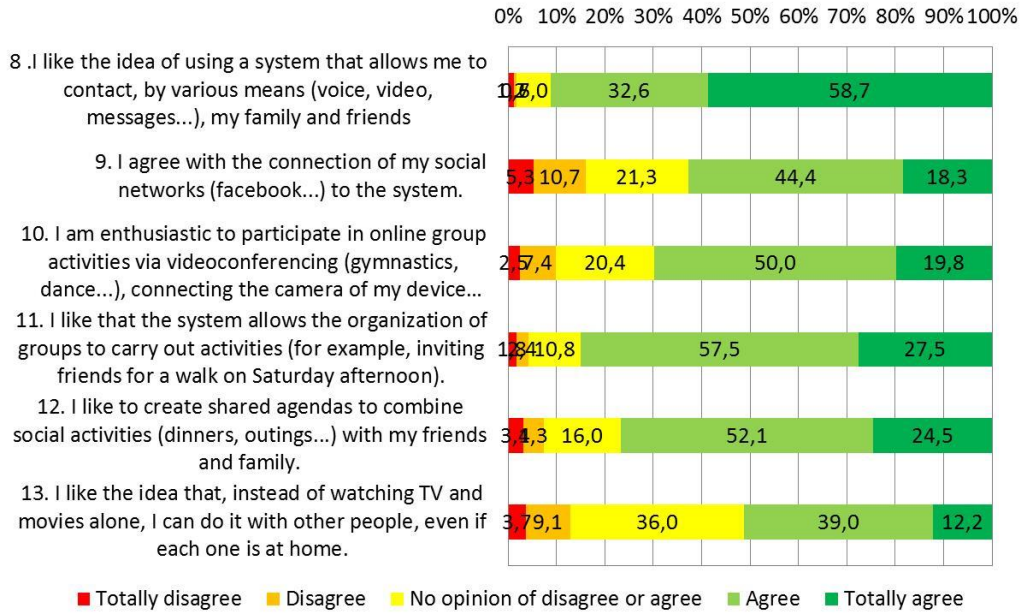
Table 15 Frequencies: Part 1. Social interaction with family and friends (without missing answers)

	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
8 . I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends	2	1,2%	1	,6%	12	7,0%	56	32,6%	101	58,7%
9. I agree with the connection of my social networks (Facebook...) to the system.	9	5,3%	18	10,7%	36	21,3%	75	44,4%	31	18,3%
10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)	4	2,5%	12	7,4%	33	20,4%	81	50,0%	32	19,8%
11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon).	3	1,8%	4	2,4%	18	10,8%	96	57,5%	46	27,5%
12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family.	5	3,1%	7	4,3%	26	16,0%	85	52,1%	40	24,5%

	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.	6	3,7%	15	9,1%	59	36,0%	64	39,0%	20	12,2%

1- Totally disagree; 2- Disagree; 3- No opinion of disagreeing or agree; 4- Agree; 5- Totally agree.

Figure 33 Frequencies: Part 1. Social interaction with family and friends (without missing answers)



The agreement is high for all statements, higher for "8 . I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends" (91,3%), followed by "11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon). " (85,0%), then by "12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family. " (76,7%), followed by "10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...) " (69,8%), then by "9. I agree with the connection of my social networks (facebook...) to the system. " (62,7%), and lower for "13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home. " (51,2%).

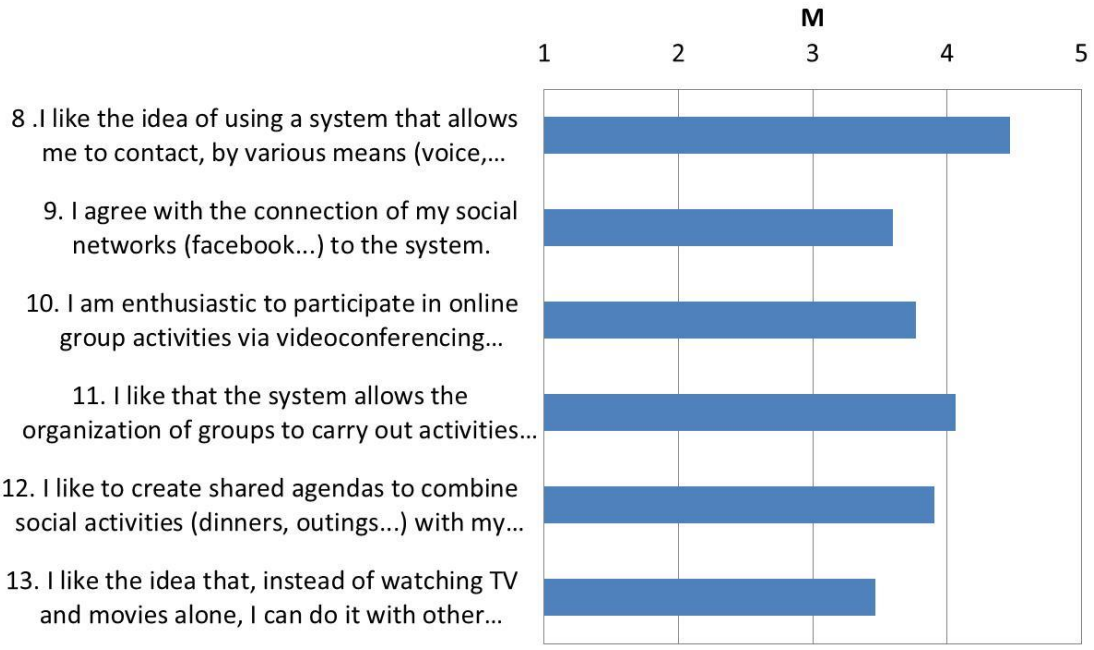
Table 16 Statistics: Part 1. Social interaction with family and friends

	N	M	SD	VC
8 . I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends	172	4,47	0,75	17%
9. I agree with the connection of my social networks (Facebook...) to the system.	169	3,60	1,07	30%
10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)	162	3,77	0,93	25%

11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon).	167	4,07	0,80	20%
12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family.	163	3,91	0,92	24%
13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.	164	3,47	0,95	27%

Measurement scale: 1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 34 Means chart: Part 1. Social interaction with family and friends



In the sample, the mean for the agreement is higher for "8 .I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends" (M=4,47), followed by "11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon). " (M=4,07) and "12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family. " (M=3,91), then by "10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...) " (M=3,77) and "9. I agree with the connection of my social networks (facebook...) to the system. " (M=3,60), and finally by "13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home. " (M=3,47), all items with mean value higher than the scale middle-point.

To the question “14. If you'd like, let us know what you think of additional ways the system can promote interaction with family and friends:”, there are the following answers from 15 elements of the sample:

- All forms of positive socialization.
- always have the option to say "thanks, today, I'm not interested"
- Being able to discover people with a similar profile of preferences to ours would be very useful
- to communicate and or share about facts with the world. Share handicrafts with a certain group. video calls with family, alert systems for SOS assistance.
- For me, the ones that exist are enough for now.
- form of communication
- I have no opinion at the moment
- I hope to dispel doubts.
- I like this system
- I prefer to be in person with people
- I think it's quite complete
- It's an unnecessary app.
- Personally, I regularly promote family or friends' meetings, always putting topics for discussion or games suitable for the participants.
- Share photos of leisure work, tours, general culture posts...
- The need for these age groups and conviviality. The online format can help to schedule events, but affection, conversation, and physical activity, all face-to-face, are essential. I'm an Ed teacher. Physics and we are saturated with online! It helps in communication and organization, but lack of contact, face-to-face relationship, and affection that technology does not allow by itself. There is also a lot of difficulty on the part of the elderly and with some dementias associated with the use of informatics. Go

6.4. Part 2. Medical follow-up

Table 17 Frequencies: Part 2. Medical follow-up

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)	2	1,1%	3	1,7%	21	11,7%	84	46,9%	58	32,4%	11	6,1%
16. Knowing that my doctor receives a report with data regarding my health is reassuring.			2	1,1%	27	15,1%	71	39,7%	72	40,2%	7	3,9%
17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).			2	1,1%	14	7,8%	84	46,9%	72	40,2%	7	3,9%
18. I appreciate the idea of using an alarm system bracelet for emergencies (falls, sudden illness, etc.).			5	2,8%	18	10,1%	79	44,1%	67	37,4%	10	5,6%
19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity.	2	1,1%	10	5,6%	34	19,0%	79	44,1%	40	22,3%	14	7,8%
20. I find it useful for the system (through the wristband, mobile phone app, television, etc.)	2	1,1%	7	3,9%	11	6,1%	92	51,4%	48	26,8%	19	10,6%

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
to alert me when taking medication or scheduling appointments.												
21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).	1	,6%	8	4,5%	19	10,6%	89	49,7%	55	30,7%	7	3,9%
22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)	1	,6%	2	1,1%	22	12,3%	79	44,1%	66	36,9%	9	5,0%
23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.	1	,6%	4	2,2%	14	7,8%	79	44,1%	72	40,2%	9	5,0%
24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.	1	,6%	3	1,7%	21	11,7%	87	48,6%	56	31,3%	11	6,1%

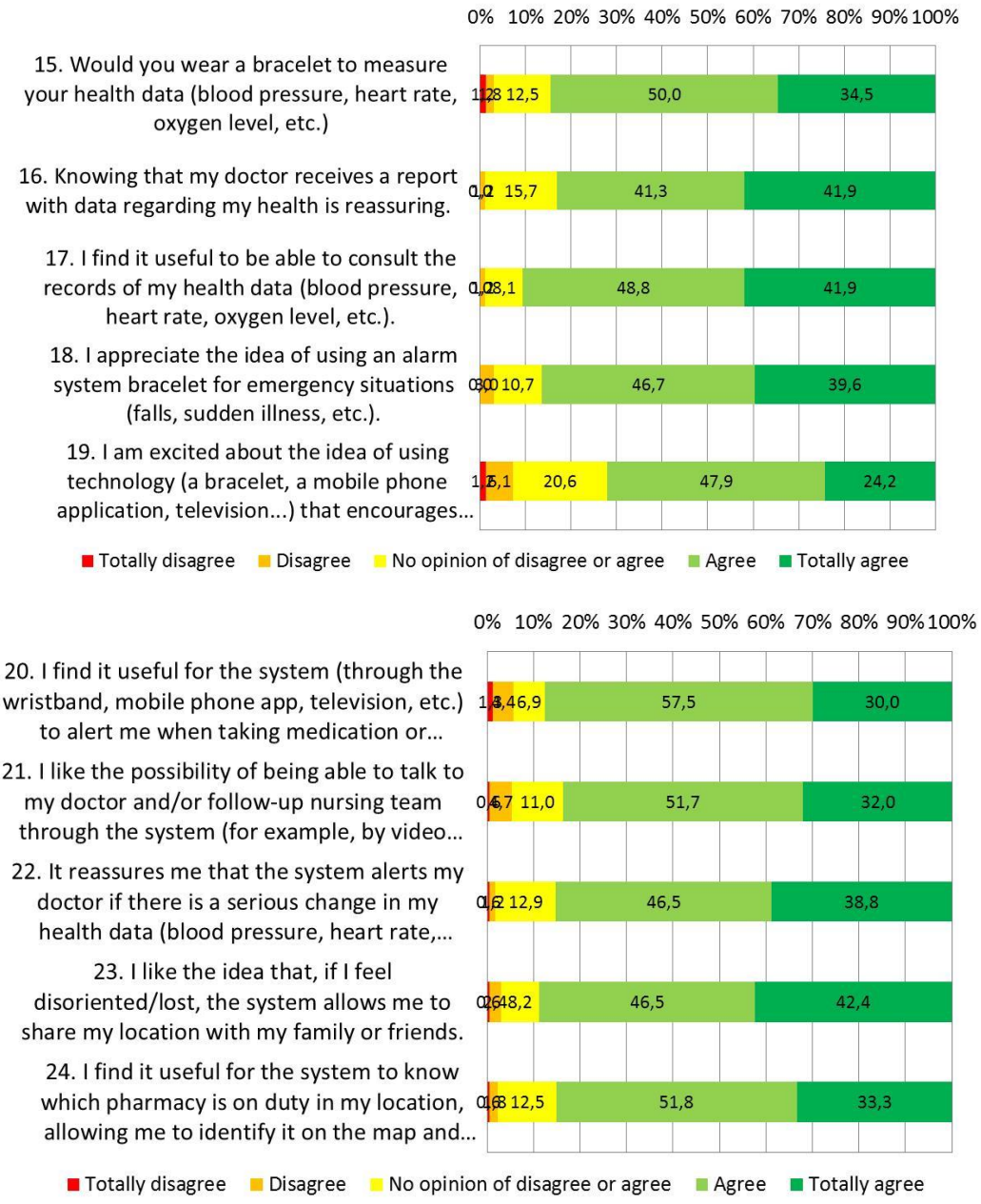
1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree; 9- Does not apply to my case

Table 18 Frequencies: Part 2. Medical follow-up (without missing answer)

	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)	2	1,2%	3	1,8%	21	12,5%	84	50,0%	58	34,5%
16. Knowing that my doctor receives a report with data regarding my health is reassuring.			2	1,2%	27	15,7%	71	41,3%	72	41,9%
17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).			2	1,2%	14	8,1%	84	48,8%	72	41,9%
18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).			5	3,0%	18	10,7%	79	46,7%	67	39,6%
19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity.	2	1,2%	10	6,1%	34	20,6%	79	47,9%	40	24,2%
20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments.	2	1,3%	7	4,4%	11	6,9%	92	57,5%	48	30,0%
21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).	1	,6%	8	4,7%	19	11,0%	89	51,7%	55	32,0%
22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)	1	,6%	2	1,2%	22	12,9%	79	46,5%	66	38,8%
23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.	1	,6%	4	2,4%	14	8,2%	79	46,5%	72	42,4%
24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.	1	,6%	3	1,8%	21	12,5%	87	51,8%	56	33,3%

1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 35 Frequencies chart: Part 2. Medical follow-up (without missing answer)



The agreement is very high for all statements, in the following order, “17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).” (90,7%), “23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.” (88,8%), “20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments.” (87,5%), “18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).” (86,4%), “22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)” (85,3%), “24. I find it useful for the system to know which pharmacy is on duty in my location,

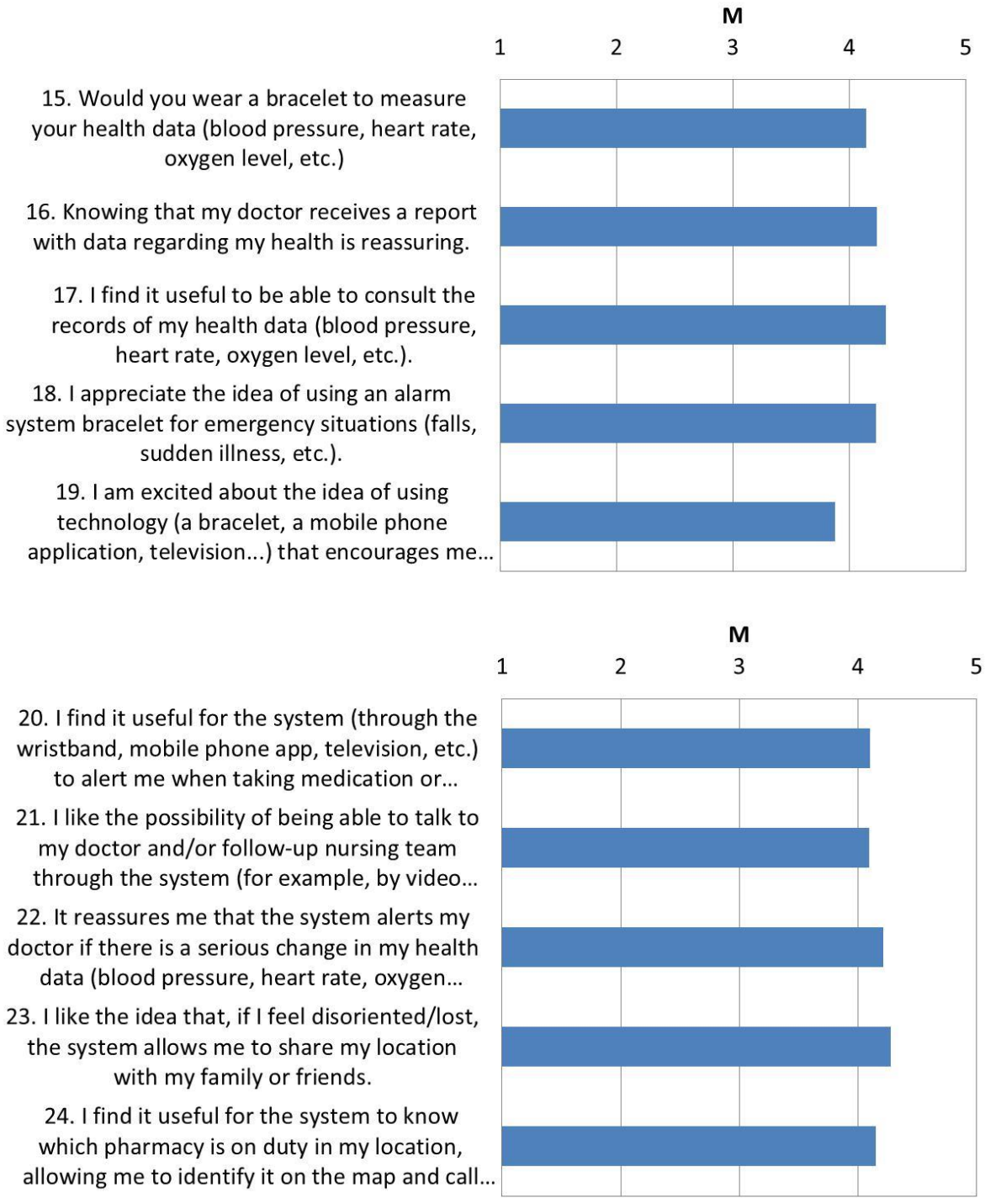
allowing me to identify it on the map and call it directly." (85,1%), "15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)" (84,5%), "21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call)." (83,7%), "16. Knowing that my doctor receives a report with data regarding my health is reassuring." (83,1%) and "19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity." (72,1%).

Table 19 Statistics: Part 2. Medical follow-up

	N	M	SD	VC
15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)	168	4,15	0,79	19%
16. Knowing that my doctor receives a report with data regarding my health is reassuring.	172	4,24	0,75	18%
17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).	172	4,31	0,67	16%
18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).	169	4,23	0,76	18%
19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity.	165	3,88	0,89	23%
20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments.	160	4,11	0,81	20%
21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).	172	4,10	0,81	20%
22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)	170	4,22	0,76	18%
23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.	170	4,28	0,76	18%
24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.	168	4,15	0,75	18%

Measurement scale: 1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 36 Means chart: Part 2. Medical follow-up



In the sample, the mean for the agreement is higher for "17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.). (M=4,31), followed by "23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends. (M=4,28), "16. Knowing that my doctor receives a report with data regarding my health is reassuring. (M=4,24), "18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.). (M=4,23), and "22. It

reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.) (M=4,22), then by "15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.) (M=4,15), "24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly. (M=4,15), "20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments. (M=4,11) and "21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call). (M=4,10), and finally by "19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity. (M=3,88), all items with a mean value higher than the scale middle-point.

To the question "25. If you wish, let us know what you think of additional ways the system can promote interaction with your doctor and/or follow-up healthcare teams:", there are the following answers from 10 elements of the sample:

- I already do.
- I don't have an opinion on the matter.
- I have no experience in these areas. As I am in good health, I only go to my doctor 2 times a year for Diabetes and Tension control.
- I like this system
- I think that more emphasis should be given to the alternative but always present 'advisers' THE PHARMACIST, WHY? For the closeness and trust that is placed in them because they remember our history and also because they often 'finance' medicines until retirement arrives.
- Interaction should be mediated by improvements to the health 24 app, not a myriad of apps
- Nothing replaces contact with people
- there should always be an option: "thank you very much, today, I'm not interested"
- Those already in place, telephone, email
- Yes, the system must promote interaction, but without mandatory wristband use. It should be studied case by case.

6.5. Part 3. Your opinion about the system's advantages and disadvantages

Table 20 Frequencies: Part 3. Your opinion about the system's advantages and disadvantages

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.).	3	1,7%	7	3,9%	38	21,2 %	84	46,9 %	38	21,2 %	9	5,0%
27. I am reassured by the fact that the system securely restricts access to my personal data.	2	1,1%	7	3,9%	11	6,1%	68	38,0 %	88	49,2 %	3	1,7%

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
28. It reassures me to be able to customize privacy levels, defining who can see my data and shares.	1	,6%	9	5,0%	14	7,8%	68	38,0%	86	48,0%	1	,6%
29. I like to be able to define how each friend and family member can communicate with me through the system.			3	1,7%	21	11,7%	81	45,3%	68	38,0%	6	3,4%
30. I consider it essential to be able to disable some system features whenever you want.			3	1,7%	18	10,1%	70	39,1%	85	47,5%	3	1,7%
31. I am concerned that other people may unduly gain access to my personal data recorded in the system.	4	2,2%	13	7,3%	10	5,6%	56	31,3%	93	52,0%	3	1,7%
32. I am concerned that the system constantly monitors my social interactions and health data.	3	1,7%	16	8,9%	32	17,9%	75	41,9%	50	27,9%	3	1,7%

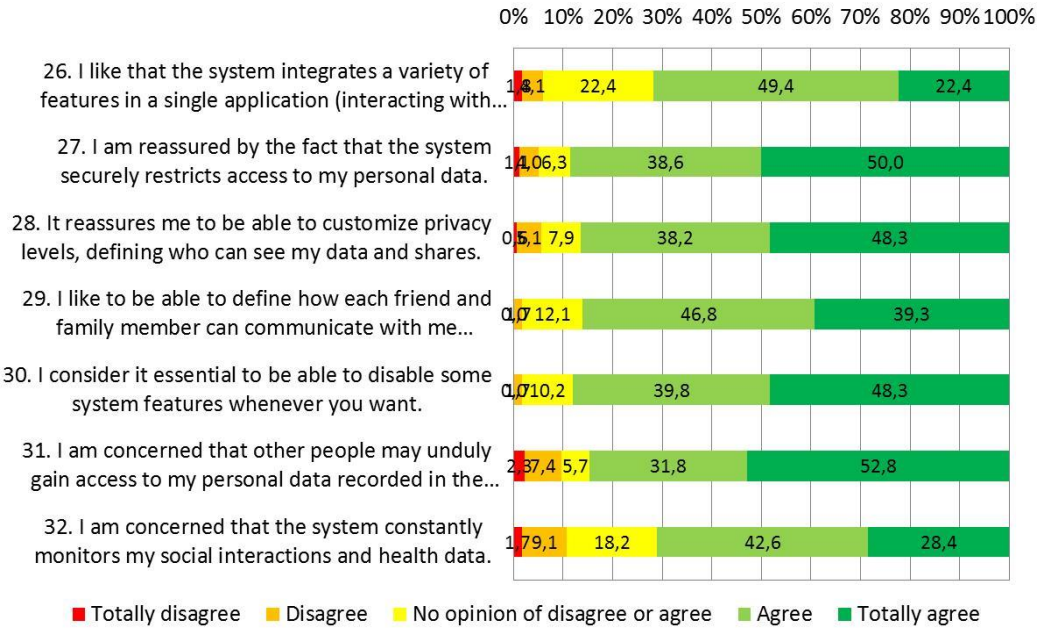
1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree; 9- Does not apply to my case

Table 21 Frequencies: Part 3. Your opinion about the system's advantages and disadvantages (without missing an answer)

	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.).	3	1,8%	7	4,1%	38	22,4%	84	49,4%	38	22,4%
27. I am reassured by the fact that the system securely restricts access to my personal data.	2	1,1%	7	4,0%	11	6,3%	68	38,6%	88	50,0%
28. It reassures me to be able to customize privacy levels, defining who can see my data and shares.	1	,6%	9	5,1%	14	7,9%	68	38,2%	86	48,3%
29. I like to be able to define how each friend and family member can communicate with me through the system.			3	1,7%	21	12,1%	81	46,8%	68	39,3%
30. I consider it essential to be able to disable some system features whenever you want.			3	1,7%	18	10,2%	70	39,8%	85	48,3%
31. I am concerned that other people may unduly gain access to my personal data recorded in the system.	4	2,3%	13	7,4%	10	5,7%	56	31,8%	93	52,8%
32. I am concerned that the system constantly monitors my social interactions and health data.	3	1,7%	16	9,1%	32	18,2%	75	42,6%	50	28,4%

1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 37 Frequencies chart: Part 3. Your opinion about the system's advantages and disadvantages (without missing answer)



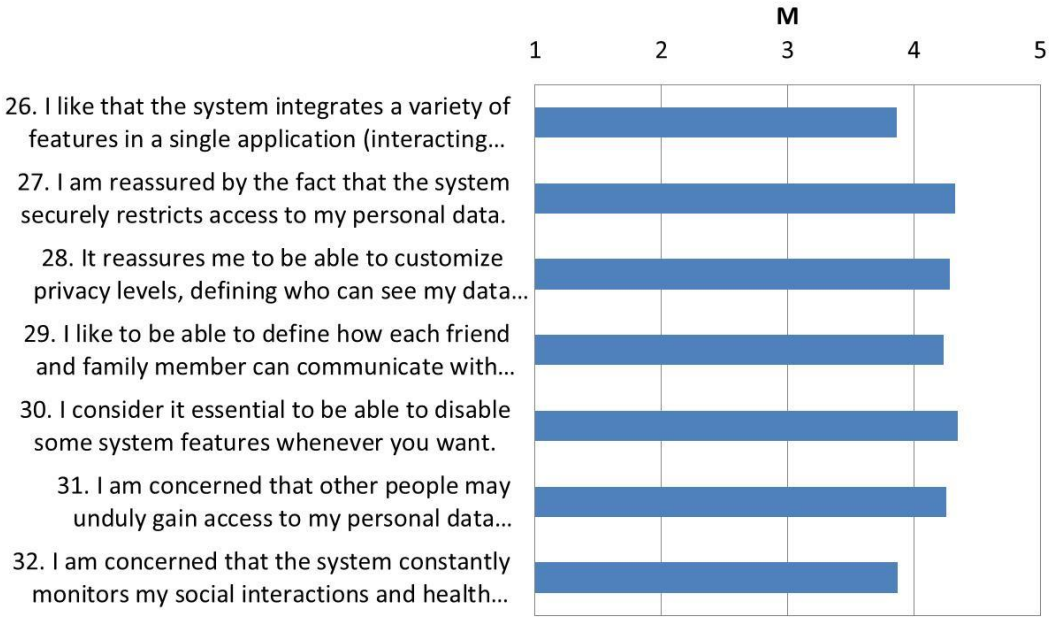
The agreement is very high for all statements, in the following order, "27. I am reassured by the fact that the system securely restricts access to my personal data." (88,6%), "30. I consider it essential to be able to disable some system features whenever you want. " (88,1%), "28. It reassures me to be able to customize privacy levels, defining who can see my data and shares. " (86,5%), "29. I like to be able to define how each friend and family member can communicate with me through the system. " (86,1%), "31. I am concerned that other people may unduly gain access to my personal data recorded in the system. " (84,7%), and then "26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.). " (71,8%), and "32. I am concerned that the system constantly monitors my social interactions and health data. " (71,0%).

Table 22 Statistics: Part 3. Your opinion about the system's advantages and disadvantages

	N	M	SD	VC
26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.).	170	3,86	0,87	23%
27. I am reassured by the fact that the system securely restricts access to my personal data.	176	4,32	0,85	20%
28. It reassures me to be able to customize privacy levels, defining who can see my data and shares.	178	4,29	0,86	20%
29. I like to be able to define how each friend and family member can communicate with me through the system.	173	4,24	0,73	17%
30. I consider it essential to be able to disable some system features whenever you want.	176	4,35	0,73	17%
31. I am concerned that other people may unduly gain access to my personal data recorded in the system.	176	4,26	1,01	24%
32. I am concerned that the system constantly monitors my social interactions and health data.	176	3,87	0,99	25%

Measurement scale: 1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 38 Means chart: Part 3. Your opinion about the system's advantages and disadvantages



In the sample, the mean for the agreement is higher for “30. I consider it essential to be able to disable some system features whenever you want.” (M=4,35), “27. I am reassured by the fact that the system securely restricts access to my personal data. ” (M=4,32), “28. It reassures me to be able to customize privacy levels, defining who can see my data and shares. ” (M=4,29), “31. I am concerned that other people may unduly gain access to my personal data recorded in the system. ” (M=4,26) and “29. I like to be able to define how each friend and family member can communicate with me through the system. ” (M=4,24), and then by “32. I am concerned that the system constantly monitors my social interactions and health data. ” (M=3,87) and “26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.). ” (M=3,86), all items with a mean value higher than the scale middle-point.

To the question “33. If you wish, describe other advantages and disadvantages that you think may exist in the system:”, there are the following answers from 8 elements of the sample:

- At the moment I don't see any advantages in the system
- Excessive exposure to personal data.
- I hope the system is completely secure. I don't want anyone accessing my data.
- I like this system
- I think that the terminology used for us seniors should be simple and very intuitive to use.
- It is handy for some iterations, but the systematic control of some parameters becomes obsessive.
- The privacy of each of us must be defended
- there should always be an option: "thank you very much, today, I'm not interested"

6.6. Part 4. Your predisposition to use or not use a system of this nature

Table 23 Frequencies: Part 4. Your predisposition to use or not use a system of this nature

	1		2		3		4		5		9	
	N	%	N	%	N	%	N	%	N	%	N	%
34. I would use the system because it would help improve my physical well-being.	3	1,7%	5	2,8%	26	14,5%	99	55,3%	34	19,0%	12	6,7%
35. I would use the system because it would help improve my psychological well-being.	4	2,2%	7	3,9%	27	15,1%	88	49,2%	39	21,8%	14	7,8%
36. I would use the system because it would help improve my social well-being.	4	2,2%	8	4,5%	35	19,6%	89	49,7%	31	17,3%	12	6,7%
37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.	6	3,4%	50	27,9%	55	30,7%	37	20,7%	20	11,2%	11	6,1%
38. I would use the system to have a more assiduous and direct interaction with my family and friends.	5	2,8%	14	7,8%	32	17,9%	80	44,7%	30	16,8%	18	10,1%
39. I give privilege to face-to-face contacts and, therefore, I would not use the system.	6	3,4%	47	26,3%	41	22,9%	45	25,1%	29	16,2%	11	6,1%
40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.	3	1,7%	7	3,9%	26	14,5%	84	46,9%	51	28,5%	8	4,5%
41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.	11	6,1%	26	14,5%	57	31,8%	50	27,9%	18	10,1%	17	9,5%
42. I already use other platforms to ensure social contact with friends and family and I'm not willing to change, so I wouldn't use the system.	3	1,7%	37	20,7%	53	29,6%	41	22,9%	15	8,4%	30	16,8%
43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.	8	4,5%	10	5,6%	51	28,5%	67	37,4%	22	12,3%	21	11,7%
44. I'm not a skilled user of technology, so I wouldn't use the system.	12	6,7%	55	30,7%	42	23,5%	27	15,1%	16	8,9%	27	15,1%

1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree; 9- Does not apply to my case

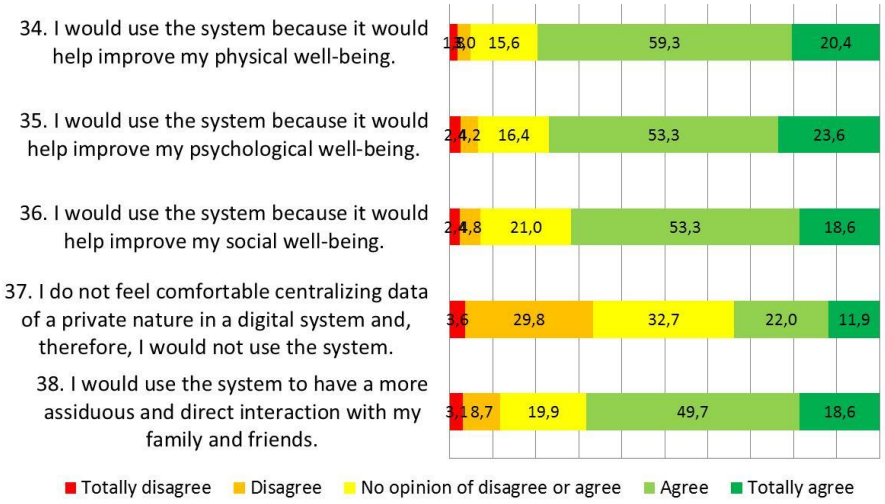
Table 24 Frequencies: Part 4. Your predisposition to use or not use a system of this nature (without missing an answer)

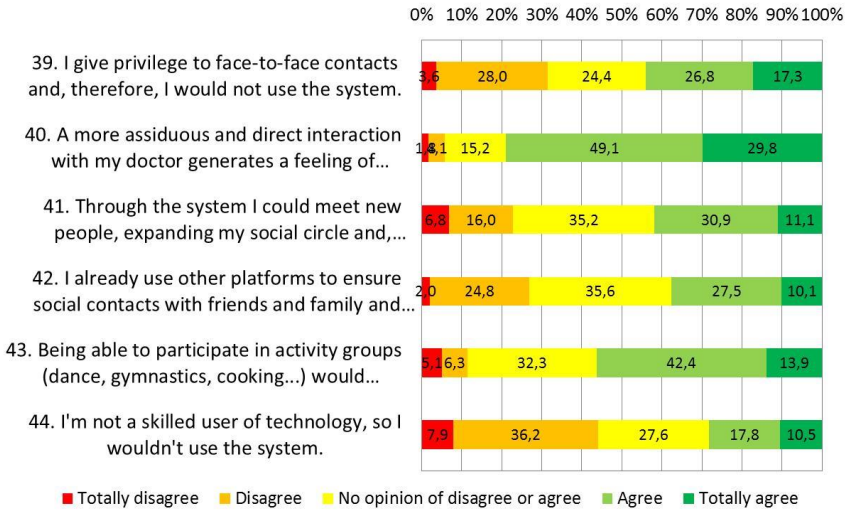
	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
34. I would use the system because it would help improve my physical well-being.	3	1,8%	5	3,0%	26	15,6%	99	59,3%	34	20,4%
35. I would use the system because it would help improve my psychological well-being.	4	2,4%	7	4,2%	27	16,4%	88	53,3%	39	23,6%
36. I would use the system because it would help improve my social well-being.	4	2,4%	8	4,8%	35	21,0%	89	53,3%	31	18,6%
37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.	6	3,6%	50	29,8%	55	32,7%	37	22,0%	20	11,9%
38. I would use the system to have a more assiduous and direct interaction with my family and friends.	5	3,1%	14	8,7%	32	19,9%	80	49,7%	30	18,6%
39. I give privilege to face-to-face contacts and, therefore, I would not use the system.	6	3,6%	47	28,0%	41	24,4%	45	26,8%	29	17,3%

	1		2		3		4		5	
	N	%	N	%	N	%	N	%	N	%
40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.	3	1,8%	7	4,1%	26	15,2 %	84	49,1 %	51	29,8 %
41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.	11	6,8%	26	16,0 %	57	35,2 %	50	30,9 %	18	11,1 %
42. I already use other platforms to ensure social contact with friends and family and I'm not willing to change, so I wouldn't use the system.	3	2,0%	37	24,8 %	53	35,6 %	41	27,5 %	15	10,1 %
43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.	8	5,1%	10	6,3%	51	32,3 %	67	42,4 %	22	13,9 %
44. I'm not a skilled user of technology, so I wouldn't use the system.	12	7,9%	55	36,2 %	42	27,6 %	27	17,8 %	16	10,5 %

1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.
2-

Figure 39 Frequencies : Part 4. Your predisposition to use or not use a system of this nature (without missing answer)





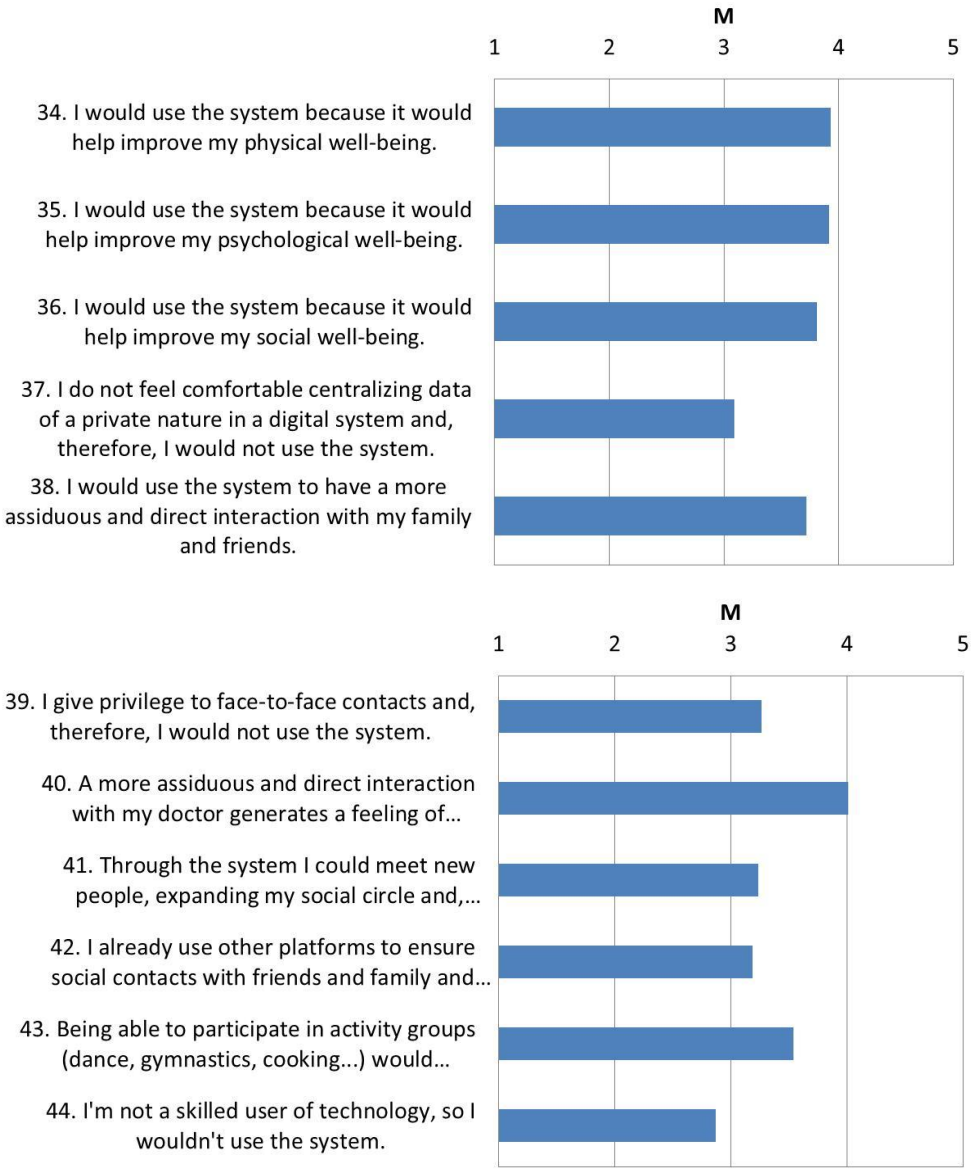
The agreement is relatively high for some statements, in the following order, “34. I would use the system because it would help improve my physical well-being.” (79,6%), “40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.” (78,9%), “35. I would use the system because it would help improve my psychological well-being.” (77,0%), “36. I would use the system because it would help improve my social well-being.” (71,9%), “38. I would use the system to have a more assiduous and direct interaction with my family and friends.” (68,3%) and “43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.” (56,3%), but lower for other statements, in the following order, “39. I give privilege to face-to-face contacts and, therefore, I would not use the system.” (44,0%), “41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.” (42,0%), “42. I already use other platforms to ensure social contacts with friends and family and I'm not willing to change, so I wouldn't use the system.” (37,6%), “37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.” (33,9%) and “44. I'm not a skilled user of technology, so I wouldn't use the system.” (28,3%).

Table 25 Statistics: Part 4. Your predisposition to use or not use a system of this nature

	N	M	SD	VC
34. I would use the system because it would help improve my physical well-being.	167	3,93	0,80	20%
35. I would use the system because it would help improve my psychological well-being.	165	3,92	0,89	23%
36. I would use the system because it would help improve my social well-being.	167	3,81	0,88	23%
37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.	168	3,09	1,07	34%
38. I would use the system to have a more assiduous and direct interaction with my family and friends.	161	3,72	0,97	26%
39. I give privilege to face-to-face contacts and, therefore, I would not use the system.	168	3,26	1,15	35%
40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.	171	4,01	0,88	22%
41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.	162	3,23	1,07	33%
42. I already use other platforms to ensure social contact with friends and family and I'm not willing to change, so I wouldn't use the system.	149	3,19	0,99	31%
43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.	158	3,54	0,98	28%
44. I'm not a skilled user of technology, so I wouldn't use the system.	152	2,87	1,13	39%

Measurement scale: 1- Totally disagree; 2- Disagree; 3- No opinion of disagree or agree; 4- Agree; 5- Totally agree.

Figure 40 Means chart: Part 4. Your predisposition to use or not use a system of this nature



In the sample, the mean for the agreement is higher for “40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.” (M=4,01), “34. I would use the system because it would help improve my physical well-being.” (M=3,93) and “35. I would use the system because it would help improve my psychological well-being.” (M=3,92), followed by “36. I would use the system because it would help improve my social well-being.” (M=3,81) and “38. I would use the system to have a more assiduous and direct interaction with my family and friends.” (M=3,72), then by “43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction,

promoting my well-being and, therefore, I would use the system." (M=3,54), "39. I give privilege to face-to-face contacts and, therefore, I would not use the system." (M=3,26), "41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system." (M=3,23), "42. I already use other platforms to ensure social contacts with friends and family and I'm not willing to change, so I wouldn't use the system." (M=3,19), items with mean value higher than the scale middle-point, and then by "37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system." (M=3,09) and "44. I'm not a skilled user of technology, so I wouldn't use the system." (M=2,87), items with mean value close to the scale middle-point.

To the question "45. If desired, describe other reasons for using or not using such a system:", there are the following answers from 13 elements of the sample:

- I'm not a big fan of social media, but I'm willing to try others other than Facebook
- I'm not yet at a stage where I need such a system. But I think it will be advantageous for some seniors, it depends on the physical and mental state of each one. The loss of privacy would worry me, there's just no alternative.
- I already regularly use platforms to contact friends, family and even my family doctor
- I am a regular user of some technologies to interact with family and friends, but I do not venture into the digital search for new knowledge for reasons of the growing existence of false profiles, etc.
- I am already part of a Senior University and for that reason, I have many social contacts and many activities.
- I don't find any use in this type of system for me, obviously
- I like said system
- I still move easily, so I consider myself autonomous.
- I would use this system depending on the needs inherent to the problem that has arisen
- It has to be well analyzed. In health, I see interest in this system.
- New technologies allow us to make great strides. It may have advantages in technological terms but in my opinion, we cannot neglect the personal aspect and proximity or rather the face-to-face factor is also very important.
- there should always be an option: "thank you very much, today, I'm not interested"
- The unnecessary app, the need will be upgrading existing and frankly much safer apps

6.7. Scales Reliability

The scale is a Likert-type scale, with five possible answers from "Totally disagree" to "Totally agree", with the items organized into six dimensions.

Table 26 Dimensions

DIMENSIONS	ITEMS
Part 1. Social interaction with family and friends	8 . I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends 9. I agree with the connection of my social networks (Facebook...) to the system. 10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)

	11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon). 12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family. 13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.
Part 2. Medical follow-up	15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.) 16. Knowing that my doctor receives a report with data regarding my health is reassuring. 17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.). 18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.). 19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity. 20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments. 21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call). 22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.) 23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends. 24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.
Part 3.1. Opinion about the system's advantages	26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.). 27. I am reassured by the fact that the system securely restricts access to my personal data. 28. It reassures me to be able to customize privacy levels, defining who can see my data and shares. 29. I like to be able to define how each friend and family member can communicate with me through the system. 30. I consider it essential to be able to disable some system features whenever you want.
Part 3.2. Opinion about the system's disadvantages	31. I am concerned that other people may unduly gain access to my personal data recorded in the system. 32. I am concerned that the system constantly monitors my social interactions and health data.
Part 4.1. Predisposition to use a system of this nature	34. I would use the system because it would help improve my physical well-being. 35. I would use the system because it would help improve my psychological well-being. 36. I would use the system because it would help improve my social well-being. 38. I would use the system to have a more assiduous and direct interaction with my family and friends. 40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system. 41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system. 43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.
Part 4.2. Predisposition does not use a system of this nature	37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system. 39. I give privilege to face-to-face contacts and, therefore, I would not use the system. 42. I already use other platforms to ensure social contact with friends and family and I'm not willing to change, so I wouldn't use the system. 44. I'm not a skilled user of technology, so I wouldn't use the system.

Table 27 Internal consistency statistics: Dimensions

Dimension	Cronbach's Alpha	N of Items
Part 1. Social interaction with family and friends	0,838	6
Part 2. Medical follow-up	0,918	10
Part 3.1. Opinion about the system's advantages	0,827	5
Part 3.2. Opinion about the system's disadvantages	0,620	2

Part 4.1. Predisposition to use a system of this nature	0,910	7
Part 4.2. Predisposition does not use a system of this nature	0,758	4

The value of Cronbach's alpha is higher than the value of 0,80 for the dimensions “Part 1. Social interaction with family and friends”, “Part 2. Medical follow-up”, “Part 3.1. Opinion about the system's advantages” and “Part 4.1. Predisposition to use a system of this nature”, so this dimension is adequately measured, is higher than 0,60 for the dimensions “Part 3.2. Opinion about the system's disadvantages” and “Part 4.2. Predisposition does not use a system of this nature”, so the measurement of this dimensions is acceptable.

Table 28 Item-total correlation and effect of the elimination of each item: Dimensions

		Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Part 1. Social interaction with family and friends	8. I like the idea of using a system that allows me to contact, by various means (voice, video, messages...), my family and friends	,492	,834
	9. I agree with the connection of my social networks (Facebook.) to the system.	,492	,842
	10. I am enthusiastic to participate in online group activities via videoconferencing (gymnastics, dance...), connecting the camera of my device (mobile phone, tablet, computer...)	,689	,797
	11. I like that the system allows the organization of groups to carry out activities (for example, inviting friends for a walk on Saturday afternoon).	,712	,795
	12. I like to create shared agendas to combine social activities (dinners, outings...) with my friends and family.	,718	,791
	13. I like the idea that, instead of watching TV and movies alone, I can do it with other people, even if each one is at home.	,622	,811
Part 2. Medical follow-up	15. Would you wear a bracelet to measure your health data (blood pressure, heart rate, oxygen level, etc.)	,609	,914
	16. Knowing that my doctor receives a report with data regarding my health is reassuring.	,660	,911
	17. I find it useful to be able to consult the records of my health data (blood pressure, heart rate, oxygen level, etc.).	,717	,909
	18. I appreciate the idea of using an alarm system bracelet for emergency situations (falls, sudden illness, etc.).	,699	,909
	19. I am excited about the idea of using technology (a bracelet, a mobile phone application, television...) that encourages me to do physical activity.	,635	,914
	20. I find it useful for the system (through the wristband, mobile phone app, television, etc.) to alert me when taking medication or scheduling appointments.	,754	,906
	21. I like the possibility of being able to talk to my doctor and/or follow-up nursing team through the system (for example, by video call).	,618	,914
	22. It reassures me that the system alerts my doctor if there is a serious change in my health data (blood pressure, heart rate, oxygen level, etc.)	,808	,903
	23. I like the idea that, if I feel disoriented/lost, the system allows me to share my location with my family or friends.	,760	,906
	24. I find it useful for the system to know which pharmacy is on duty in my location, allowing me to identify it on the map and call it directly.	,707	,909

Part 3.1. Opinion about the system's advantages	26. I like that the system integrates a variety of features in a single application (interacting with family and friends, interacting with healthcare teams, organizing and participating in activities, etc.).	,423	,851
	27. I am reassured by the fact that the system securely restricts access to my personal data.	,701	,769
	28. It reassures me to be able to customize privacy levels, defining who can see my data and shares.	,692	,773
	29. I like to be able to define how each friend and family member can communicate with me through the system.	,719	,768
	30. I consider it essential to be able to disable some system features whenever you want.	,614	,796
Part 3.2. Opinion about the system's disadvantages	31. I am concerned that other people may unduly gain access to my personal data recorded in the system.	,449	n.a. for 2 items
	32. I am concerned that the system constantly monitors my social interactions and health data.	,449	
Part 4.1. Predisposition to use a system of this nature	34. I would use the system because it would help improve my physical well-being.	,787	,891
	35. I would use the system because it would help improve my psychological well-being.	,841	,884
	36. I would use the system because it would help improve my social well-being.	,835	,885
	38. I would use the system to have a more assiduous and direct interaction with my family and friends.	,704	,899
	40. A more assiduous and direct interaction with my doctor generates a feeling of security and well-being and, therefore, I would use the system.	,751	,894
	41. Through the system I could meet new people, expanding my social circle and, therefore, I would use the system.	,570	,917
	43. Being able to participate in activity groups (dance, gymnastics, cooking...) would improve my level of social interaction, promoting my well-being and, therefore, I would use the system.	,679	,902
Part 4.2. Predisposition does not use a system of this nature	37. I do not feel comfortable centralizing data of a private nature in a digital system and, therefore, I would not use the system.	,564	,698
	39. I give privilege to face-to-face contacts and, therefore, I would not use the system.	,544	,710
	42. I already use other platforms to ensure social contact with friends and family and I'm not willing to change, so I wouldn't use the system.	,656	,652
	44. I'm not a skilled user of technology, so I wouldn't use the system.	,477	,746

The additional tests in the previous table indicate that there are no items correlated negatively with the dimensions (all correlations are higher than 0,40), or that its elimination increases the value of Alpha in a relevant way.

6.8. Dimensions

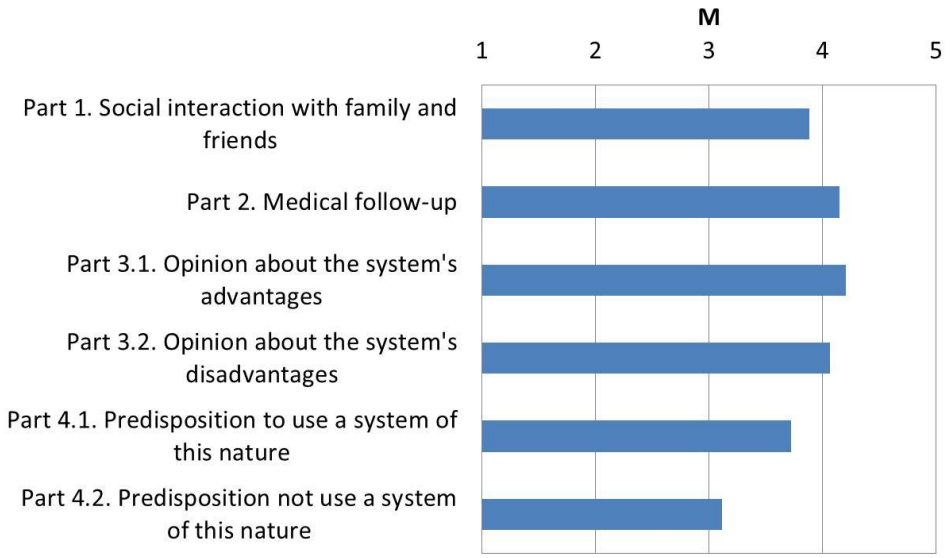
For the dimensions, its values were determined by calculating the mean of the items that constitute them.

Table 29 Dimensions: Statistics

	N	M	SD	VC	Min.	Max.
Part 1. Social interaction with family and friends	176	3,88	0,68	18%	1,00	5,00
Part 2. Medical follow-up	177	4,15	0,60	14%	2,30	5,00
Part 3.1. Opinion about the system's advantages	178	4,21	0,62	15%	2,00	5,00
Part 3.2. Opinion about the system's disadvantages	177	4,06	0,85	21%	1,00	5,00
Part 4.1. Predisposition to use a system of this nature	172	3,73	0,76	20%	1,00	5,00
Part 4.2. Predisposition does not use a system of this nature	176	3,12	0,83	27%	1,00	5,00

Values are reported to the used scale, from 1 to 5.

Table 30 Mean Chart: Dimensions



The mean value is higher for the dimensions “Part 3.1. Opinion about the system's advantages” (M=4,21) and “Part 2. Medical follow-up” (M=4,15), followed by “Part 3.2. Opinion about the system's disadvantages” (M=4,06), then by “Part 1. Social interaction with family and friends” (M=3,88) and “Part 4.1. Predisposition to use a system of this nature” (M=3,73), all with values higher than the scale middle-point, and finally by “Part 4.2. Predisposition does not use a system of this nature” (M=3,12), with a value close to the scale middle-point.

6.9. Correlation between the dimensions

Table 31 Correlation between dimensions

		Part 1. Social interaction with family and friends	Part 2. Medical follow-up	Part 3.1. Opinion about the system's advantages	Part 3.2. Opinion about the system's disadvantages	Part 4.1. Predisposition to use a system of this nature	Part 4.2. Predisposition not to use a system of this nature
1. Social interaction with family and friends	Correlation p N						
2. Medical follow-up	Correlation p N	0,590 0,000 ** 175					
3.1. Opinion about the system's advantages	Correlation p N	0,397 0,000 ** 175	0,643 0,000 ** 177				
3.2. Opinion about the system's disadvantages	Correlation p N	-0,105 0,168 174	0,087 0,250 175	0,398 0,000 ** 176			
4.1. Predisposition to use a system of this nature	Correlation p N	0,699 0,000 ** 171	0,670 0,000 ** 172	0,451 0,000 ** 172	-0,023 0,766 171		
4.2. Predisposition not to use a system of this nature	Correlation p N	-0,122 0,111 173	-0,255 0,001 ** 175	-0,156 0,038 * 176	0,239 0,001 ** 174	-0,140 0,068 171	
				* p<0,05	** p<0,01		

In order of magnitude, there is a positive significant correlation between:

- Dimension “Part 1. Social interaction with family and friends” and dimension “Part 4.1. Predisposition to use a system of this nature” (r=0,699, p<0,001),
- Dimension “Part 2. Medical follow-up” and dimension “Part 4.1. Predisposition to use a system of this nature” (r=0,670, p<0,001),
- Dimension “Part 2. Medical follow-up” and dimension “Part 3.1. Opinion about the system's advantages” (r=0,643, p<0,001),
- Dimension “Part 1. Social interaction with family and friends” and dimension “Part 2. Medical follow-up” (r=0,590, p<0,001),
- Dimension “Part 3.1. Opinion about the system's advantages” and dimension “Part 4.1. Predisposition to use a system of this nature” (r=0,451, p<0,001),
- Dimension “Part 1. Social interaction with family and friends” and dimension “Part 3.2. Opinion about the system's disadvantages” (r=0,398, p<0,001),
- Dimension “Part 1. Social interaction with family and friends” and dimension “Part 3.1. Opinion about the system's advantages” (r=0,397, p<0,001),
- Dimension “Part 3.2. Opinion about the system's disadvantages” and dimension “Part 4.2. Predisposition not use a system of this nature” (r=0,239, p=0,001).

Meaning that an increase in one dimension is related to a significant increase in the other dimension.

In order of magnitude, there is a negative significant correlation between:

- Dimension “Part 2. Medical follow-up” and dimension “Part 4.2. Predisposition does not use a system of this nature” (r=-0,255, p=0,001),
- Dimension “Part 3.1. Opinion about the system's advantages” and dimension “Part 4.2. Predisposition does not use a system of this nature” (r=-0,156, p=0,038),

Meaning that an increase in one dimension is related to a significant decrease in the other dimension.

6.10. Discussion

Presenting the results obtained in the quantitative analysis of the questionnaire leads to an understanding of the features of the proposed model which may enhance the well-being of the elderly. Some indications help to explain the understandable role of the social hybrid model in social and physical activities. These indications suggest that the use of social hybrid models plays a significant role in improving social and physical interactions and helps prevent psychological problems.

Thus, with regards to the current physical and psychological situation of older adults, the social isolation, and psychological and physical health issues in older adults are unanimous. In affirming passive and intentional communication, from older adults to family, friends, and doctors. The perspective of the older adults still indicates that the main objective of the model to which they have access is to interact with family members, friends, and doctors for social and physical activities to improve their well-being and improve their performance in daily life activities. The perspective of the older adults still indicates that the main objective of the model to which they have access is to interact with family members, friends, and doctors for social and physical activities to improve their well-being and improve their performance in daily life activities.

From the perspective of older adults, the model offers a communication platform, where users can initiate face-to-face or online social communication. Moreover, the design of the model also encourages users to participate in outdoor physical or social activities that are helpful not only to physical well-being but also to psychological well-being. This perspective was not only evidenced in the data analyses, which pointed out social and physical activities have privileged means to improve the well-being of older adults.

The use of the social hybrid scenario model, with emphasis also on social communication tools, means privileged also for older adults in passive or social communication with family members, friends, and medical doctors etc. already some older adults are using different applications, but they have extremely limited options to interact with others. In this model, the dynamics of involvement between different actors such as older adults, family members and doctors can initial various online or outdoor activities which help to enhance the older adults' social circle and physical and psychological health.

Stakeholders agree, though not unanimously. Older adults have a small number of opportunities to take in social or physical activities, particularly indoor and outdoor activities eventually covered in knowledge replicated in the various layers of literature, despite the lack of knowledge presented in older adults' physical and psychological well-being and fact that that there is still some distance between existing knowledge and older adults wellbeing.

Another discrepancy in the perspectives of older adults is centred on the context of passive communication: older adults are states that passive communication it accesses focuses on a moment to provide healthcare from long distances, with information on critical health alerts about older adults and communicate with services stakeholders such as medical doctors, nurses, friends and family members, passive communication indicates prevention, awareness and awareness preventive practices and behaviour as the main passive communication focus with older adults.

Concerning needs, the perspective of older adults, in the model focuses on unique features. older adults highlighted needs related to social networks infrastructures to communicate, also focuses on communication between family, friends and doctors needs to be expanded with privacy and data protection and provide a safer social and passive environment where they do not have doubt somebody can disturb their privacy and their data is protected.

In turn, the social hybrid scenario model focuses on social communication needs arising from older adults. The social hybrid scenario model characteristics focus to provide a social scenario. Through social scenarios, the model has focused to prevent social isolation and psychological health issues. The model encourages social communication and activities. The model encourages older adults to use digital media or applications should be used, along with a face to face or online contact that allows them proximity and activities and social participation with friends and family.

Specifically in this scenario community needs to consider all stakeholders such as older adults, family members, friends and medical doctors then develop an application, considering

relevant to literacy, awareness, communication, and technology about preventing practice to reduce social isolation, and physical health issue and play a vital role in active participation of older adults in all daily life physical and social activities that cause to enhance the wellbeing level in older adults. it is precisely in the context of co-creation that different perspectives between the actors stand out.

Presented model, considered stakeholder has importance in the model, for fostering literacy on older adults' wellbeing. it means, that every stakeholder who is going to use this model application, he or she is going to contribute to enhancing the good physical and psychological well-being of older adults. in the same sense the participation of all stakeholders (family members, friends, medical doctors, and older adults provides a scenario where passive and social communication activities are without any hurdles and distance problems. The social interaction in the presented model both with family members and friends recognize as the pertinence of popular communication platforms in the context of social, and psychological wellbeing.

The study model offered here includes several situations in which older persons can practice social interaction and communication. The fundamental goal of presenting various social settings is to increase older individuals' psychological well-being. Social contact and connection, whether online or in-person, have various health benefits for older persons, including a probable reduction in the risk of dementia and a wide variety of physical difficulties, such as high blood pressure, arthritis, and cardiovascular activity.

The social hybrid model provides a vital social interaction opportunity in which the system allows the older adults to contact their friends and family members through various means such as text messages, and audio or video calls and increase their social circle through messages and video calls, the older adults can discuss various, political, religious, socio and economic topics. As the study has solid evidence that indicated older adults have a great interest to interact with their family and friends through text, audio, and video messages. This evidence indicates that older adults feel comfortable communicating with others and this communication helps them to keep their social circle active and expand. But social communication discussion and participation are not enough to maintain the well-being level, and the need to participate in physical activities. likewise, the social hybrid model enables physical activities for older adults such as participation in dance or gym classes via videoconferencing, connecting the camera of my device (mobile phone, tablet, computer). the participation video conference activities, there are no minimum skills requirements needed; anybody can participate whether he or she beginner or professional. This kind of

interaction with various people with different education and professional background is healthy because older adults can engage themself with several types of people for learning or teaching context. Regular online gym classes or dance classes including muscle strengthening, endurance, flexibility, and balance exercise is essential for healthier ageing and helps to improve physical stability physical and possible prevent fall. As a result, the older adults indicate, that they are looking for platforms like the social hybrid scenario model where they can not only interact with people for social activities but also, they can participate in physical activities via their mobiles, tablet, and laptop, or computer.

Physical activity is widely acknowledged as an important factor in maintaining physical and mental health(Haskell, Blair, & Hill, 2009), and, more precisely, as a viral infection preventative factor(Zhu, 2020). Nieman and Wentz concluded that moderate exercise improved immunosurveillance and lowered systemic inflammation in their assessment of literature on immunological responses to physical activity(Nieman & Wentz, 2019).

Persons should engage in 150 minutes of moderate activity each such as brisk walking, stretching, and gardening, according to American Heart Association (American Heart Association, 2018). Because of the increased danger of physical and psychological concerns among the elderly, as well as the possibility of exercise to boost their immune protection against viral respiratory infections, recreation professionals must make it simpler for seniors to participate in physical activity. Physical and Social activities are linked to the health and well-being of older adults. Social and physical engagement help to improve well-being among older adults in later life(Lee, Ryu, & Heo, 2022).

The findings of the study show that older adults not only enjoy participating in online social or physical activities but also enjoy participating in outdoor physical and social activities. Physical activities give mental and physical health benefits, with the added benefit of exposure to nature and time spent outdoors. older adults are the least active segment of our community, older adult individuals are less likely to spend time outside than other age groups.

In older adults living in retirement communities, the relationship between time spent outside and different physical and mental health outcomes may be studied(Strutt et al., 2022). In this context, the proposed model allows the older adults or other users to invite their friends for a walk, visit the historical place, and participate in religious, political, or cultural activities. The design of outdoor activities wide accepted by the participants, which means, the older adult population looking such services that allow them to meet different people and have social interactions but

also these systems or services allow them to go outside with their friends by inviting them. For invitation, the system should have the option to invite their friends or create an event like the social hybrid scenario model offer older adults to invite their friends and create events in which anybody can participate social and physical activities.

In this context, the proposed model allows the older adults or other users to invite their friends for a walk, visit the historical place, and participate in religious, political, or cultural activities. Outdoor activities wide accepted by the participants, which means, the older adult population looking such services that allow them to meet different people and have social interactions, but the system should allow older adults generate invitation messages. This message should send to the older adults' family and friends in which older adults requesting them to join him or them for an evening walk or to-door cultural, political, religious, and social activities

For outdoor activities participation invitation, the system should have the option to invite their friends or create an event like the social hybrid scenario model offer in which older adults can invite their friends and create events in which anybody can participate in social and physical activities. The hypothetical social hybrid scenario model has outdoor and indoor social and physical activities has different goals. one of the main goals is to improve the level of physical and psychological well-being. therefore, model characteristics encourage the older adult's outdoor social interaction that helps to improve their concentration and learning ability. once older adults have good concertation and learning skills that leads to increase confidence and self-awareness. good confidence and self-awareness help to reduce depression, and anxiety (Chadwick, Edmondson, & McDonald, 2022). A huge number of older adults widely show their interest in model social and physical activities scenarios. The older adult's interest is vital evidence that model characteristics particularly related to social and physical activities are essential ingredients to reduce social isolation, anxiety, depression, and physical health issue which leads to expanding the social circle, social interaction, physical indoor and outdoor activities.

The study results indicated psychological and physical well-being does not only rely on the social or physical characteristics of the model. In the results, the older adults like medical fellow up the feature of the model. Its means, they wanted a system in which a medical doctor, nurse, or family members, can monitor the physical health data for 7 days and 24 hours such as blood pressure, heartbeat, fall detection and many more. Older adults do not only want a system in which people monitor their physical health data rather they can communicate them. These communication and online health monitoring help to prevent the worst-case scenario. In terms of

prevention, health monitoring is critical, especially if early diagnosis of illnesses can decrease suffering and medical expenses. The early detection and treatment of many illnesses can dramatically enhance the patient's medical treatment options.

The model online health monitoring service ensures high performance for health care. The constant health monitoring of older adults allows for the management of the physical health data and improves the performance of older adults in the context of physical activities. The online health monitoring feature of the model leads to quick response times, improved computing processes and improve well-being of older adults.

Especially, the digital end-user experience is one of the main goals when dealing with real user interaction and physical health monitoring. The presented model design is capable to save the effort of interpreting such dependent events on your own and giving predictions about the physical health of older. These predictions help detect the chronic disease in the earliest stage which helps the medical practitioners to cure it without any delay.

Due to fragile physical health, it is always hard for older adults to visit the doctor physically and wait hours and hours for their turn. there is an extensive clue in the results reveal the older adults want a service in which they can make an appointment and interact with them to explain their symptoms in detail via video call or audio calls. online medical appointment and consultation reduce time consumption, are cost-effective and reduces the worrying level of older adults about physical visit to the doctors.

From the outset, the focus on the prevention of physical and social isolation and improving well-being levels through the internet of things (IoT) based applications such as the study presented a social hybrid scenario model. The study is designed wide validated by the older adult community, with content on the removal of social and physical isolation and enhancement of well-being levels. The main objective of the model is to provide such passive and intentional communication service that is easy to adopt and widely accepted among the older adult community to prevent psychological and physical health issues and improve their well-being among the older adults.

The environment of the model helps the older adults what to do if they are feeling isolated and do not have physical and social activities, but also environment multidisciplinary scientific research, more linked to the older adults and themes related to wellbeing, and in the communication, content raises awareness of the risk associated with the growth of age, particularly focuses on social and physical wellbeing.

On the other hand, the contribution of IoT technology to the improvement of well-being among the older adult community also be addressed, based on the removal of social and physical isolation, and advancement of older adults' wellbeing, with immediate effect on their psychological and physical health. As older adults are provided solid clues in the results, how IoT technology-based applications can be very effective in reducing physical and social health issues and enhancing connectedness, especially among older adults. The main approaches by which IoT technology can help to expand the social circle, physical activities, and physical and psychological well-being is by increasing connectivity, and communication between doctors, family, and friends.

Thus, the presented study design provides an opportunity for the older adult community to make strong connections with their peers, friends, and doctors for two different communication such as passive and intentional communication for sake of their wellbeing development.

However, the model has a different impact level on different individual older adults, the problem associated with characteristics of the model must be addressed, therefore it is necessary to validate all characteristics of the model as the study validated above. Here the scientific community points out design of this type of model that has passive, and social communication with data privacy increases the older adults' participation, this type of participation not only increases the social well-being but also improves the physical well-being of older adults. also, part of the scientific community asses the need to provide more autonomy to the model and older adults, based on passive communication and intention communication, particularly through social networks, to increase their psychological and physical wellbeing.

Regarding the functionality of the model, the model has three different logs for three different users such as older adults, family friends and doctors who have a different long screen with different tools according to their long types., the model should allow a more restricted use to the area of interest to potential users of the model, to enhance the proximity between various model users.

Following this is proximity, the function of dynamizing and disseminating the events, as well as the existence of space for social communication and passive communication, where can comments or giving an opinion about social activities or physical activities, is widely accepted by older adults as a tool promote the older adults social, and physical participation and interaction. however, everyone can restrict their space for social or passive communication by using privacy control options, to minimize the risk of data stealing and interruption in daily life.

Also, the system has alerts and notification features, fall detection, physical health data and geolocation in real-time that help to monitor the older adults24 hours for their health wellbeing.24 hours monitoring service also predicts the future health issue that can resolve before getting the worst condition. Finally, to promote the physical and psychological well-being of older adults, the model gives multiple passive and intention scenarios that are not only allowing interaction with older adults. this kind of interaction through IoT based system ensures the inclusion of social and physical isolation and increases the older adults' social and physical participation which increases the older adults' well-being level.

6.11. Reformulation of the proposed model

Throughout this chapter, we collected the data via an online survey from senior Universities located in Portugal. The data has been analysed and discussed to understand the various characteristics of the proposed model in the context of well-being development. The reason behind the analyses and discussion is to identify the means, communication and interaction level that helps to remove or decrease the isolation of older adults and increase their physical and social wellbeing level. The proposed social hybrid model was also focused on these analyses, from the use by fragile older adults to their difficulties and needs that underlie them in physical and social activities.

After analysing the perception of older adults about proposed modes and making understanding what types of difficulties and needs they have. After that the study proposes the reformulation of the initial proposal of the model, considering the answers that the seniors gave in the survey. The Survey was carried out to obtain the opinion of potential users of the system and thus propose a final model.

We made three following major changes in the initial proposed model

1 Design

In a survey, some of the participants raised concerns about the small size of the font in the model application because we used 11 pixels for the main title and the small title or text was 9, but small font size is more difficult to read, especially for older adults with limited literacy skills. therefore, we increase the main title font from 11 to 19 and the small title or text increased from 9 pixels to 14. Due to these font sizes, they can read application headlines, titles, and text without having the glasses.

2 Scenarios

The primary scenarios of the proposed model remain unchanged but older adults demanded in the survey to have such a tool for sharing geo-location with their friends and family members when

they are participating in any outdoor physical or social activities such as participating in a cultural, religious festival or having dinner at any restaurant that time they can share their geo-location and have fun with their loved ones. Secondly, this tool helps families and Dr help to keep eye on older adults' physical activities which later helps to evaluate physical health data. due to the high demand and importance of location-sharing tools added to the system.

3. Privacy or security

During the survey analyses, we observed that older adults reported a higher level of privacy concern because in general older adults have less trust level in online activities than younger groups and older adults have less privacy self-efficacy than the then younger generation so that older adults need a higher level of protection while providing a social hybrid scenario service. Thus, the final proposed model has a tool in which older adults can control their privacy level and can restrict anybody to access their medical or social data without their permission.

CONCLUSION

The doctor's thesis began with the premise that the growth of the aged population in Portugal is a constant reality, with social isolation and physical well-being impacts. Portugal is one of those European countries where 21 per cent of the population is age 65 plus. The growth of the older adult population is facing many economic, social-psychological, and physical health issues. Mental and physical health issues among the older adult's community are becoming a burden on the health care system. in that sense, statistics indicate clear investment in such technology or services that helps to reduce physical and physical health problems from the older adult's community.

As results of this study indicate that investment in such technology or services which has focused on older adults' social and physical well-being is very poor because current IoT-based services are not focusing on all perspectives of social and physical well-being, some are offering social well-being or some physical well-being but with the high cost and low-quality services.

In this context, novel technology named the Internet of things is becoming the main element in passive and intentional communication. through this technology. can provide various passive and intentional communication scenarios in the context of psychological and physical well-being development that will bring older adults close to family friends, and medical doctors for effective interaction for reduction of mental and physical health problems.

The development of well-being is at the centre of this study. The trends that analysed the ideas that emerged and solutions that were presented always had focal points in the development of social and physical wellbeing, precisely because it is considered that the context of older adults' well-being has been neglected by the government and private sectors. But above all, because it is considered that older adults' well-being can contribute to a more impact way to a real paradigm shift: we can provide a healthy life for older adults through social and physical activities. these health activities can reduce the burden on private and public hospitals or medical health service providers. Above all physical and social activities can reduce the economic burden from the government because the government gives a huge amount of their GDP for medical services.

Throughout this chapter, the study analysed and discussed the data collected through an online survey to senior Universities were understood the dynamics and importance of IoT the based social hybrid model among the older adult community within the scope of physical and psychological wellbeing levels. Its mean, technology, channels, different social scenarios, passive and social communication types, and objectives were identified. Design of model also part of

analyses, identified difficulties and needs identified for wellbeing context that potentially allow the older adults to remove their social and physical isolation context to be involved.

Considering the testimonies collected, and the perception of individual older adults in the context of defined objectives that were intended with this data collection, it is quickly deduced that there is in fact confluence in what all older adult's needs and desires are: better strong social connection, good health monitoring service, high level of involvement in physical activities and greater psychological wellbeing. Essentially, the results of the study reveal, that the design of the model has the potential to increase the older adult's social and physical participation and remove social isolation that helps to promote well-being levels among older adults.

The results shed light on how the social hybrid scenario model offers different social scene combinations of noel technologies, the technology helps to improve the older adult's social participation by analysing the needs of older adults and striving to adapt to change the situation. The results contribute to an enhanced understanding of how maintaining social indoor and outdoor social participation is an active process. The findings of this study indicate that model design has the potential to take initiative to develop social relations, preserve older adults' community bonds and engage in social events and activities. As the older adult population in Portugal continues to grow and older adults' social isolation level is increasing as previously chapters social isolation has a direct negative impact on older adults' physical and psychological health that leads to many chronic, technologies such as IoT must be utilized to improve their social and physical wellbeing level. By introducing the Internet of things IoT-based applications targeting older adults, it is possible to decrease feelings of social isolation, loneliness, and hostility. IoT Technology can help to create an atmosphere in which older adults can live healthier, are friendly communities and be more productive for their society.

This study presents the design of a social hybrid model based on IoT the Internet of things that is capable of remote monitoring older adults through mobile applications and wearable smart bracelet devices. The study design was based on a contextual study in geriatric senior universities, in which semi-structured online questionnaires were applied to older adults. The Passive and intentional scenarios of the hypothetical model showed that it is feasible to carry out and implemented the proposal of this research. In addition, it is aligned to IoT Paradigm; the most important characteristics are, social and physical indoor and outdoor activities, the fact that it allows older adults to interact with people online, or face to face with their family, peers or friends that is effective to reduce the mental and physical health issue and improve the psychological and physical wellbeing of older adults because when they interact with different people for different

activities, through these activities they can learn many skills, gain knowledge and increase their social circle. once older adults make them busy with different social and physical activities that help to reduce their social isolation and improve their overall well-being level. Furthermore, the model offers real-time tracking of the general health condition of older adults, the fact that it allows the older adults and medical doctors or family members to interact with older adults, that is accessible remotely, and helps to keep an eye on older adult's physical health data, physical activities, and geolocation of adults. moreover, the design of the model can analyse the physical health data of older adults and predict the future illness of older adults and pass this information to doctors. The doctors can take precautionary measures after getting production from the systems that help to avoid chronic diseases such as heart attack, fall detection, high blood pressure or diabetes, etc.

The results of model validation are very promising and positive, showing that the social hybrid scenario model was well received by older adults, providing, initial evidence that the proposal of the hypothetical model could improve the social and physical wellbeing of older adults and additionally, it offered valuable evidence that can be used to rectify the usability complications that may affect the acceptance of the IoT technology by older adults.

The study investigation was outlined based on the following elements IoT technology, wellbeing, passive, and intentional communication under study (Portuguese Seniors universities), which aimed to answer the research question "**To what extent a social IoT hybrid scenario model of passive and intentional communication can be a promoter of the physical, psychological, and social well-being of the elderly?**" which set out three major objectives: **T**o undertake a comprehensive Literature review on the role of technology, namely IoT, and social media in the promotion of physical, psychological, and social well-being, To Sketch, design and validate IoT social hybrid model that is capable to promote wellbeing among the older adults, to identify (and eventually adopt) scales to measures the physical, psychological, and social well- being of the elderly.

IoT Technology and well-being are the primary elements of research

The thesis was developed to achieve the research objectives and answer the research question. thus, the first three chapters highlighted the main scientific research trends regarding IoT technology, well-being, and Portuguese older adults' characteristics.

The essence of how technology contributes to society is the discovery of new knowledge and then the use of that knowledge to improve human wellbeing and address societal problems. From antiquity to the present, technology has had a positive impact on human life by addressing issues in everyday life and making numerous jobs easier to do. Technology has made it simpler to build smart cities, smart travelling, smart farming, and social and health services, among other things, effectively connecting all countries on the planet, contributing to globalization and making it easier for economies to flourish and businesses to conduct business Using technology solutions, virtually every aspect of human existence may be made simpler, more effective, and faster, resulting in fewer issues in one direction and more problems in the other.

While technology has had some unfavourable effects on society, there are likely to be more beneficial than bad consequences. Many people's lives have been made simpler because of such influences and many have been given the resources, education, and tools they require to live a better life. Agriculture, communication, health, transportation, and educations sectors in countries throughout the world have suffered significant consequences because of these effects

Smart wristbands and health applications have enabled a world increasingly afflicted by chronic illness to use computer systems to monitor, evaluate, and change personal health practices. Advanced software may allow doctors to electronically acquire health information from patients via Wi-Fi-enabled nano-pills, and even Sci-Fi-like gadgets, such as the medical tricorder, are being created for fast medical evaluations.

Furthermore, many hospital systems include online portals that allow patients to access their medical information or connect with their doctors very quickly.

In short, I concluded from the first chapter need for a closer look to understand IoT (Internet of things) technology as emerging technology and integrate it into our life. This chapter discusses the various IoT evolutionary phases and generations that have experienced IoT technologies in various eras, including the first-generation experience with embedded things, a second-generation experience with a complex social web of things, and a third-generation experience with autonomous social objects and cloud computing. Interconnectivity, intelligence, heterogeneity, safety, monitoring and control, big data and analytics, information sharing, and collaboration are all discussed in this chapter.

This chapter also discusses the many uses of IoT scenarios in agriculture, education, healthcare, and medical domains, as well as environmental and renewable energy scenarios. This initial chapter presents evidence linking well-being with age, mental and physical health, and

technology's role in older adults' life. The analysis presented considers the total number of Portuguese older adults, not just tabular population data, but data that are spatially explicit and of global extent at a moderate resolution. In this chapter, data were gathered from different years and platforms for constructing estimates of the Portuguese elderly population distribution, their education level, household information, and medical facilities suitable for geographical analysis.

The third chapter addressed IoT-based health care and social applications as a social and health care support for psychological and physical wellness processes after evaluating the features of the Portuguese population. The fundamental purpose of the third chapter is to comprehend the characteristics and systems of present IoT healthcare technologies, as well as social IoT applications. It then attempts to determine if these systems are meeting their requirements. The IoT solutions that aid physical well-being is discussed in the first section of this chapter. The second section were cover social IoT.

After understanding the IoT concept, characteristics of older adults and finally IoT bases health care and social application through existing literature. Based on current literature, the study sketched the design of the model and proposed different passive and intentional scenarios in chapter five such as online, or face-to-social activities, remote health care services, home care services, and social interaction with friends and family members, and interaction with their doctors. In the proposed model, the main motive gets a perception of older adults about proposed scenarios that can satisfy older adults' social needs, proactive involvement in social activities, stimulate social contacts, share knowledge and above all promote older adults' physical and psychological wellbeing.

Internet of things IoT bass' applications are capable to connects physical devices, sensors, and buildings to exchange information in real time, creating more possibilities for immediate integration of the physical world with computer-based devices or applications. Smart wearable health care devices, home security or monitoring devices and smarts vehicle to all else humans use to digitise and improve the way humans live, the possibilities of the internet of things are boundaryless. As the Internet of things and smart devices become an essential part of human daily life, a human can understand the way it can assist humans to manage and treat our mental health.

IoT could be one of the keys to improved mental health by, accurately monitoring human feelings and tracking physical health data, enhancing communication, and offering access to use online social, education, and health resources. IoT technologies can help to bridge the gap as humans turn to digital devices that enable users to keep in touch with family friends and medical

doctors that help to remove the social and physical isolation after a certain age number and promote social and physical wellbeing.

The IoT-based social hybrid model answers the research question

The fifth chapter of this thesis presents the IoT social hybrid scenario model intending to improve the well-being of older adults. The two premises that underline this model are passive and intentional communication. The passive communication concept in identifying the needs of older adults particularly related to their physical and psychological health issues that make up the social hybrid model a tool to remove the physical isolation. The objective is to sketch the model in the context of connection and interconnection of all characteristics of the characteristics that compose.

The goal is to provide all the qualities that make up this model with a framework of connection and interconnectedness. These characteristics are based on the functionalities of IoT-based digital services, and social and health care services must be explored in IoT-based services, as well as passive and social communication- in a connection perspective between various objective ouR applications and with physical context actors who must be users of IoT-based social hybrid services because they are part of the development of wellbeing context.

As a result, the model's passive and social qualities must work together to ensure the development of well-being, whether physical or psychological, that supports this paradigm. The setting, on the other hand, emerges as a premise in the sense that the model's many characters are based on distinct viewpoints and requirements of older people, notably Portuguese older adults.

This gives this model adaptability and scalability that enhance its usage in an older adult's wellbeing well-being context, depending on the older adult's digital literacy, and physical and social needs that persuaded them to use the proposed model for the wellbeing development context. Thus, the social hybrid model is assumed to answer the research question and the main objective of this thesis: to Sketch, design and validate an IoT social hybrid model that is capable to promote well-being among older adults. The proposed model design, scenarios and characteristics are based on the flow of passive and intentional communication, believing that the realisation of the IoT social hybrid scenario model can remove promote the physical and psychological wellbeing of older adults.

Precisely this realization of this model, the present investigation went a step beyond what had been initially foreseen, and in the context of teamwork, a prototype android application has been developed with all passive and intentional scenarios s that we discussed in chapter 5 including in the implemented functional requirement. This main objective is to develop a prototype mobile application that provides a reflection of all characteristics of the model and how the model will work and will help to develop the model and implementation of the model in the field. Thus, the IoT social hybrid model, in addition to responding to the main objective of this thesis, also includes a potential for real usage.

In fact, different communication concepts and technology integrates into a single IoT model, the different actors such as older adults, family, friends and doctors that will be potential users, the real needs of the older adult community in the context of promotion of well-being in a combination of IoT technology and various communication concepts through social, and physical interactions.

On other hand, the design and characteristics of the model provide passive and intentional communication opportunities to enhance the physical and physical well-being of the older adults, growth of the aged population raised many concerns about the social and physical well-being of older adults that could be promoted through novel technology.

Finally, the development of a hypothetical IoT social hybrid model gives clues that its characteristics can promote the well-being of older adults and it has the potential for real practical applicability because this model can integrate with new technology via blue tooth, and it represents real needs and demands of older adults

Future work

Future research on the scalability and applicability of the social hybrid scenario model approach to promoting wellbeing from the model is certainly needed. The study given in this thesis presents some of the underlying benefits of system development, as well as future directions for work in these areas. The following section gives an outline of various future works.

The first possible application of the IoT social hybrid model in software engineering development, the work on this research was to investigate the design and define the characteristics of the mode for support of older adults' wellbeing. The model design is potentially applicable to the well-being promotion research area, therefore, there is a need to develop a physical social hybrid model with

working prototype software and find private or public stakeholder who has the authority to do its implementation and management aimed to promote the wellbeing of older adults.

In terms of future work and the development of the IoT social hybrid model, which is still in its early stages, it will be necessary to continue working on the development and validation of functionalities, as well as robust integration and convergence planning. of systems and the dynamics of interaction and communication based on an IoT technology, passive, and intentional communication approach

Bibliography

1. ABI, R. (2013). Home Automation Systems. Retrieved June 22, 2020, from ABI Research website: https://www.abiresearch.com/market-research/product/1016484-home-automation-systems.

2. Aceto, G., Persico, V., & Pescapé, A. (2020). Industry 4.0 and Health: Internet of Things, Big Data, and Cloud Computing for Healthcare 4.0. Journal of Industrial Information Integration, 18(February 2019), 100129. https://doi.org/10.1016/j.jii.2020.100129.

3. Afzal, B., Umair, M., Asadullah, G., & Ahmed, E. (2019). Enabling IoT platforms for social IoT applications : Vision, feature mapping, and challenges. Future Generation Computer Systems, 92, 718–731. https://doi.org/10.1016/j.future.2017.12.002.

4. Ahmed, E., & Rehmani, M. H. (2017). Introduction to the Special Section on Social Collaborative Internet of Things. Computers and Electrical Engineering, 58, 382–384.https://doi.org/10.1016/j.compeleceng.2017.04.023.

5. Akrim, A., & Sulasmi, E. (2020). Talent Development & Excellence Student Perception of Cyberbullying in Social Media. Talent Development and Excellence, 12(1), 322–333. Retrieved from http://www.iratde.com.

6. Al-Turjman, F., Altrjman, C., Din, S., & Paul, A. (2019). Energy monitoring in IoT-based ad hoc networks: An overview. Computers and Electrical Engineering, 76, 133–142. https://doi.org/10.1016/j.compeleceng.2019.03.013.

7. Ali, O., Ishak, M. K., Bhatti, M. K. L., Khan, I., & Kim, K. Il. (2022). A Comprehensive Review of Internet of Things: Technology Stack, Middlewares, and Fog/Edge Computing Interface. *Sensors*, *22*(3), 1–43. https://doi.org/10.3390/s22030995

8. Al-Turjman, F., Zahmatkesh, H., & Shahroze, R. (2022). An overview of security and privacy in smart cities' IoT communications. Transactions on Emerging Telecommunications Technologies, 33(3), 1–19. https://doi.org/10.1002/ett.3677.

9. Ali, O., Ishak, M. K., Bhatti, M. K. L., Khan, I., & Kim, K. Il. (2022). A Comprehensive Review of Internet of Things: Technology Stack, Middlewares, and Fog/Edge Computing Interface. Sensors, 22(3), 1–43. https://doi.org/10.3390/s22030995.

10. Alterman, T., Tsai, R., Ju, J., & Kelly, K. M. (2019). Trust in the work environment and cardiovascular disease risk: Findings from the gallup-sharecare well-being index. International Journal of Environmental Research and Public Health, 16(2). https://doi.org/10.3390/ijerph16020230a.

11. Alkhayyat, A., Thabit, A. A., Al-Mayali, F. A., & Abbasi, Q. H. (2019). WBSN in IoT health-based application: Toward delay and energy consumption minimization. Journal of Sensors, 2019. https://doi.org/10.1155/2019/2508452.

12. Alshaheen, H. (2018). Energy Saving and Reliability for Wireless Body Sensor Networks (WBSN). IEEE Access, 6, 16678–16695. https://doi.org/10.1109/ACCESS.2018.2817025.

13. Alsina-Pagès, R. M., Navarro, J., Alías, F., & Hervás, M. (2017). Homesound: Real-time audio event detection based on high-performance computing for behaviour and surveillance remote monitoring.

Sensors (Switzerland), 17(4). https://doi.org/10.3390/s17040854.

14. Alwan, O. S., & Prahald Rao, K. (2017). Dedicated real-time monitoring system for health care using ZigBee. Healthcare Technology Letters, 4(4), 142–144. https://doi.org/10.1049/htl.2017.0030.
15. Amadeo, M., Ruggeri, G., Campolo, C., & Molinaro, A. (2019). IoT services allocation at the edge via named data networking: From optimal bounds to practical design. IEEE Transactions on Network and Service Management, 16(2), 661–674. https://doi.org/10.1109/TNSM.2019.2900274.
16. Amadeo, M., Campolo, C., Quevedo, J., Corujo, D., Molinaro, A., Iera, A., … Vasilakos, A. V. (2016). Information-centric networking for the internet of things: Challenges and opportunities. IEEE Network, 30(2), 92–100. https://doi.org/10.1109/MNET.2016.7437030.
17. American Heart Association. (2018). American Heart Association Recommendations for Physical Activity in Adults and Kids | American Heart Association. Retrieved May 8, 2022, from Heart Attack and Stroke Symptoms website: https://www.heart.org/en/healthy-living/fitness/fitness-basics/aha-recs-for-physical-activity-in-adults
18. Aminian, M. (2013). A Hospital Healthcare Monitoring System Using Wireless Sensor Networks. Journal of Health & Medical Informatics, 04(02), 4–9. https://doi.org/10.4172/2157-7420.1000121.
19. Ammar, M., Haleem, A., Javaid, M., Bahl, S., & Verma, A. S. (2022). Implementing Industry 4.0 technologies in self-healing materials and digitally managing the quality of manufacturing. Materials Today: Proceedings, 52, 2285–2294. https://doi.org/10.1016/j.matpr.2021.09.248.
20. Arntz, A., Adler, F., Kitzmann, D., Eimler, S.C. (2022). Augmented Reality Supported Real-Time Data Processing Using Internet of Things Sensor Technology. In: Streitz, N.A., Konomi, S. (eds) Distributed, Ambient and Pervasive Interactions. Smart Living, Learning, Well-being and Health, Art and Creativity. HCII 2022. Lecture Notes in Computer Science, vol 13326. Springer, Cham. https://doi.org/10.1007/978-3-031-05431-0_1.
21. ANAND, P. (2015). Happiness Explained: What Human Flourishing Is and What We Can Do To Promote It (Vol. 1). Vol. 1.
22. Andreasson, U., & Birkjær, M. (2018). In the S In the Shadow of Happinesshadow of Happiness. In In the S In the Shadow of Happinesshadow of Happiness. https://doi.org/10.6027/anp2018-799.
23. Andres, C., Eduardo, C., & Javier, O. (2011). Biosignal Monitoring Using Wireless Sensor Networks. Biomedical Engineering, Trends in Electronics, Communications and Software, 2011(January 2011). https://doi.org/10.5772/12946.
24. Ang, K. L. M., Seng, J. K. P., & Ngharamike, E. (2022). Towards Crowdsourcing Internet of Things (Crowd-IoT): Architectures, Security and Applications. Future Internet, 14(2). https://doi.org/10.3390/fi14020049.
25. Angelini, L., Carrino, S., Khaled, O. A., Riva-Mossman, S., & Mugellini, E. (2016). Senior living lab: An ecological approach to foster social innovation in an ageing society. Future Internet, 8(4), 1–19. https://doi.org/10.3390/fi8040050.
26. Anusha, C. (2018). Automation in Wireless Control System : A Small. IJRASET, 6(Iv), 512–514.

27. Asiamah, N., Mensah, H. K., & Oteng-Abayie, E. F. (2017). General, target, and accessible population: Demystifying the concepts for effective sampling. The Qualitative Report, 22(6), 1607–1621. https://doi.org/10.1002/chem.201102203.
28. Atzori, L., Iera, A., & Morabito, G. (2017). Understanding the Internet of Things: definition, potentials, and societal role of a fast evolving paradigm. Ad Hoc Networks, 56, 122–140. https://doi.org/10.1016/j.adhoc.2016.12.004.
29. Atzori, L., Carboni, D., & Iera, A. (2014). Smart things in the social loop: Paradigms, technologies, and potentials. Ad Hoc Networks, 18, 121–132. https://doi.org/10.1016/j.adhoc.2013.03.012
30. Babar, M., & Arif, F. (2017). Smart urban planning using Big Data analytics to contend with the interoperability in Internet of Things. Future Generation Computer Systems, 77(2017), 65–76. https://doi.org/10.1016/j.future.2017.07.029.
31. Baccelli, E. (2018). The Internet of Things and The Web of Things Emmanuel Baccelli , Dave Raggett HAL Id : hal-01244735. (April 2015).
32. Baer, B., Ma, A. B., Abou, H., Drph, T., Llm, J. V., & Llm, R. T. (2016). The Right to Health of OlderPeople. The Gerontologist, 56(S2,S206), 206–217. https://doi.org/10.1093/geront/gnw039.
33. Bahareh Javid, Faranak Fotouhi- Ghazvini, F. S. Z. (2018). Noninvasive Optical Diagnostic Techniques for Mobile Blood Glucose and Bilirubin Monitoring. Journal of Medical Signals and Sensor, 8(3), 125. https://doi.org/10.4103/jmss.JMSS.
34. Bayoumy, K., Gaber, M., Elshafeey, A., Mhaimeed, O., Dineen, E. H., Marvel, F. A., Martin, S. S., Muse, E. D., Turakhia, M. P., Tarakji, K. G., & Elshazly, M. B. (2021). Smart wearable devices in cardiovascular care: where we are and how to move forward. Nature Reviews Cardiology, 18(8), 581–599. https://doi.org/10.1038/s41569-021-00522-7.
35. Balakrishnan, S., Sheeba Rani, S., & Ramya, K. C. (2019). Design and Development of IoT Based Smart Aquaculture System in a Cloud Environment. International Journal of Oceans and Oceanography, 13(1), 121–127. Retrieved from http://www.ripublication.com/ijoo19/ijoov13n1_10.pdf%0Ahttp://www.ripublication.com.
36. Bandyopadhyay, D., & Sen, J. (2011). Internet of things: Applications and challenges in technology and standardization. Wireless Personal Communications, 58(1), 49–69. https://doi.org/10.1007/s11277-011-0288-5.
37. Basabi, A. E., He, J., Hashemi, S. M., Xuan, X., Pathan, M. S., & Zardari, Z. A. (2021). A ZigBee Software Defined Network Security. International Journal of Network Security, 1816(November), 10.
38. Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. Social Science and Medicine, 51(6), 843–857. https://doi.org/10.1016/S0277-9536(00)00065-4.
39. Belli, L., Cilfone, A., Davoli, L., Ferrari, G., Adorni, P., Di Nocera, F., Dall'olio, A., Pellegrini, C., Mordacci, M., & Bertolotti, E. (2020). IoT-enabled smart sustainable cities: Challenges and approaches. In Smart Cities (Vol. 3, Issue 3, pp. 1039–1071). https://doi.org/10.3390/smartcities3030052.
40. Biedenweg, K., Hanein, A., Nelson, K., Stiles, K., Wellman, K., Horowitz, J., & Vynne, S. (2014). Developing Human Wellbeing Indicators in the Puget Sound: Focusing on the Watershed Scale. Coastal Management, 42(4), 374–390. https://doi.org/10.1080/08920753.2014.923136.

41. Belli, L., Cilfone, A., Davoli, L., Ferrari, G., Adorni, P., Di Nocera, F., … Bertolotti, E. (2020). IoT-enabled smart sustainable cities: Challenges and approaches. Smart Cities, Vol. 3, pp. 1039–1071. https://doi.org/10.3390/smartcities3030052.
42. Blackman, S., Matlo, C., Bobrovitskiy, C., Waldoch, A., Fang, M. L., Jackson, P., … Sixsmith, A. (2016). Ambient Assisted Living Technologies for Aging Well: A Scoping Review. Journal of Intelligent Systems, 25(1), 55–69. https://doi.org/10.1515/jisys-2014-0136.
43. Bluetooth. (2020). Bluetooth SIG and DiiA collaborate to accelerate IoT-enabled commercial lighting – Bluetooth® Technology Website. Retrieved June 22, 2020, from Bluetooth website: https://www.bluetooth.com/press/bluetooth-sig-and-diia-collaborate-to-accelerate-iot-enabled-commercial-lighting/
44. Borelli, E., Paolini, G., Antoniazzi, F., Barbiroli, M., Benassi, F., Chesani, F., … Costanzo, A. (2019). HABITAT: An IoT solution for independent elderly. Sensors (Switzerland), 19(5). https://doi.org/10.3390/s19051258.
45. Bolt, R., Beranek, L., Newman, R.A. (1981). A History of the ARPANET: The First decades; DARPA Report No. 4799 Inc.: Cambridge, MA, USA, 1918. 11. Qin.
46. Brazier, J. E., Harper, R., Jones, N. M., O'Cathain, a, Thomas, K. J., Usherwood, T., & Westlake, L. (1992). Validating the SF-36 health survey questionnaire: new outcome measure for primary care. BMJ (Clinical Research Ed.), 305(6846), 160–164. https://doi.org/10.1136/bmj.305.6846.160.
47. Brewer, M., Phillips, D., Alastair, M., & Sibiera, L. (2008). Poverty and Inequality in the UK : 2008 (Payne Juldith, Ed.). London: The institute for Fiscal studies.
48. Brüggen, E. C., Hogreve, J., Holmlund, M., Kabadayi, S., & Löfgren, M. (2017). Financial well-being: A conceptualization and research agenda. Journal of Business Research, 79, 228–237. https://doi.org/10.1016/j.jbusres.2017.03.013.
49. Brush, A. J. B., Lee, B., Mahajan, R., Agarwal, S., Saroiu, S., & Dixon, C. (2011). Home automation in the wild. Proceedings of the 2011 Annual Conference on Human Factors in Computing Systems - CHI '11, 2115. https://doi.org/10.1145/1978942.1979249.
50. Bryman, A. (2012). Social research methods. In Oxford (Fourth edi, Vol. 4). Retrieved from http://marefateadyan.nashriyat.ir/node/150.
51. Byun, J., Woo, S., Tolcha, Y., & Kim, D. (2018). Oliot EPCIS: Engineering a web information system complying with EPC Information Services standards towards the Internet of Things. Computers in Industry, 94(September 2016), 82–97. https://doi.org/10.1016/j.compind.2017.10.004.
52. Cantril, H. (1965). The Pattern of Human Concerns. The British Journal of Sociology, 18, 212. https://doi.org/10.2307/588624.
53. Carr, D., Freedman, V. A., Cornman, J. C., & Schwarz, N. (2014). Happy marriage, happy life? Marital quality and subjective well-being in later life. Journal of Marriage and Family, 76(5), 930–948. https://doi.org/10.1111/jomf.12133.
54. Carritech Communications. (2015). The Evolution of Mobile Communications, from 1G to 5G. Retrieved from http://www.carritech.com/news/evolution-mobile-communication-1g-5g.
55. Castiglia, P., & Dettori, M. (2022). Second Edition of Special Issue "Strategies and Evidence in Health Communication: Evidence and Perspectives." International Journal of Environmental Research and Public Health, 19(3), 4–7. https://doi.org/10.3390/ijerph19031460.
56. Costantini, A., Di Modica, G., Ahouangonou, J. C., Duma, D. C., Martelli, B., Galletti, M., Antonacci, M., Nehls, D., Bellavista, P., Delamarre, C., & Cesini, D. (2022). IoTwins: Toward Implementation of Distributed Digital Twins in Industry 4.0 Settings. Computers, 11(5), 1–18. https://doi.org/10.3390/computers11050067.
57. Costa, F., Genovesi, S., Borgese, M., Michel, A., Dicandia, F. A., & Manara, G. (2021). A review of rfid sensors, the new frontier of internet of things. Sensors, 21(9). https://doi.org/10.3390/s21093138.
58. Census. (n.d.). Census in Portugal over the time - Formacao livre Censos. Retrieved April 15, 2020, from https://sites.google.com/site/formacaolivrecensos/home/inicial-page/census-in-portugal/censos-in-portugal-over-the-time.
59. Chadwick, Z., Edmondson, A., & McDonald, S. (2022). Engaging with animal-assisted interventions (AAIs): exploring the experiences of young people with ASD/ADHD diagnoses. Support for Learning, 37(1), 44–61. https://doi.org/10.1111/1467-9604.12394.

60. Cheng, J., & Hung, M. (2007). A ZigBee-Based Power Monitoring System with Direct Load Control Capabilities EquihmentiSiMe SergerSIde CaMpagy. Design, TuesE04(April), 15–17.

61. Chianese, A., Piccialli, F., & Valente, I. (2015). Smart environments and Cultural Heritage: a novel approach to create intelligent cultural spaces. Journal of Location-Based Services, 9(3), 209–234. https://doi.org/10.1080/17489725.2015.1099752.

62. Chong, G. P. L. (2022). Xiaomi and the Promises of the Good Life? Issues of Security and Risk in the Making of the Smart Home in China. Science, Technology and Society, (2022), 1–20. https://doi.org/10.1177/09717218221075128.

63. Chong, T. W. H., Doyle, C. J., Cyarto, E. V., Cox, K. L., Ellis, K. A., Ames, D., & Lautenschlager, N. T. (2014). Physical activity program preferences and perspectives of older adultswith and without cognitive impairment. Asia-Pacific Psychiatry, 6(2), 179–190. https://doi.org/10.1111/appy.12015

64. Chung, C., & Jeong, J. P. (2020). A Design of IoT Device Configuration Translator for Intent-Based IoT-Cloud Services. 2020 22nd International Conference on Advanced Communication Technology (ICACT), Advanced Communication Technology (ICACT), 2020 22nd International Conference On, pp. 52–56.

65. Čolaković, A., & Hadžialić, M. (2018). Internet of Things (IoT): A review of enabling technologies, challenges, and open research issues. Computer Networks, 144, 17–39. https://doi.org/10.1016/j.comnet.2018.07.017.

66. Commission, E. (2020). Smart and Healthy Ageing through People Engaging in Supportive Systems. Retrieved March 8, 2021, from Cordis.europa website: https://cordis.europa.eu/project/id/857159.

67. Connier, J., Zhou, H., De Vaulx, C., Li, J., Shi, H., Vaslin, P., & Hou, K. M. (2020). Perception Assistance for the Visually Impaired Through Smart Objects: Concept, Implementation, and Experiment Scenario. IEEE Access, Access, IEEE, Vol. 8, pp. 46931–46945.

68. Conti-Ramsden, G., Durkin, K., Mok, P. L. H., Toseeb, U., & Botting, N. (2016). Health, employment and relationships: Correlates of personal wellbeing in young adults with and without a history of childhood language impairment. Social Science and Medicine. https://doi.org/10.1016/j.socscimed.2016.05.014.

69. Cooper, C., & Quick, J. C. (2017). The Handbook of Stress and Health. In The Handbook of Stress and Health (2017th ed.). https://doi.org/10.1002/9781118993811.

70. Courtois, A., Taillade, F., & Placko, D. (2022). Optimization of sensor location and method analyzing for in-situ monitoring of concrete containment structures: a case involving embedded moisture sensors. Materials and Structures/Materiaux et Constructions, 55(2), 1–11. https://doi.org/10.1617/s11527-022-01915-x.

71. Criticalcomms. (2010, August 30). Wavenis Open Standard Alliance. Retrieved June 22, 2020, from criticalcomms website: https://www.criticalcomms.com.au/content/public-safety/product/wavenis-open-standard-alliance-284857067#axzz6Q5N97KwG.

72. Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika. 16, 297-334.

73. Cui, L., Zhang, Z., Gao, N., Meng, Z., & Li, Z. (2019). Radio frequency identification and sensing techniques and their applications—A review of the state-of-the-art. Sensors (Switzerland), 19(18). https://doi.org/10.3390/s19184012.

74. De Oliveira, G. A. A., Oliveira, O. de F., de Abreu, S., de Bettio, R. W., & Freire, A. P. (2022). Opportunities and accessibility challenges for open-source general-purpose home automation mobile applications for visually disabled users. Multimedia Tools and Applications, 81(8), 10695–10722. https://doi.org/10.1007/s11042-022-12074-0.

75. Da Xu, L. (2022). Emerging Enabling Technologies for Industry 4.0 and Beyond. Information Systems Frontiers, September 2021. https://doi.org/10.1007/s10796-021-10213-w.

76. Dannewitz, C., Kutscher, D., Ohlman, B., Farrell, S., Ahlgren, B., & Karl, H. (2013). Network of information (NetInf)-An information-centric networking architecture. Computer Communications, 36(7), 721–735. https://doi.org/10.1016/j.comcom.2013.01.009.

77. David, D. R., Nait-Sidi-moh, A., Durand, D., & Fortin, J. (2015). Using Internet of Things technologies for a collaborative supply chain: Application to tracking of pallets and containers. Procedia Computer Science, 56(1), 550–557. https://doi.org/10.1016/j.procs.2015.07.251.
78. Dastjerdi, A. V., & Buyya, R. (2016). Fog Computing: Helping the Internet of Things Realize Its Potential. Computer, 49(8), 112–116. https://doi.org/10.1109/MC.2016.245.
79. DeVellis, R.F. (1991). Scale Development. Theory and applications. London: Sage Publications.
80. Dias, D., & Cunha, J. P. S. (2018). Wearable health devices—vital sign monitoring, systems and technologies. Sensors (Switzerland), 18(8). https://doi.org/10.3390/s18082414.
81. Diener, E., Emmons, R., Larsen, R., & Griffin, S. (1985). The Satisfaction With Life Scale. Journal of Personality Assessment, Vol. 49, pp. 71–75. https://doi.org/10.1207/s15327752jpa4901_13.
82. Dockray, S. (2008). A Comparison of Affect Ratings Obtained with Ecological Momentary Assessment and the Day Reconstruction Method Samantha. Bone, 23(1), 1–7. https://doi.org/10.1038/jid.2014.371.
83. Dudakiya, S., Galani, H., Shaikh, A., Thanki, D., Late, R. A., & Pawar, S. E. (2016). Monitoring mobile patients using predictive analysis by data from wearable sensors. International Conference on Electrical, Electronics, and Optimization Techniques, ICEEOT 2016, 332–335. https://doi.org/10.1109/ICEEOT.2016.7755305.
84. Dunnell, K. (2008). Diversity and different experiences in the UK. National Statistician's Annual Article on Society. … National Statistics. Http://Www. Statistics. Gov. Uk/Articles …, 1–15.
85. Djalilova, Z. O., & Davlatov, S. S. (2022). PHYSICAL ACTIVITY AND ITS IMPACT ON HUMAN HEALTH AND LONGEVITY. BUKHARA STATE MEDICAL INSTITUTE NAMED AFTER ABU ALI IBN SINO, BUKHARA, REPUBLIC OF UZBEKISTAN, 05..
86. Easwaran, E. (2013). The Yoga of Work: Love Your Job, Love Your Life! Retrieved April 3, 2020, from yogs international website: https://yogainternational.com/article/view/the-yoga-of-work-love-your-job-love-your-life.
87. El, A., & Abtoy, A. (2019). Understanding the ambient Assisted Living systems: concepts, architectural trends and challenges. International Journal of Open Information Technologies, 7(1).
88. El murabet, A., Abtoy, A., Touhafi, A., & Tahiri, A. (2018). Ambient Assisted living system's models and architectures: A survey of the state of the art. Journal of King Saud University - Computer and Information Sciences, xxx(xxx), 10. https://doi.org/10.1016/j.jksuci.2018.04.009.
89. Elena-Lenz, C. (2014). Internet of Things: Six Key Characteristics | Design Mind. Retrieved August 22, 2018, from Design mind website: https://designmind.frogdesign.com/2014/08/internet-things-six-key-characteristics/
90. Elliq. (2021). Healthy Living Made Simple: Join ElliQ's Free Insiders Program. Retrieved March 8, 2021, from elliq.com website: https://info.elliq.com/insiders.
91. Ellison, N. B., & Boyd, D. M. (2013). Sociality Through Social Network Sites. 1. https://doi.org/10.1093/oxfordhb/9780199589074.013.0008.
92. Estatística, I. N. de. (2020). Censos 2020 Resultados Definitivos - Portugal. In I. . Instituto Nacional de Estatística (Ed.), Science. Lisbon.
93. Evans, D. (2011). The Internet of Things - How the Next Evolution of the Internet is Changing Everything. CISCO White Paper, (April), 1–11. https://doi.org/10.1109/IEEESTD.2007.373646.
94. Fioramonti, L. (2016). A Post-GDP World? Rethinking International Politics in the 21st Century. Global Policy, 7(1), 15–24. https://doi.org/10.1111/1758-5899.12269.
95. Farahsari, P. S., Farahzadi, A., Rezazadeh, J., & Bagheri, A. (2022). A Survey on Indoor Positioning Systems for IoT-Based Applications. IEEE Internet of Things Journal, 9(10), 7680–7699. https://doi.org/10.1109/JIOT.2022.3149048.
96. Firouzi, F., Farahani, B., & Marinšek, A. (2022). The convergence and interplay of edge, fog, and cloud in the AI-driven Internet of Things (IoT). Information Systems, 107, 101840. https://doi.org/10.1016/j.is.2021.101840.

97. Fischer, B., Peine, A., & Östlund, B. (2020). The Importance of User Involvement: A Systematic Review of Involving OlderUsers in Technology Design. The Gerontologist, 60(7), e513–e523. https://doi.org/10.1093/geront/gnz163.
98. Freitas, E., & Azevedo, A. (2016). Wireless Biomedical Sensor Networks: The Technology. Proceedings of the 2nd World Congress on Electrical Engineering and Computer Systems and Science, 5. https://doi.org/10.11159/icbes16.134.
99. Garg, S. K., Versteeg, S., & Buyya, R. (2013). A framework for ranking of cloud computing services. Future Generation Computer Systems, 29(4), 1012–1023. https://doi.org/10.1016/j.future.2012.06.006.
100. Gartner. (2015). The Importance of "Big Data": A Definition. Retrieved August 29, 2018, from https://www.gartner.com/doc/2057415/importance-big-data-definition.
101. Gilchrist, A., Gilchrist Bangken, A., & Thailand, N. (2016). THE INDUSTRIAL INTERNET OF THINGS Industry 4.0: The Industrial Internet of Things. In Library of Congress Control Number. https://doi.org/10.1007/978-1-4842-2047-4.
102. Gokhal, P., Bhat, O., & Bhat, S. (2018). Introduction to IOT. International Advanced Research Journal in Science, Engineering and Technology (IARJSET), 5(1), 41–44. https://doi.org/10.17148/IARJSET.2018.517.
103. Gray. E, D. (2013). Doing Research ub the reak world (3rd ed.).
104. Gutierrez Pascual, M. D. (2012). Indoor Location Systems based on ZigBee networks. Mikkeli University of Applied Sciences, thesis(2012), 46. Retrieved from https://www.theseus.fi/bitstream/handle/10024/43966/Gutierrez_Deseada.pdf.
105. Ghosh, U., Chakraborty, C., Garg, L., & Srivastava, G. (2022). Intelligent Internet of Things for Healthcare and Industry. In Internet of Things. http://dx.doi.org/10.1007/978-3-030-81473-1%0Ahttps://link.springer.com/content/pdf/10.1007/978-3-030-81473-1.pdf.
106. Guimarães, R. C. e Sarsfield Cabral, J. A. (2010). Estatística, 2ª Edição. Verlag Dashöfer, 2010.
107. Guerci, M., Hauff, S., & Gilardi, S. (2022). High performance work practices and their associations with health, happiness and relational well-being: are there any tradeoffs? International Journal of Human Resource Management, 33(2), 329–359. https://doi.org/10.1080/09585192.2019.1695647.
108. Gürdür Broo, D., Kaynak, O., & Sait, S. M. (2022). Rethinking engineering education at the age of industry 5.0. Journal of Industrial Information Integration, 25(May 2021), 100311. https://doi.org/10.1016/j.jii.2021.100311.
109. Gunduz, D., Qin, Z., Aguerri, I. E., Dhillon, H. S., Yang, Z., Yener, A., Wong, K. K., & Chae, C.-B. (2022). Beyond Transmitting Bits: Context, Semantics, and Task-Oriented Communications. 1–28. http://arxiv.org/abs/2207.09353.
110. Gavrilović, N., & Mishra, A. (2021). Software architecture of the internet of things (IoT) for smart city, healthcare and agriculture: analysis and improvement directions. Journal of Ambient Intelligence and Humanized Computing, 12(1), 1315–1336. https://doi.org/10.1007/s12652-020-02197-3.
111. Habib, M. (2019). Handbook of Research on the Evolution of IT and the Rise of E-Society (M. Habib, Ed.). https://doi.org/10.4018/978-1-5225-7214-5.
112. Hammer, J. H., Parent, M. C., Spiker, D. A., & World Health Organization. (2018). Global status report on alcohol and health 2018. In Global status report on alcohol. https://doi.org/10.1037/cou0000248
113. Haskell, W. L., Blair, S. N., & Hill, J. O. (2009). Physical activity: Health outcomes and importance for public health policy. Preventive Medicine, 49(4), 280–282.

https://doi.org/10.1016/j.ypmed.2009.05.002.

114. Heaton, D. P. (2010). The Story of StuffThe Story of Stuff, by LeonardA., and Waste = Food, VPRO Television, 2006, 2007. Academy of Management Learning & Education. https://doi.org/10.5465/amle.9.3.zqr553.

115. HelpAge International. (2011). Insights on Ageing : a survey. HelpAge International, 2011, 16. Retrieved from https://cdn.uclouvain.be/public/Exports reddot/aisbl-generations/documents/DocPart_Etud_InsightsOnAgeing_2011.pdf.

116. Hickel, J., & Kallis, G. (2020). Is Green Growth Possible ? Is Green Growth Possible ? New Political Economy ISSN:, 3467(2020), 19. https://doi.org/10.1080/13563467.2019.1598964.

117. Hidalgo Vicario, M. H., & Rodríguez Hernández, P. R. (2013). DSM-5. manual diagnóstico y estadístico de los trastornos mentales. últimas novedades. In Pediatria Integral (Vol. 17).

118. Hill, M., & Hill, A. (2002). Investigação por questionário (2a ed.). Lisboa: Sílabo.

119. Hoebel, J., Rommel, A., Schröder, S. L., Fuchs, J., Nowossadeck, E., & Lampert, T. (2017). Socioeconomic Inequalities in Health and Perceived Unmet Needs for Healthcare among the Elderly in Germany. International Jopurnal of Enviroemtn Research Amnd Public Health, 1127(2017), 18. https://doi.org/10.3390/ijerph14101127.

120. Hoonakker, P. L. T., Carayon, P., Brown, R. L., Cartmill, R. S., Wetterneck, T. B., & Walker, J. M. (2013). Changes in end-user satisfaction with computerized provider order entry over time among nurses and providers in intensive care units. Journal of the American Medical Informatics Association, 20(2), 252–259. https://doi.org/10.1136/amiajnl-2012-001114.

121. Hofman, J., Do, T. H., Qin, X., Bonet, E. R., Philips, W., Deligiannis, N., & La Manna, V. P. (2022). Spatiotemporal air quality inference of low-cost sensor data: Evidence from multiple sensor testbeds. Environmental Modelling and Software, 149(December 2021), 105306. https://doi.org/10.1016/j.envsoft.2022.105306.

122. Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. PLoS Medicine, 7(7). https://doi.org/10.1371/journal.pmed.1000316.

123. Holmquist, L. E., Mattern, F., Schiele, B., Alahuhta, P., Beigl5, M., & Gellersen, H.-W. (2001). Smart-Its Friends: A Technique for Users to Easily Establish Connections between Smart Artefacts. Ubicomp 2001: Ubiquitous Computing SE - 10, 2201, 116–122. https://doi.org/10.1007/3-540-45427-6_10.

124. Hu, F., Xie, D., & Shen, S. (2013). On the Application of the Internet of Things in the Field of Medical and Health Care. https://doi.org/10.1109/GreenCom-iThings-CPSCom.2013.384

125. Hui, B., Wang, W., Yu, J., Gong, Z., Ku, W.-S., Sun, M.-T., & Lu, H. (2022). RFID-Based Indoor Spatial Query Evaluation with Bayesian Filtering Techniques. 1(1). Retrieved from http://arxiv.org/abs/2204.00747.

126. Hui, J. (2011). COMPRESSION FORMAT FOR ipv6 Datagrams over IEEE 802.15.4/Based Network. IETF, 6282(4944), 1–24.

127. Huo, R., Zeng, S., Wang, Z., Shang, J., Chen, W., Huang, T., … Liu, Y. (2022). A Comprehensive Survey on Blockchain in Industrial Internet of Things: Motivations, Research Progresses, and Future Challenges.

IEEE Communications Surveys and Tutorials, 24(1), 88–122. https://doi.org/10.1109/COMST.2022.3141490.

128. Husebo, B. S., Flo, E., Aarsland, D., Selbaek, G., Testad, I., Gulla, C., … Ballard, C. (2015). COSMOS-improving the quality of life in nursing home patients: Protocol for an effectiveness-implementation cluster randomized clinical hybrid trial. Implementation Science, 10(1), 1–13. https://doi.org/10.1186/s13012-015-0310-5

129. Hussaini, M., Naeem, M. A., Kim, B. S., & Maijama'a, I. S. (2019). Efficient Producer Mobility Management Model in Information-Centric Networking. IEEE Access, 7, 42032–42051. https://doi.org/10.1109/ACCESS.2019.2907653

130. Ibarra-Esquer, J. E., González-Navarro, F. F., Flores-Rios, B. L., Burtseva, L., & Astorga-Vargas, M. A. (2017). Tracking the evolution of the internet of things concept across different application domains. Sensors (Switzerland), 17(6), 1–24. https://doi.org/10.3390/s17061379.

131. Imani, M., Qiyasi, A., Zarif, N., Ali, M., Noshiri, O., Faramarzi, K., … Joudaki, M. (2020). A survey on subjecting electronic product code and non-ID objects to IP identification . Engineering Reports, 2(6), 1–20. https://doi.org/10.1002/eng2.12171

132. INE. (2016). (2016) Inquérito Nacional de Saúde 2014_Instituto Nacional de Estatística. https://doi.org/10.1017/CBO9781107415324.004

133. Institute, N. S. (2019). INE Portal. Retrieved April 2, 2020, from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&contecto=pi&indOcorrCod=0008273&selTab=tab0

134. Instituto Nacional de Estatística. (2016). Portal do Instituto Nacional de Estatística. Retrieved May 17, 2018, from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_destaques&DESTAQUESdest_boui=224739516&DESTAQUESmodo=2

135. Interconnected, W., & Networks, B. S. (2019). Validation of Wired and Wireless Interconnected Body Sensor Networks. Sensor, 2019(2019), 1–23. https://doi.org/10.3390/s19173697.

136. Intille, S. S. (2002). Designing a home of the future. IEEE Pervasive Computing, 1(2), 76–82. https://doi.org/10.1109/MPRV.2002.1012340.

137. Jacobson, V., Smetters, D. K., Thornton, J. D., Plass, M. F., Briggs, N. H., & Braynard, R. L. (2009). Network Named Content. Proceedings of the 5th International Conference on Emerging Networking Experiments and Technologies, 24(11), 1–12. https://doi.org/10.1145/1658939.1658941.

138. Jara, A. J., Zamora, M. A., & Skarmeta, A. (2012). Global IP: An adaptive and transparent IPv6 integration in the Internet of Things. Mobile Information Systems, 8(3), 177–197. https://doi.org/10.3233/MIS-2012-0138.

139. Jara, A. J., Moreno-Sanchez, P., Skarmeta, A. F., Varakliotis, S., & Kirstein, P. (2013). IPv6 addressing proxy: Mapping native addressing from legacy technologies and devices to the internet of things (IPv6). Sensors (Switzerland), 13(5), 6687–6712. https://doi.org/10.3390/s130506687.

140. Javed, F., Afzal, M. K., Sharif, M., & Kim, B. S. (2018). Internet of Things (IoT) operating systems support, networking technologies, applications, and challenges: A comparative review. IEEE Communications Surveys and Tutorials, 20(3), 2062–2100. https://doi.org/10.1109/COMST.2018.2817685

141. Jenny, Kennedy, Y. S. (2022). The human decisions behind programming emotion-sensing and caregiving into digital assistants. In Paper Knowledge. Toward a Media History of Documents.
142. Jones, T. L., Baxter, M., & Khanduja, V. (2013). A quick guide to survey research. Annals of the Royal College of Surgeons of England, 95(1), 5–7. https://doi.org/10.1308/003588413X13511609956372.
143. Jamil, F., Ahmad, S., Iqbal, N., & Kim, D. H. (2020). Towards a remote monitoring of patient vital signs based on iot-based blockchain integrity management platforms in smart hospitals. Sensors (Switzerland), 20(8). https://doi.org/10.3390/s20082195.
144. Khar.Manju. (2020). Internet of Everything (IoE). In Manju Khar (Ed.), 1st ed., Vol. 1999, Issue December). CRC PRESS.
145. Kadhim, K. T., Alsahlany, A. M., Wadi, S. M., & Kadhum, H. T. (2020). An Overview of Patient's Health Status Monitoring System Based on Internet of Things (IoT). Wireless Personal Communications, 114(3), 2235–2262. https://doi.org/10.1007/s11277-020-07474-0.
146. Kahneman, D., Diener, E., & Schwarz, N. (1999). Well-being: The foundations of hedonic psychology. Health San Francisco. https://doi.org/10.7758/9781610443258.
147. Katal, A., Dahiya, S., & Choudhury, T. (2022). Energy efficiency in cloud computing data center: a survey on hardware technologies. In Cluster Computing (Vol. 25, Issue 1). Springer US. https://doi.org/10.1007/s10586-021-03431-z.
148. Khanna, A., & Kaur, S. (2019). Evolution of Internet of Things (IoT) and its significant impact in the field of Precision Agriculture. Computers and Electronics in Agriculture, 157(January), 218–231. https://doi.org/10.1016/j.compag.2018.12.039.
149. Kahneman, D., Krueger, A. B., Schkade, D., Schwarz, N., & Stone, A. (2004). Toward national well-being accounts. American Economic Review, 94(2), 429–434. https://doi.org/10.1257/0002828041301713.
150. Kim, Kyungmin.Jasmine, Q. (2020). Social media communication and Loneliness Among OlderAdults. Clinical Nutrition, 1–41.
151. Karunanayake, N., Gnanasekera, M., & Kodikara, N. D. (2016). Vehicle Theft Detection and Prevention Using GSM and GPS. International Journal of Innovative Research in Computer and Communication Engineering (An ISO Certified Organization), 3297(9), 9177–9184. https://doi.org/10.15680/IJIRCCE.2015
152. Kittichotsatsawat, Y., Jangkrajarng, V., & Tippayawong, K. Y. (2021). Enhancing coffee supply chain towards sustainable growth with big data and modern agricultural technologies. Sustainability (Switzerland), 13(8), 1–20. https://doi.org/10.3390/su13084593.
153. Kawamoto, R., Emori, T., Sakata, S., Yuasa, K., Furuhata, K., & Hara, S. (2007). Energy-efficient sensor control scheme for home networks based on DLNA-ZigBee gateway architecture. 2007 1st International Global Information Infrastructure Symposium, GIIS 2007 - "Closing the Digital Divide," (2007), 73–79. https://doi.org/10.1109/GIIS.2007.4404170.

154. Kirchner, T. R., & Shiffman, S. (2016). Spatio-temporal determinants of mental health and well-being: advances in geographically-explicit ecological momentary assessment (GEMA). Social Psychiatry and Psychiatric Epidemiology, 51(9), 1211–1223. https://doi.org/10.1007/s00127-016-1277-5.

155. Kim, J., & Park, E. (2020). Understanding social resistance to determine the future of Internet of Things (IoT) services. Behaviour and Information Technology. https://doi.org/10.1080/0144929X.2020.1827033.

156. Kranz, M., Roalter, L., & Michahelles, F. (2010). Things that twitter: Social networks and the Internet of Things. What Can the Internet of Things Do for the Citizen (CIoT) Workshop at The Eighth International Conference on Pervasive Computing (Pervasive 2010), (May 2014), 1–10.

157. Krishna, Y. B., & Nagendram, S. (2012). Zigbee Based Voice Control System for Smart Home. International Journal Computer Technology & Applications, 3(1), 163–168.

158. Kubiszewski, I., Costanza, R., Franco, C., Lawn, P., Talberth, J., Jackson, T., & Aylmer, C. (2013). Beyond GDP: Measuring and achieving global genuine progress. Ecological Economics, 93, 57–68. https://doi.org/10.1016/j.ecolecon.2013.04.019.

159. Kumar, N. (2018). IoT architecture and system design for healthcare systems. Proceedings of the 2017 International Conference On Smart Technology for Smart Nation, SmartTechCon 2017, 1118–1123. https://doi.org/10.1109/SmartTechCon.2017.8358543.

160. Kydd, A., & Fleming, A. (2017). Ageism in the Third Age. In Innovation in Aging (Vol. 1). https://doi.org/10.1093/geroni/igx004.044.

161. Lee, S., Ryu, J., & Heo, J. (2022). Leisure and Social Supports in Relation to Positive Affect Among OlderAdults. Journal of Applied Gerontology, 41(2), 551–559. https://doi.org/10.1177/0733464821990485

162. Lei, X., Bai, C., Hong, J., & Liu, H. (2022). Long-term care insurance and the well-being of older adultsand their families: Evidence from China. Social Science and Medicine, 296(August 2021), 114745. https://doi.org/10.1016/j.socscimed.2022.114745.

163. Li, Z., Shen, J., Abdalla, I., Yu, J., & Ding, B. (2017). Nanofibrous membrane constructed wearable triboelectric nanogenerator for high-performance biomechanical energy harvesting. Nano Energy, 36(April), 341–348. https://doi.org/10.1016/j.nanoen.2017.04.035.

164. Lim, C. G., Lee, T. S., Guan, C., Fung, D. S. S., Zhao, Y., Teng, S. S. W., … Krishnan, K. R. R. (2012). A Brain-Computer Interface Based Attention Training Program for Treating Attention Deficit Hyperactivity Disorder. PLoS ONE, 7(10). https://doi.org/10.1371/journal.pone.0046692.

165. Lin, X., & Kishore, R. (2021). Social media-enabled healthcare: A conceptual model of social media affordances, online social support, and health behaviors and outcomes. Technological Forecasting and Social Change, 166(December 2020), 120574. https://doi.org/10.1016/j.techfore.2021.120574.

166. Lin, D., & Cui, J. (2021). Transport and mobility need for an ageing society from a policy perspective: Review and implications. In International Journal of Environmental Research and Public Health (Vol. 18, Issue 22). https://doi.org/10.3390/ijerph182211802.

167. Liotta, C., Kervinio, Y., Levrel, H., & Tardieu, L. (2020). Planning for environmental justice - reducing well-being inequalities through urban greening. Environmental Science and Policy, 112(September

2019), 47–60. https://doi.org/10.1016/j.envsci.2020.03.017.

168. Litwin H. (2011). Physical activity, social network type and depressive symptoms in late life: An analysis of data from the National Social Life, Health and Aging Project. NIH, 23(1), 1–7. https://doi.org/10.1161/CIRCULATIONAHA.110.956839.

169. Lopez Research. (2013). An Introduction to the Internet of Things (IoT). Lopez Research Llc, Part 1. of(November), 1–6.

170. Levinger, P., Cerin, E., Milner, C., & Hill, K. D. (2022). Olderpeople and nature: the benefits of outdoors, parks and nature in light of COVID-19 and beyond– where to from here? International Journal of Environmental Health Research, 32(6), 1329–1336. https://doi.org/10.1080/09603123.2021.1879739.

171. Luprano, J., De Carvalho, P., Eilebrecht, B., Kortelainen, J., Muehlsteff, J., Sipila, A., … Ulbrich, M. (2013). HeartCycle: Advanced sensors for telehealth applications. Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS, 35(2013), 6984–6987. https://doi.org/10.1109/EMBC.2013.6611165

172. Lemus-Zúñiga, L. G., Félix, J. M., Fides-Valero, A., Benlloch-Dualde, J. V., & Martinez-Millana, A. (2022). A Proof-of-Concept IoT System for Remote Healthcare Based on Interoperability Standards. Sensors, 22(4), 1–17. https://doi.org/10.3390/s22041646.

173. Luprano, J., Sola, J., Dasen, S., Koller, J. M., & Chetelat, O. (2016). Combination of body sensor networks and on-body signal processing algorithms: The practical case of my heart project. Proceedings - BSN 2006: International Workshop on Wearable and Implantable Body Sensor Networks, 2016, 76–79. https://doi.org/10.1109/BSN.2006.15

174. M., A., & Ravi, R. V. (2020). A Detailed Investigation on Embedded Computing Systems for IoT Applications. 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), Advanced Computing and Communication Systems (ICACCS), 2020 6th International Conference On, pp. 161–164.

175. Majumder, S., Aghayi, E., Noferesti, M., Memarzadeh-Tehran, H., Mondal, T., Pang, Z., & Deen, M. J. (2017). Smart homes for elderly healthcare—Recent advances and research challenges. Sensors (Switzerland), 17(11). https://doi.org/10.3390/s17112496.

176. Malekshahi Rad, M., Rahmani, A. M., Sahafi, A., & Nasih Qader, N. (2020). Social Internet of Things: vision, challenges, and trends. Human-Centric Computing and Information Sciences, 10(1). https://doi.org/10.1186/s13673-020-00254-6.

177. Manavalan, E., & Jayakrishna, K. (2019). A review of Internet of Things (IoT) embedded sustainable supply chain for industry 4.0 requirements. Computers and Industrial Engineering, 127(November 2017), 925–953. https://doi.org/10.1016/j.cie.2018.11.030.

178. Maple, C. (2017). Security and privacy in the internet of things. Journal of Cyber Policy, 2(2), 155–184. https://doi.org/10.1080/23738871.2017.1366536.

179. Marinescu, D. C. (2019). Cloud Computing: Theory and Practice. Cloud Computing: Theory and Practice, 1–396. https://doi.org/10.1016/C2012-0-02212-0.

180. Maroun, W. (2020). A Conceptual Model for Understanding Corporate Social Responsibility Assurance Practice. Journal of Business Ethics, 161(1), 187–209. https://doi.org/10.1007/s10551-018-3909-z.

181. Maroco, João (2011). Análise Estatística com o SPSS Statistics. 5.ª Edição. Edições ReportNumber.

182. Martela, F., & Steger, M. F. (2016). The three meanings of meaning in life : Distinguishing coherence , purpose , and significance. The Journal of Positive Psychology, 11(5), 1743–9779. https://doi.org/10.1080/17439760.2015.1137623.

183. Maalla, H. A. (2021). Artificial Intelligence in Public Sector: A Review for Government Leaders about AI Integration into Government Administrations. International Journal of Academic Research in Economics and Management Sciences, 10(4). https://doi.org/10.6007/ijarems/v10-i4/11911.

184. McClelland, C., (2017). IoT Explained -how does an IoT system works. Retrieved from https://medium.com/iotforall/iot-explained-how-does-an-iot-system-actually-work-e90e2c435fe7.

185. Mégret, R., Gaëstel, Y., Dartigues, J.-F., Dovgalecs, V., Wannous, H., Karaman, S., … André-Obrecht, R. (2010). The IMMED project. University of Bordeaux, (2010), 1299. https://doi.org/10.1145/1873951.1874206.

186. Mendes, P. (2011). Social-driven Internet of Connected Objects. SITI, 1–3.

187. Meola, A. (2016). Why IoT, Big Data & Smart Farming Are the Future of Agriculture - Business Insider. Retrieved March 7, 2019, from Business Insider website: https://www.businessinsider.com/internet-of-things-smart-agriculture-2016-10?IR=T.

188. Mighali, V., Patrono, L., Stefanizzi, M. L., Rodrigues, J. J. P. C., & Solic, P. (2017). A smart remote elderly monitoring system based on IoT technologies. International Conference on Ubiquitous and Future Networks, ICUFN, 43–48. https://doi.org/10.1109/ICUFN.2017.7993745.

189. Miles, M., & Huberman, M. (1994). Qualitative Data Analysis. In CEUR Workshop Proceedings (Vol. 1304). Oaks: Sage Publication.

190. Miori, V., & Russo, D. (2017). Improving life quality for the elderly through the Social Internet of Things (SIoT). GIoTS 2017 - Global Internet of Things Summit, Proceedings, (iii). https://doi.org/10.1109/GIOTS.2017.8016215.

191. Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012). Internet of things: Vision, applications and research challenges. Ad Hoc Networks, 10(7), 1497–1516. https://doi.org/10.1016/j.adhoc.2012.02.016.

192. Motlagh, N. H., Mohammadrezaei, M., Hunt, J., & Zakeri, B. (2020). Internet of things (IoT).

193. Montana, P. (2020). Intentional Communication - ParentingMontana. Retrieved May 22, 2022, from https://parentingmontana.org/intentional-communication.

194. Müller, M., Müller, T., Ashtari Talkhestani, B., Marks, P., Jazdi, N., & Weyrich, M. (2021). Industrial autonomous systems: A survey on definitions, characteristics and abilities. At-Automatisierungstechnik, 69(1), 3–13. https://doi.org/10.1515/auto-2020-0131.

195. Muñiz, J. (2003). Teoria clássica de los tests. Madrid: Pirâmide.

196. Muñiz, J., Fidalgo, A.M., García-Cueto, E., Martinez, R.J. & Moreno, R. (2005). Análisis de los ítems. Madrid: La Muralla.

197. Mutanu, L., Gupta, K., & Gohil, J. (2022). Leveraging IoT solutions for enhanced health information exchange. Technology in Society, 68(January), 101882. https://doi.org/10.1016/j.techsoc.2022.101882.

198. Nance, R. E. (1994). The Conical Methodology and the evolution of simulation model development. Annals of Operations Research, 53(1), 1–45. https://doi.org/10.1007/BF02136825.

199. Narayanan, V. S., & Gayathri, S. (2013). Design of Wireless Home automation and security system using PIC Microcontroller. IJACAES, III(August), 135–140.

200. Naslund, J. A., Bondre, A., Torous, J., & Aschbrenner, K. A. (2020). Social Media and Mental Health: Benefits, Risks, and Opportunities for Research and Practice. Journal of Technology in Behavioral Science, 5(3), 245–257. https://doi.org/10.1007/s41347-020-00134-x
201. Na-songkhla, J. (2011). An Effect of Interactive Media in a Social Awareness Ubiquitous Learning Community. International Conference on Lifelong Learning 2011 (ICLLL2011): Transforming Nations through Enculturation of Lifelong Learning, 2011, 1–24. Retrieved from http://proxy.lib.utk.edu:90/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED536195&scope=site.
202. Nations, U. (2015). World Population Ageing 2015. United Nations New York: Department of Economic and Social Affairs Population Division.
203. Nesi, P., & Pantaleo, G. (2022). applied sciences IoT-Enabled Smart Cities : A Review of Concepts , Frameworks and Key Technologies. Applied Sceinces, 02, 21.
204. Nelson, L. A., Noonan, C. J., Goldberg, J., & Buchwald, D. S. (2013). Social Engagement and Physical and Cognitive Health Among American Indian Participants in the Health and Retirement Study. Journal of Cross-Cultural Gerontology, 28(4), 453–463. https://doi.org/10.1007/s10823-013-9213-6.
205. Nesi, P., & Pantaleo, G. (2022). applied sciences IoT-Enabled Smart Cities : A Review of Concepts , Frameworks and Key Technologies. Applied Sceinces, 02, 21.
206. Ni, S. (2020). Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19 . The COVID-19 resource centre is hosted on Elsevier Connect , the company ' s public news and information . (January).
207. Nieman, D. C., & Wentz, L. M. (2019). The compelling link between physical activity and the body's defense system. Journal of Sport and Health Science, 8(3), 201–217. https://doi.org/10.1016/j.jshs.2018.09.009.
208. Nunnaly, J.C. (1978). Psychometric theory. New York: McGraw-Hill.
209. Obaid, T., Rashed, H., El Nour, A. A., Rehan, M., Saleh, M. M., & Tarique, M. (2014). Zigbee Based Voice Controlled Wireless Smart Home System. International Journal of Wireless & Mobile Networks, 6(1), 47–59. https://doi.org/10.5121/ijwmn.2014.6104.
210. OECD. (2019). Education at a Glance 2019. Country Note, 1–7. https://doi.org/10.1787/f6dc8198-es
211. Ozioko, O., & Dahiya, R. (2022). Smart Tactile Gloves for Haptic Interaction, Communication, and Rehabilitation. Advanced Intelligent Systems, 4(2), 2100091. https://doi.org/10.1002/aisy.202100091.
212. ODPHP (Office of Disease Prevention and Health Promotion) (2016). Health-related quality of life and well-being. ODPHP, Rockville, MD. At http://www.healthypeople.gov/2020/topics-objectives/topic/health-related-quality-of- life-well-being (accessed 2020).
213. O'Connor, R. C., Wetherall, K., Cleare, S., McClelland, H., Melson, A. J., Niedzwiedz, C. L., O'Carroll, R. E., O'Connor, D. B., Platt, S., Scowcroft, E., Watson, B., Zortea, T., Ferguson, E., & Robb, K. A. (2021). Mental health and well-being during the COVID-19 pandemic: Longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. British Journal of Psychiatry, 218(6), 326–333. https://doi.org/10.1192/bjp.2020.212.

214. P., R., & D.J., C. (2009). Keeping the resident in the loop: Adapting the smart home to the user. IEEE Transactions on Systems, Man, and Cybernetics Part A: Systems and Humans, 39(5), 949–959. https://doi.org/10.1109/TSMCA.2009.2025137.
215. Paganelli, A. I., Velmovitsky, P. E., Miranda, P., Branco, A., Alencar, P., Cowan, D., … Morita, P. P. (2022). A conceptual IoT-based early-warning architecture for remote monitoring of COVID-19 patients in wards and at home. Internet of Things (Netherlands), 18, 100399. https://doi.org/10.1016/j.iot.2021.100399.
216. Panda, S., Mondal, S., & Kumar, N. (2022). SLAP: A Secure and Lightweight Authentication Protocol for machine-to-machine communication in industry 4.0. Computers and Electrical Engineering, 98(December 2021), 107669. https://doi.org/10.1016/j.compeleceng.2021.107669.
217. Palumbo, F., Ullberg, J., Štimec, A., Furfari, F., Karlsson, L., & Coradeschi, S. (2014). Sensor network infrastructure for a home care monitoring system. Sensors (Switzerland), 14(3), 3833–3860. https://doi.org/10.3390/s140303833.
218. Passos, J., Lopes, S. I., Clemente, F. M., Moreira, P. M., Rico-González, M., Bezerra, P., & Rodrigues, L. P. (2021). Wearables and internet of things (Iot) technologies for fitness assessment: A systematic review. Sensors, 21(16), 1–18. https://doi.org/10.3390/s21165418.
219. Pal, S., De, D., & Buyya, R. (2022). Artificial Intelligence-based Internet of Things Systems. In S. Pal, D. De, & R. Buyya (Eds.), Internet of Things (2022nd ed.). Springer Switzerland. http://dx.doi.org/10.1007/978-3-030-87059-1%0Ahttps://link.springer.com/content/pdf/10.1007/978-3-030-87059-1.pdf.
220. Palumbo, G. (2013). clevermind by Glenn Palumbo — Kickstarter. Retrieved February 28, 2021, from kickstarter website: https://www.kickstarter.com/projects/1957572863/clevermind
221. Pandey, P. V., Kushwaha, V., Rukhsar, A., & Shinde, S. (2017). A Survey of Internet of Things and its Applications. Ijarcce, 6(3), 456–458. https://doi.org/10.17148/ijarcce.2017.63105.
222. Patel, K. K., & Patel, S. M. (2016). Internet of Things-IoT: definition, characteristics, architecture, enabling technologies, application & future challenges. International Journal of Engineering Science and Computing, 6(5), 6122–6131. https://doi.org/10.4010/2016.1482.
223. Partridge, L., Deelen, J., & Slagboom, P. E. (2018). Facing up to the global challenges of ageing. Nature, 561(7721), 45–56. https://doi.org/10.1038/s41586-018-0457-8
224. Pauli, K. S., Liu, J., & Bengtsson, B. (2020). Sustainable strategy in housing renovation: Moving from a technology-and-engineering-focused model to a user-oriented model. Sustainability (Switzerland), 12(3), 1–16. https://doi.org/10.3390/su12030971.
225. Pawar, P., Parolia, N., Shinde, S., Edoh, T. O., & Singh, M. (2022). eHealthChain—a blockchain-based personal health information management system. Annales Des Telecommunications/Annals of Telecommunications, 77(1–2), 33–45. https://doi.org/10.1007/s12243-021-00868-6.
226. Pequeno, N. P. F., Pequeno, N. P. F., Cabral, N. L. de A., Marchioni, D. M., Lima, S. C. V. C., & Lyra, C. de O. (2020). Quality of life assessment instruments for adults: a systematic review of population-based studies. Health and Quality of Life Outcomes, 18(1), 1–13. https://doi.org/10.1186/s12955-020-01347-7.
227. Perera, C., Zaslavsky, A., Christen, P., & Georgakopoulos, D. (2014). Context-aware computing for the internet of things: A survey. IEEE Communications Surveys and Tutorials, 16(1), 414–454.

https://doi.org/10.1109/SURV.2013.042313.00197.
228. Philip, N. Y., Rodrigues, J. J. P. C., Wang, H., Fong, S. J., & Chen, J. (2021). Internet of Things for In-Home Health Monitoring Systems: Current Advances, Challenges and Future Directions. IEEE Journal on Selected Areas in Communications, 39(2), 300–310. https://doi.org/10.1109/JSAC.2020.3042421.
229. Picard, R. (2000). Affective Computing. In Вестник Казнму (01 ed., Vol. 2000). The MIT Press, Year: 2000.
230. Pickett, K. E., & Wilkinson, R. G. (2015). Income inequality and health: A causal review. Social Science and Medicine, 128, 316–326. https://doi.org/10.1016/j.socscimed.2014.12.031.
231. Pittman, S. J., Rodwell, L. D., Shellock, R. J., Williams, M., Attrill, M. J., Bedford, J., … Rees, S. E. (2019). Marine parks for coastal cities: A concept for enhanced community well-being, prosperity and sustainable city living. Marine Policy, 103(March), 160–171. https://doi.org/10.1016/j.marpol.2019.02.012.
232. Pochiraju, B., & Seshadri, S. (2019). Essentials of Business Analytics: An Introduction (Vol. 264). Retrieved from http://link.springer.com/10.1007/978-3-319-68837-4.
233. Provisórios, C. 2011 – R. (2011). Censos2011_ResultadosProvisorios (Vol. 2011). https://doi.org/10.13541/j.cnki.chinade.2011.07.013.
234. Pudāne, M., & Lavendelis, E. (2017). General Guidelines for Design of Affective Multi-Agent Systems. Applied Computer Systems, 22(1), 5–12. https://doi.org/10.1515/acss-2017-0012.
235. Puspitasari, I. M., Garnisa, I. T., Sinuraya, R. K., & Witriani, W. (2020). Perceptions, knowledge, and attitude toward mental health disorders and their treatment among students in an Indonesian University. Psychology Research and Behavior Management, 13, 845–854. https://doi.org/10.2147/PRBM.S274337.
236. Qian, C., Liu, X., Ripley, C., Qian, M., Liang, F., & Yu, W. (2022). Digital Twin—Cyber Replica of Physical Things: Architecture, Applications and Future Research Directions. Future Internet, 14(2), 1–25. https://doi.org/10.3390/fi14020064.
237. Quivy, R. &, & Campenhoudt, L. Van. (2005). Manual de investigação em ciências sociais. Gradiva, 289. https://doi.org/10.1145/2018602.2018605
238. Qiu, S., Wang, Z., & Zhao, H. (2017). Heterogeneous data fusion for three-dimensional gait analysis using wearable MARG sensors Huosheng Hu. UNSPECIFIED.
239. Qiu, T., Chen, N., Li, K., Atiquzzaman, M., & Zhao, W. (2018). How can heterogeneous internet of things build our future: A survey. IEEE Communications Surveys and Tutorials, 20(3), 2011–2027. https://doi.org/10.1109/COMST.2018.2803740
240. Rahman, H., & Hussain, M. I. (2020). A comprehensive survey on semantic interoperability for Internet of Things: State-of-the-art and research challenges. Transactions on Emerging Telecommunications Technologies, 31(12), 1–25. https://doi.org/10.1002/ett.3902.
241. Rahmani, A. M., Thanigaivelan, N. K., Gia, T. N., Granados, J., Negash, B., Liljeberg, P., & Tenhunen, H. (2015). Smart e-Health Gateway: Bringing intelligence to Internet-of-Things based ubiquitous healthcare systems. 2015 12th Annual IEEE Consumer Communications and Networking Conference, CCNC 2015, (June), 826–834. https://doi.org/10.1109/CCNC.2015.7158084.
242. Rana, A., Chakraborty, C., Sharma, S., Dhawan, S., Pani, S. K., & Ashraf, I. (2022). Internet of Medical Things-Based Secure and Energy-Efficient Framework for Health Care. Big Data, 10(1), 18–33. https://doi.org/10.1089/big.2021.0202
243. Rao, A. S., Radanovic, M., Liu, Y., Hu, S., Fang, Y., Khoshelham, K., … Ngo, T. (2022). Real-time monitoring of construction sites: Sensors, methods, and applications. Automation in Construction, 136(August 2021), 104099. https://doi.org/10.1016/j.autcon.2021.104099.
244. Rathnayaka, A. J. D., Potdar, V. M., & Kuruppu, S. J. (2011). Evaluation of wireless home automation technologies. IEEE International Conference on Digital Ecosystems and Technologies, (July 2011), 76–81. https://doi.org/10.1109/DEST.2011.5936601.
245. Rajan Jeyaraj, P., & Nadar, E. R. S. (2019). Smart-Monitor: Patient Monitoring System for IoT-Based Healthcare System Using Deep Learning. IETE Journal of Research, 02(68), 09. https://doi.org/10.1080/03772063.2019.1649215.
246. Ray, P. P. (2018). A survey on Internet of Things architectures. Journal of King Saud University - Computer and Information Sciences, Vol. 30, pp. 291–319. https://doi.org/10.1016/j.jksuci.2016.10.003

247. Reker, G. T., & Wong, P. T. P. (1984). Psychological and Physical Well-Being in the Elderly: The Perceived Well-Being Scale (PWB). Canadian Journal on Aging / La Revue Canadienne Du Vieillissement, 3(01), 23–32. https://doi.org/10.1017/S0714980800006437.
248. Richardson, N. (2016). Systems Approaches to Managing Change: A Practical Guide. In Philosophy of Management (Vol. 15). https://doi.org/10.1007/s40926-016-0039-5.
249. Riaz, M. T., Ahmed, E. M., Durrani, F., & Mond, M. A. (2017). Wireless android based home automation system. Advances in Science, Technology and Engineering Systems, 2(1), 234–239. https://doi.org/10.25046/aj020128.
250. Rodrigues, N. G., Han, C. Q. Y., Su, Y., Klainin-Yobas, P., & Wu, X. V. (2022). Psychological impacts and online interventions of social isolation amongst older adultsduring COVID-19 pandemic: A scoping review. Journal of Advanced Nursing, 78(3), 609–644. https://doi.org/10.1111/jan.15063.
251. Riggins, F. J., &, S. F. (2015). Research Directions on the Adoption , Usage and Impact of the Internet of Things through the Use of Big Data Analytics. https://doi.org/10.1109/HICSS.2015.186.
252. Robinson, S. (2015). A tutorial on conceptual modelling for simulation. Winter Simulation Conference, (December 2015). https://doi.org/10.1109/WSC.2015.7408298.
253. Rodríguez-Gómez, I., Mañas, A., Losa-Reyna, J., Rodríguez-Mañas, L., Chastin, S. F. M., Alegre, L. M., … Ara, I. (2018). Associations between sedentary time, physical activity and bone health among olderpeople using compositional data analysis. PLoS ONE, 13(10), 1–17. https://doi.org/10.1371/journal.pone.0206013
254. Rutherford, B. R., Brewster, K., Golub, J. S., Kim, A. H., & Roose, S. P. (2018). Sensation and psychiatry: Linking age-related hearing loss to late-life depression and cognitive decline. American Journal of Psychiatry, 175(3), 215–224. https://doi.org/10.1176/appi.ajp.2017.17040423.
255. Ryerson, N. C. (2022). Behavioral and Psychological Correlates of Well-Being during COVID-19. Psychological Reports, 125(1), 200–217. https://doi.org/10.1177/0033294120978160.
256. Ryff, C. D. (2018). Well-Being With Soul: Science in Pursuit of Human Potential. Perspectives on Psychological Science, 13(2), 242–248. https://doi.org/10.1177/1745691617699836
257. Ryff, C. D., Singer, B. H., & Love, G. D. (2004). Positive health: Connecting well-being with biology. Philosophical Transactions of the Royal Society B: Biological Sciences, 359(1449), 1383–1394. https://doi.org/10.1098/rstb.2004.1521
258. S. D., M., Prakash, S. P. S., & Krinkin, K. (2022). Service-Oriented R-ANN Knowledge Model for Social Internet of Things. Big Data and Cognitive Computing, 6(1), 32. https://doi.org/10.3390/bdcc6010032.
259. S. Leroux. (2013). Sébastien André Leroux Convergência entre dispositivos móveis e redes de sensores sem fios.
Singh, N., Raza, M., Paranthaman, V. V., Awais, M., Khalid, M., & Javed, E. (2021). Internet of Things and cloud computing. Digital Health: Exploring Use and Integration of Wearables, January, 151–162. https://doi.org/10.1016/B978-0-12-818914-6.00013-2.
261. Shukla, P. K., & Shukla, P. K. (2022). Patient Health Monitoring Using Feed Forward Neural Network With Cloud Based Internet of Things. Journal of Intelligent Systems and Internet of Things, 65–77. https://doi.org/10.54216/jisiot.000203.
262. Landaluce, H., Arjona, L., Perallos, A., Falcone, F., Angulo, I., & Muralter, F. (2020). A review of iot sensing applications and challenges using RFID and wireless sensor networks. Sensors (Switzerland), 20(9), 1–18. https://doi.org/10.3390/s20092495.

263. Saeed, N., Alouini, M., & Al-Naffouri, T. Y. (2020). Accurate 3-D Localization of Selected Smart Objects in Optical Internet of Underwater Things. IEEE Internet of Things Journal, Internet of Things Journal, IEEE, IEEE Internet Things J., Vol. 7, pp. 937–947.

264. Salih, K. O. M., Rashid, T. A., Radovanovic, D., & Bacanin, N. (2022). A comprehensive survey on the Internet of Things with the industrial marketplace. Sensors, 22(3), 730.

265. Sajedi, S. N., Maadani, M., & Nesari Moghadam, M. (2022). F-LEACH: a fuzzy-based data aggregation scheme for healthcare IoT systems. Journal of Supercomputing, 78(1), 1030–1047. https://doi.org/10.1007/s11227-021-03890-6.

266. Sixsmith, A., Horst, B. R., Simeonov, D., & Mihailidis, A. (2022). OlderPeople's Use of Digital Technology During the COVID-19 Pandemic. Bulletin of Science, Technology and Society, 42(1–2), 19–24. https://doi.org/10.1177/02704676221094731.

267. Samuel, L. J., Dennison Himmelfarb, C. R., Szklo, M., Seeman, T. E., Echeverria, S. E., & Diez Roux, A. V. (2015). Social engagement and chronic disease risk behaviors: The Multi-Ethnic Study of Atherosclerosis. Preventive Medicine, 71, 61–66. https://doi.org/10.1016/j.ypmed.2014.12.008.

268. Satija, U., Ramkumar, B., & Manikandan, S. M. (2017). Real-Time Signal Quality-Aware ECG Telemetry System for IoT-Based Health Care Monitoring. IEEE Internet of Things Journal, 4(3), 815–823. https://doi.org/10.1109/JIOT.2017.2670022.

269. Sebestyen, G., Hangan, A., Oniga, S., & Gal, Z. (2014). eHealth solutions in the context of the internet of things. Proceedings of 2014 IEEE International Conference on Automation, Quality and Testing, Robotics, AQTR 2014. https://doi.org/10.1109/AQTR.2014.6857876.

270. Sedghi, A. (2014). Facebook: 10 Years of social networking, in numbers. The Guardian. Retrieved from https://www.theguardian.com/news/datablog/2014/feb/04/facebook-in-numbers-statistics.

271. Seligman, M. E. P., & Csikszentmihalyi, M. (2014). Positive psychology: An introduction. In Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi. https://doi.org/10.1007/978-94-017-9088-8_18.

272. Shanafelt, T. D., & Noseworthy, J. H. (2017). Executive Leadership and Physician Well-being: Nine Organizational Strategies to Promote Engagement and Reduce Burnout. Mayo Clinic Proceedings, 92(1), 129–146. https://doi.org/10.1016/j.mayocp.2016.10.004.

273. Shehab, M., Abualigah, L., Shambour, Q., Abu-Hashem, M. A., Shambour, M. K. Y., Alsalibi, A. I., & Gandomi, A. H. (2022). Machine learning in medical applications: A review of state-of-the-art methods. Computers in Biology and Medicine, 145(November 2021), 105458. https://doi.org/10.1016/j.compbiomed.2022.105458.

274. Sheng, Q. Z., Qin, Y., Yao, L., Wales, S., & Boualem Benatallah, A. (2018). Managing the Web of Things. Retrieved from www.elsevier.com/permissions.

275. Shelby, Z. (2013). CoRE Resource Directory draft-shelby-core-resource-directory-04. University BREMEN TZI, 2013(c), 1–22.

276. Shimada, K., Yamazaki, S., Nakano, K., Ngoma, A. M., Takahashi, R., & Yasumura, S. (2014). Prevalence of social isolation in community-dwelling elderly by differences in household composition and related factors: From a social network perspective in urban Japan. Journal of Aging and Health, 26(5), 807–823. https://doi.org/10.1177/0898264314531616.

277. Singh, A., Kaur, A., Dhillon, A., Ahuja, S., & Vohra, H. (2022). Software system to predict the infection in COVID-19 patients using deep learning and web of things. Software - Practice and Experience, 52(4), 868–886. https://doi.org/10.1002/spe.3011.

278. Sinha, B. B., & Dhanalakshmi, R. (2022). Recent advancements and challenges of the Internet of Things in smart agriculture: A survey. Future Generation Computer Systems, 126, 169–184. https://doi.org/10.1016/j.future.2021.08.006

279. Sioslife. (2018). Tablet Senior Inclusive - SENINC. Retrieved February 28, 2021, from Sioslife website: https://sioslife.com/seninc/?gclid=CjwKCAiAiMLBRAAEiwAuWVggjlAUhu7zcLjxl2GWvHm2y9TDUwcCLhKqFfj1XgNjyAJkOiwcnx7dhoCqR8QAvD_BwE.

280. Sleye, H. (1975). Stress without Distress. In Journal of Chemical Information and Modeling (Vol. 53). https://doi.org/10.1017/CBO9781107415324.004.
281. Smarter, L. (2020). What is AAL? - SMARTER LIVES. Retrieved June 22, 2020, from Smarter Lives website: https://www.smarter-lives.eu/en/what-is-aal/
282. Smith, L. M., Case, J. L., Smith, H. M., Harwell, L. C., & Summers, J. K. (2013). Relating ecoystem services to domains of human well-being: Foundation for a U.S. index. Ecological Indicators, 28, 79–90. https://doi.org/10.1016/j.ecolind.2012.02.032.
283. Soga, M., Cox, D. T. C., Yamaura, Y., Gaston, K. J., Kurisu, K., & Hanaki, K. (2017). Health benefits of urban allotment gardening: Improved physical and psychological well-being and social integration. International Journal of Environmental Research and Public Health. https://doi.org/10.3390/ijerph14010071.
284. Song, A., & Si, G. (2017). Remote monitoring system based on Zigbee wireless sensor network. Proceedings of the 29th Chinese Control and Decision Conference, CCDC 2017, 2618–2621. https://doi.org/10.1109/CCDC.2017.7978956.
285. Stolojescu-Crisan, C., Crisan, C., & Butunoi, B. P. (2021). An iot-based smart home automation system. Sensors, 21(11). https://doi.org/10.3390/s21113784.
286. Souri, A., Hussien, A., Hoseyninezhad, M., & Norouzi, M. (2022). A systematic review of IoT communication strategies for an efficient smart environment. Transactions on Emerging Telecommunications Technologies, 33(3), 1–19. https://doi.org/10.1002/ett.3736.
287. Souri, A., Hussien, A., Hoseyninezhad, M., & Norouzi, M. (2022). A systematic review of IoT communication strategies for an efficient smart environment. Transactions on Emerging Telecommunications Technologies, 33(3), 1–19. https://doi.org/10.1002/ett.3736.
288. Steptoe, A., Deaton, A., & Stone, A. A. (2015). Psychological wellbeing, health and ageing. Lancet, 385(9968), 640–648. https://doi.org/10.1016/S0140-6736(13)61489-0.Psychological.
289. Statista. (2018). Elderly UK population projection, by age 2020-2050 | Statista. STATISTA. https://www.statista.com/statistics/749078/elderly-population-of-the-uk-by-age-2017-2032/
290. Strengers, Y., Dahlgren, K., Pink, S., Sadowski, J., & Nicholls, L. (2022). Digital technology and energy imaginaries of future home life: Comic-strip scenarios as a method to disrupt energy industry futures. Energy Research and Social Science, 84(November 2021), 102366. https://doi.org/10.1016/j.erss.2021.102366.
291. Strutt, P. A., Johnco, C. J., Chen, J., Muir, C., Maurice, O., Dawes, P., … Wuthrich, V. M. (2022). Stress and Coping in OlderAustralians During COVID-19: Health, Service Utilization, Grandparenting, and Technology Use. Clinical Gerontologist, Vol. 45, pp. 106–119. https://doi.org/10.1080/07317115.2021.1884158
292. Storrs, C. (2016, April 21). People who are and lonely are at a greater risk of the heart disease. Retrievedfrom:https://edition.cnn.com/2016/04/20/health/can-loneliness-lead-to-heart-disease/index.html.
293. Sudan Jha. (2022). Industrial Internet of Things: Technologies, Design, and Applications (Artificial Intelligence (AI): Elementary to Advanced Practices).
294. Szabo, S., Tache, Y., & Somogyi, A. (2012). The legacy of Hans Selye and the origins of stress research: A retrospective 75 years after his landmark brief “letter” to the Editor# of Nature. Stress, 15(5), 472–478. https://doi.org/10.3109/10253890.2012.710919.
295. Taylor, H. (2012). Social media for social change. Using the internet to tackle intolerance. Institute for strategic dialogue, Retrieved from://http://tsforum.event123.no/UD/rehc.2013/pop.cfm.
296. Thacker, B. H., Doebling, S. W., Hemez, F. M., Anderson, M. C., Pepin, J. E., & Rodriguez, E. a. (2018). Concepts of Model Verification and Validation.
297. TIM BERNERS-LEE, J. H. and O. L. (2001). The semantic web: a brain for humankind. IEEE Intelligent Systems, 16(2), 24–25. https://doi.org/10.1109/MIS.2001.920595.
298. Tamrakar, A. K., Shukla, A., Kalifullah, A. H., Reegu, F. A., & Shukla, K. (2022). extended review on internet of things (IoT) and its characterisation. International Journal of Health Sciences, May, 8490–8500. https://doi.org/10.53730/ijhs.v6ns2.7177.
299. Tian D, M. J. (2019). Exercise for Prevention and Relief of Cardiovascular Disease: Prognoses, Mechanisms, and Approaches. HINDAWI, 2019(2019+), 11. https://doi.org/10.1155/2019/3756750.

300. Tjörnbo, O., & McGowan, K. (2022). A complex-systems perspective on the role of universities in social innovation. *Technological Forecasting and Social Change*, *174*(February 2020). https://doi.org/10.1016/j.techfore.2021.121247.
301. Tanwar, R., Nandal, N., Zamani, M., & Manaf, A. A. (2022). Pathway of Trends and Technologies in Fall Detection: A Systematic Review. Healthcare (Switzerland), 10(1), 1–27. https://doi.org/10.3390/healthcare10010172.
302. Tran-Dang, H., Krommenacker, N., Charpentier, P., & Kim, D. S. (2022). The Internet of Things for Logistics: Perspectives, Application Review, and Challenges. IETE Technical Review (Institution of Electronics and Telecommunication Engineers, India), 39(1), 93–121. https://doi.org/10.1080/02564602.2020.1827308.

Thomsen, B. D. (2012). BODY PERCEPTION IMPORTANCE FOR WELLBEING. Internationa Conference on Engineering and Product Design Education, September,(September), 6.

303. Tolentino, R. S., Kim, Y.-T., Park, B., & Park, G.-C. (2011). A Design and Analysis Ubiquitous Healthcare Monitoring System over Wireless Sensor Network. International Journal of Multimedia and Ubiquitous Engineering, 6(2), 55–69. Retrieved from http://www.sersc.org/journals/IJMUE/vol6_no2_2011/6.pdf.
304. Tomar, A. (2011). Introduction to Zibgbee Technology. Element 14 the Knowde, 1(July), 1–24.
305. Trindade, A. A., Shirvani, A., & Ma, X. (2020). A Socioeconomic Well-Being Index. Applied Economics and Finance, 7(4), 19. https://doi.org/10.11114/aef.v7i4.4855.
306. Trudel, M. C., Marsan, J., Paré, G., Raymond, L., Ortiz De Guinea, A., Maillet, É., & Micheneau, T. (2017). Ceiling effect in EMR system assimilation: A multiple case study in primary care family practices. BMC Medical Informatics and Decision Making, 17(1), 1–14. https://doi.org/10.1186/s12911-017-0445-1
307. Tsai, C., Lai, C., Chiang, M., & Yang, L. T. (2014). Data Mining for Internet of Things : A Survey. IEEE Communications Surveys and Tutorials, 16(1), 77–97.
308. Tsao, Y.-C., Cheng, F.-J., Li, Y.-H., & Liao, L.-D. (2022). An IoT-Based Smart System with an MQTT Broker for Individual Patient Vital Sign Monitoring in Potential Emergency or Prehospital Applications. Emergency Medicine International, 2022, 1–13. https://doi.org/10.1155/2022/7245650
309. Tsimane, T. A., & Downing, C. (2020). Transformative learning in nursing education: A concept analysis. International Journal of Nursing Sciences, 7(1), 91–98. https://doi.org/10.1016/j.ijnss.2019.12.006.
310. United Nations, P. D. D. of E. and S. A. (2017). World Aging Population 2017. In United Nations New York. https://doi.org/10.1049/el:20000788
311. Van Alphen, A., Halfens, R., Hasman, A., & Imbos, T. (1994). Likert or Rasch? Nothing is more applicable than good theory. Journal of Advanced Nursing, 20(1), 196–201. https://doi.org/10.1046/j.1365-2648.1994.20010196.x.
312. Vasilakos, A. V., Li, Z., Simon, G., & You, W. (2015). Information centric network: Research challenges and opportunities. Journal of Network and Computer Applications, 52(2015), 1–10. https://doi.org/10.1016/j.jnca.2015.02.001

313. Van Gaans, D., & Dent, E. (2018). Issues of accessibility to health services by olderAustralians: A review. Public Health Reviews, 39(1), 1–16. https://doi.org/10.1186/s40985-018-0097-4.

314. VanderWeele, T. J. (2019). Measures of Community Well-Being: a Template. International Journal of Community Well-Being, 2(3–4), 253–275. https://doi.org/10.1007/s42413-019-00036-8.

315. Vanoli, A. (2017). On the Report by the Commission on the Measurement of Economic Performance and Social Progress (2009). SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1714428.

316. Vaportzis, E., Clausen, M. G., & Gow, A. J. (2017). Older adultsperceptions of technology and barriers to interacting with tablet computers: A focus group study. Frontiers in Psychology, 8(OCT), 1–11. https://doi.org/10.3389/fpsyg.2017.01687.

317. Vazi, M. L. M., Ruiter, R. A. C., van den Borne, B., Martin, G., Dumont, K., & Reddy, P. S. (2013). The relationship between wellbeing indicators and teacher psychological stress in Eastern Cape public schools in South Africa. SA Journal of Industrial Psychology, 39(1), 1–10. https://doi.org/10.4102/sajip.v39i1.1042

318. Verma, P. K., Verma, R., Prakash, A., Agrawal, A., Naik, K., Tripathi, R., … Abogharaf, A. (2016). Machine-to-Machine (M2M) communications: A survey. Journal of Network and Computer Applications, 66, 83–105. https://doi.org/10.1016/j.jnca.2016.02.016.

319. Wach, D., Stephan, U., Weinberger, E., & Wegge, J. (2020). Entrepreneurs ' stressors and well-being : A recovery perspective and diary study. Journal of Business Venturing, 25(February), 106016. https://doi.org/10.1016/j.jbusvent.2020.106016.

320. Wagner, N., Hassanein, K., & Head, M. (2010). Computer use by olderadults: A multi-disciplinary review. Computers in Human Behavior, 26(5), 870–882. https://doi.org/10.1016/j.chb.2010.03.029.

321. Wang, Z. (2022). An Intelligent Collection System of Big Data in Medical and Health. HINDAWI, 2022(2022), 10.

322. Whiteley, P. F. (2015). Social Capital. In International Encyclopedia of the Social & Behavioral Sciences: Second Edition. https://doi.org/10.1016/B978-0-08-097086-8.93127-1

323. WHO. (1998). WHO-Five Well-Being Index (English version). Who, 0–1. Retrieved from https://www.psykiatri-regionh.dk/who-5/Documents/WHO5_English.pdf.

324. Whaiduzzaman, M., Haque, M. N., Rejaul Karim Chowdhury, M., & Gani, A. (2014). A study on strategic provisioning of cloud computing services. Scientific World Journal, 2014(894362), 16. https://doi.org/10.1155/2014/894362.

325. Whaiduzzaman, M., Haque, M. N., Rejaul Karim Chowdhury, M., & Gani, A. (2014). A study on strategic provisioning of cloud computing services. Scientific World Journal, 2014(894362), 16. https://doi.org/10.1155/2014/894362.

326. WifiVeina. (2020). WIFI Vienna. Retrieved June 22, 2020, from Wifi.org website: https://www.wifi.org.

327. Wilkinson, C., & Cornish, K. (2018). An overview of participatory design applied to physical and digital product interaction for olderpeople. Multimodal Technologies and Interaction, 2(4). https://doi.org/10.3390/mti2040079.

328. Wójcicki, K., M., Paliwoda, B., & Górna, J. (2022). Internet of Things in Industry: Research Profiling, Application, Challenges and Opportunities—A Review. Energies, 15(5). https://doi.org/10.3390/en15051806.

329. Winters-Stone, K. M., Dobek, J., Nail, L. M., Bennett, J. A., Leo, M. C., Torgrimson-Ojerio, B., … Schwartz, A. (2013). Impact + resistance training improves bone health and body composition in prematurely menopausal breast cancer survivors: A randomized controlled trial. Osteoporosis International, 24(5), 1637–1646. https://doi.org/10.1007/s00198-012-2143-2.

330. Wirth, W., Hofer, M., & Schramm, H. (2012). Beyond Pleasure: Exploring the Eudaimonic Entertainment Experience. Human Communication Research, 38(4), 406–428. https://doi.org/10.1111/j.1468-2958.2012.01434.x

331. Wolf, M. (2014). Here's Why Elder Care May Be the Next Billion-Dollar Technology.

332. Wang, S., Bolling, K., Mao, W., Reichstadt, J., Jeste, D., Kim, H. C., & Nebeker, C. (2019). Technology to support aging in place: olderadults' perspectives. Healthcare (Switzerland), 7(2), 1–18. https://doi.org/10.3390/healthcare7020060.

333. World Health Organization. (2019). What is Healthy Ageing?

334. Wójcicki, K., Biegańska, M., Paliwoda, B., & Górna, J. (2022). Internet of Things in Industry: Research

Profiling, Application, Challenges and Opportunities—A Review. Energies, 15(5). https://doi.org/10.3390/en15051806.

335. Wu, J., & Qin, H. (2008). The design of wireless intelligent home system based on ZigBee. International Conference on Communication Technology Proceedings, ICCT, 11th (60671024), 73–76. https://doi.org/10.1109/ICCT.2008.4716119.

336. Westwood, S., Hafford-Letchfield, T., & Toze, M. (2021). Physical and mental well-being, risk and protective factors among olderlesbians /gay women in the United Kingdom during the initial COVID-19 2020 lockdown. Journal of Women and Aging, 00(00), 1–22. https://doi.org/10.1080/08952841.2021.1965456.

337. Yaqoob, Ibrar, E. al. (2017). I nternet of T hings. 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), (December 2019), 3507–3508.

338. Yang, D.-L., Liu, F., & Liang, Y.-D. (2010). A Survey of the Internet of Things. Proceedings of the 1st International Conference on E-Business Intelligence (ICEBI2010), 54(15), 358–366. https://doi.org/10.1016/j.comnet.2010.05.010.

339. Ye, X., & Huang, J. (2011). A framework for cloud-based smart home. Proceedings of 2011 International Conference on Computer Science and Network Technology, ICCSNT 2011, 2, 894–897. https://doi.org/10.1109/ICCSNT.2011.6182105.

340. Yuan, B., Liu, L., & Antonopoulos, N. (2018). Efficient service discovery in decentralized online social networks. Future Generation Computer Systems, 86(2018), 775–791. https://doi.org/10.1016/j.future.2017.04.022.

341. Zammit, A., & Kenna, T. (2016). Enhancing places through technology. In ICiTy: Enhancing places through technology. Retrieved from http://cyberparksproject.eu/sites/default/files/publications/cyberparks_enhancingplacestechnology.pdf.

342. Zachariah, T., Klugman, N., Campbell, B., Adkins, J., Jackson, N., & Dutta, P. (2015). The Internet of Things Has a Gateway Problem. 27–32. https://doi.org/10.1145/2699343.2699344.

343. Zhang, Z. (2019). Outdoor group activity, depression, and subjective well-being among retirees of China: The mediating role of meaning in life. Journal of Health Psychology, 24(9), 1245–1256. https://doi.org/10.1177/1359105317695428.

344. Zhang, C., Zhang, M., Su, Y., & Wang, W. (2012). Smart home design based on ZigBee wireless sensor network. 2012 7th International ICST Conference on Communications and Networking in China, CHINACOM 2012 - Proceedings, 463–466. https://doi.org/10.1109/ChinaCom.2012.6417527.

345. Zhu, W. (2020). Should, and how can, exercise be done during a coronavirus outbreak? An interview with Dr. Jeffrey A. Woods. Journal of Sport and Health Science, 9(2), 105–107. https://doi.org/10.1016/j.jshs.2020.01.005.

346. Zigbee Alliance. (2020). Zigbee . Retrieved June 22, 2020, from Zigbee Alliance website: https://zigbeealliance.org/solution/zigbee.

347. Zyrianoff, I., Gigli, L., Montori, F., Aguzzi, C., Kaebisch, S., & Di Felice, M. (2022). Seamless Integration of RESTful Web Services with the Web of Things. 2022 IEEE International Conference on Pervasive

Computing and Communications Workshops and Other Affiliated Events, PerCom Workshops 2022, 427–432. https://doi.org/10.1109/PerComWorkshops53856.2022.9767531.

348. Zikria, Y. Bin, Yu, H., Afzal, M. K., Rehmani, M. H., & Hahm, O. (2018). Internet of Things (IoT): Operating System, Applications and Protocols Design, and Validation Techniques. Future Generation Computer Systems, *88*, 699–706. https://doi.org/10.1016/j.future.2018.07.058.

349. Zhang.L. (2022). Information Centric Networks (ICN): Architecture & Current Trends. Conference: 2021 15th International Conference on Telecommunication Systems.

350. Xu, X., Zhou, L., Asante-Antwi, H., Boafo-Arthur, A., & Mustafa, T. (2020). Reconstructing family doctors' psychological well-being and motivation for effective performance in China: The intervening role of psychological capital. BMC Family Practice, 21(1), 1–11. https://doi.org/10.1186/s12875-020-01182-1.

ANNEX

Annex 1. list of Portuguese Senior Universities

- **Total Portuguese Mainland senior`s Universities 398**
- **Total Portuguese Mainland total 18 districts**
- **Total Portuguese Island`s senior`s Universities 13**
- **Total Portuguese Island`s total 2**

Sr#	Nome da universidade seniores	Distrito	Contato
01	Universidade Sénior de Portimão	**Faro**	282418637 icportimao@outlook.com www.usp.org.pt
02	Universidade Sénior de Loulé		930 549 989 amigosusl@gmail.com www.usl.org.pt
03	Universidade Sénior de Lagos		282 040 352 https://centro-de-estudos-de-lagos.negocio.site/.
04	Universidade Sénior da Freguesia de Olhão		+351289 705 351 geral@jf-olhao.pt https://jf-olhao.pt/universidade-senior/.
05	Academia Sénior de Monchique		+351 212 221 408 / 925 913 112 redemunicipiossaudaveis@gmail.com. http://redemunicipiossaudaveis.com/index.php/pt/projetos/monchique/academia_senior_monchique.
06	Universidade do Algarve para a Terceira Idade (Faro)		925 980 106 uati-faro-dir@sapo.pt https://www.facebook.com/Universidade-do-Algarve-para-a-Terceira-Idade-670109573374061/.

07	Academia Sénior de Aprendizagem e Solidariedade - Tavira		281 321 692 academia.senior.tavira@gmail.com https://academiaseniortavira.weebly.com/orgatildeos-da-academia.html.
08	Universidade Sénior de São Brás de Alportel		289 840 000 geral@cm-sbras.pt / municipe@cm-sbras.pt https://www.cm-sbras.pt/pt/menu/331/universidade-senior.aspx
09	Universidade Sénior de Moncarapacho		289798521 us.moncarapacho@gmail.com https://www.facebook.com/universidade.senior.moncarapacho/.
10	Universidade Sénior de Moura	**Beja**	+351 285 200 060 comoiprel@comoiprel.pt https://www.comoiprel.pt/universidade-senior-de-moura/.
11	Universidade Sénior de Odemira		283320440 geral@usodemira.pt https://www.facebook.com/senioresdeodemira/.
12	Universidade Sénior de Aljustrel		284 600 070 geral@mun-aljustrel.pt. https://www.mun-aljustrel.pt/menu/541/universidade-senior-do-concelho-de-aljustrel.
13	Universidade Sénior de Almodôvar		https://cm-almodovar.pt/286%20660%20600/municipio/ assembleia.municipal@cm-almodovar.pt.
14	universidade da Associação Sénior Castrense		966 000 368 assoc.seniorcastrense@gmail.com.

			https://www.facebook.com/Associa%C3%A7%C3%A3o-S%C3%A9nior-Castrense-908141732557128/?ref=page_internal.
15	Universidade Sénior do Concelho de Ourique		213 931 300 geral@jf-campodeourique.pt. https://www.jf-campodeourique.pt/activities/1/universidade-senior.
16	Univeridade Sénior de Beja		284314300 (ext 03038 https://www.facebook.com/universidadeseniorbeja/?ref=page_internal.
17	Academia Senior de Serpa		284540130 academiasenior@cm-serpa.pt. https://www.cm-serpa.pt/pt/menu/326/academia-senior-de-serpa.aspx.
18	Universidade Sénior de Mértola		286 612 633 geral.mertola@alsud.pt https://alsud.pt/universidade-senior-mertola-projeto/.
19	Universidade Sénior do Alvito		284 480 800 geral@cm-alvito.pt. https://www.cm-alvito.pt/pt/menu/377/universidade-senior.aspx.
20	Universidade Sénior da Vidigueira		284437400 geral@cm-vidigueira.pt https://www.cm-vidigueira.pt/?fbclid=IwAR1GWeyQsOCCvRuNHvZkQeOvEoSbQry9DW1Rmw-_amkfulcyJLsjFtsxBoU.
21	Universidade Sénior de Almada		219012420/21 963871005 http://usalma.apcalmada.org/.

22	Universidade da Terceira Idade do Barreiro	**Setubal**	212068653 /212068192 212 068 000 geral@cm-barreiro.pt. https://www.cm-barreiro.pt/viver/intervencao-social/utib-universidade-da-terceira-idade-do-barreiro.
23	Universidade Sénior de Grândola		269 448 031 geral@cm-grandola.pt. https://www.cm-grandola.pt/viver/desenvolvimento-social/envelhecimento-ativo/universidade-senior-de-grandola.
24	Projecto Sénior de Artes e Saberes de Sines (PROSAS)		269085570 associacaoprosas@gmail.com. http://www.prosas.org.pt/contact.html.
25	Universidade Sénior ABC - Laranjeiro		216087188 geral@asdl.pt. http://www.m-almada.pt/redeeducativa/OfertaEducativa/Visualizar/157.
26	Universidade Sénior Dom Sancho I de Almada.		932 636 564 tkm.universidade.dom.sancho@gmail.com. https://www.facebook.com/TKM-Universidade-S%C3%A9nior-Dom-Sancho-I-de-Almada-597533060285025/?ref=page_internal.
27	Universidade Sénior do Torrão		265699245. https://www.facebook.com/UniversidadeSeniorTorrao/. http://www.torrao.freguesias.pt:444/.
28	Universidade Sénior de Rotary de Sesimbra.		212 288 500 site@cm-sesimbra.pt

			https://www.sesimbra.pt/agenda-online/evento/universidade-senior-de-rotary-de-sesimbra-26.
29	Universidade Sénior Intergeracional de Palmela		+351 914 721 671 https://www.facebook.com/UnivSeniorPalmela/.
30	Universidade Sénior de Setúbal.		265540230 secretaria.uniseti@gmail.com. https://www.facebook.com/Uniseti-Universidade-S%C3%A9nior-de-Set%C3%BAbal-683733178334801/?ref=page_internal.
31	Academia Senior de Artes e Saberes do Litoral Alentejano Santo André		269 185 385 sas.sandre@gmail.com https://asassandre.wixsite.com/asasvirtual/contatos.
32	Universidade Sénior do Seixal		212221315 unisseixal@gmail.com. http://www.unisseixal.org/.
33	Universidade Sénior de Alcácer do Sal		265 610 059 geral@m-alcacerdosal.pt http://www.cm-alcacerdosal.pt/pt/municipio/viver-em-alcacer/contactos-uteis/?category=8.
34	Universidade Sénior do Montijo.		21 232 7887. geral@mun-montijo.pt https://www.mun-montijo.pt/.
35	Universidade Sénior da Quinta do Conde		916 627 574 https://www.facebook.com/Universidade-S%C3%A9nior-da-Quinta-do-Conde-722677527765650/.
36	UNISEM- Universidade Sénior da Moita		210891005 cmmoita@mail.cm-moita.pt

			https://www.cm-moita.pt/viver/acao-social/universidade-senior-da-moita.
37	Universidade Sénior São Francisco de Assis		unisfa4@gmail.com https://www.facebook.com/unisfa.s.francisco/?ref=page_internal.
38	Universidade Intergeracional do Concelho de Almada		968036691 geral@jf-charnecacaparica-sobreda.pt. https://www.jf-charnecacaparica-sobreda.pt/.
39	Universidade Sénior de Évora	**Évora**	266 733 085 u.senior.evora@gmail.com https://universidade-senior-de-evora6.webnode.pt/.
40	Universidade Sénior do Grupo de Amigos de Montemor-o-Novo		266 890 235 g.amigos.montemor@gmail.com https://www.e-cultura.pt/promotor/82.
41	Academia Sénior de Vendas Novas		265809392 geral@cm-vendasnovas.pt https://www.cm-vendasnovas.pt/municipe/areas-de-acao/accao-social/academia-senior-de-vendas-novas/.
42	Universidade Sénior de Borba		961 624 764 geral@scmborba.pt. http://www.scmborba.pt/?page=home.
43	Universidade Sénior de Vila Viçosa		268889310 geral@cm-vilavicosa.pt https://www.cm-vilavicosa.pt/municipe/areas-de-acao/seniores/universidade-senior/.

44	Universidade Sénior de Mora		266403368 266 439 070 geral@cm-mora.pt. https://www.cm-mora.pt/municipe/areas-de-acao/universidade-senior-de-mora/.
45	Universidade Sénior de Portalegre	**Portalegre**	966 571 321 silcorreiacandeias@gmail.com. https://www.facebook.com/universidadeseniorportalegre/?ref=page_internal.
46	Universidade Politécnica de Elvas		+351 245 301 500 | F +351 245 330 353 geral@ipportalegre.pt. https://www.ipportalegre.pt/pt/ensino/escolas/esae/.
47	Universidade Sénior do Crato		965 342 983 universidadeseniorcrato@sapo.pt. http://universidadeseniorcrato.blogspot.pt/.
48	USCAC- Universidade Sénior do Concelho de Alter do Chão.		245610000 altermais@gmail.com. https://altermais.wixsite.com/alter-mais.
49	Universidade Sénior de Gavião		241639070 usg@cm-gaviao.pt http://www.cm-gaviao.pt/en/?fbclid=IwAR1vpwZ6GAEow0K8TEGViYNToTKlZKHm-FkwJyhfSoiZWegRMHwEGzi69k4.
50	Universidade Sénior de Ponte de Sor,		242206510 associacao@caminhar.org http://www.caminhar.org/useps/
51	Universidade Sénior de Monforte		245578060 – 24557806 usm@cm-monforte.pt.

			http://www.cm-monforte.pt/index.php/en/?fbclid=IwAR2sJbE1aiuIIbdqX8htm6jd0l9iNGsz50m39KhV5c-dV-30Jx4trm8aybg.
52	Universidade Sénior de Nisa		245410000 geral@cm-nisa.pt. https://www.cm-nisa.pt/index.php/contatos.
53	Universidade Sénior de Almeirim	**Santarém**	243 596 366 usal.asa@hotmail.com http://usal.almeirim.org/index.php/informacoes/contactos.html.
54	Universidade da Terceira Idade de Abrantes		241404891 utiabrantes12@gmail.com. https://www.facebook.com/Universidade-Da-Terceira-Idade-De-Abrantes-1652581821424399/.
55	Universidade da Terceira Idade do Tramagal		241890245 utit.tramagal@gmail.com https://www.facebook.com/artram.utit/.
56	Academia Sénior da Golegã		249977686 fernanda.oliveira@misericordiagolega.pt geral@misericordiagolega.pt https://misericordiagolega.pt/.
57	Universidade Sénior de Salvaterra de Magos		263509535 www.cm-salvaterrademagos.pt. edc.marinhais@ama.pt. geral@cm-salvaterrademagos.pt
58	Universidade Sénior de Tomar		249346241

			educacao@cm-tomar.pt ca.ustomar@gmail.com. http://www.cm-tomar.pt/. https://www.facebook.com/useniortomar/.
59	Universidade Sénior de Ourém		249543371 249366800 universidadesenior.ourem@gmail.com. https://usourem.blogspot.com/p/contactos.html.
60	Universidade de 3ª Idade de Ferreira do Zêzere.		249366800. regiaodozezere@gmail.com. https://regiaodozezere.pt/category/associacoes/universidade-da-terceira-idade-de-ferreira-do-zezere/.
61	Academia Sénior do Concelho de Alcanena.		249 881 667. a.cipra@hotmail.com. https://arpicaalcanena.blogspot.com/p/contactos.html.
62	Universidade Sénior de Cartaxo.		915 668 765 universidadesctx@gmail.com https://www.cm-cartaxo.pt/Info/Agenda/Paginas/2016-univ-senior.aspx.
63	Universidade Sénior de Mação		241577200 / 24157154~ geral@mansinho.pt http://www.cm-macao.pt/.
64	Universidade Sénior do Centro de Estudos de Fátima		249 539 510 cef@cef.pt. http://cef.pt/index.php.

65	Universidade Sénior de Sardoal		241 850000 universidadesenior@cm-sardoal.pt. https://www.facebook.com/universidadeseniordesardoal/.
66	Academia Sénior da Parreira e Chouto		249771051 / 24977133 geral@ufpc.pt. https://www.ufpc.pt/autarquia/noticias/65-academia_senior_de_parreira_e_chouto_ano_letivo_20192020.
67	Universidade Sénior de Ulme e Semideiro		249 770 284 gabsocial@freguesiadeulme.pt. https://www.facebook.com/USUlmeSemideiro/.
68	Universidade da Terceira Idade de Santarém		243 328 220 utisantarem@sapo.pt https://utisantarem20.wixsite.com/utis/contacto.
69	Universidade Sénior Francisco Canais Rocha - ARPE- Torres Novas		249 813 580 / 927 986 970 arpetn@gmail.com https://arpe-tn.pt/contacto/.
70	Universidade Sénior do Entroncamento		249241329 univ.senior.entroncamento@gmail.com http://encoprof.pt/.
71	Universidade Sénior de Constância		249739304. cigananegra@hotmail.com https://universidade-senior-constancia.webnode.pt/.
72	Universidade Sénior de Rio Maior		243999317 univ-senior@cm-riomaior.pt, https://universidadeseniorderiomaior.blogspot.com/.
73	Universidade Sénior do Concelho de Benavente		263659550 ducacao@cm-benavente.pt .

			https://www.cm-benavente.pt/eventos2/agenda/item/3849-senior-do-concelho-de-benavente-comemora-hoje-12-anos.
74	Academia Sénior de Alpiarça		243 558429 fcardigojunta@gmail.com juntalpiarca@gmail.com http://www.jf-alpiarca.pt/index.php?option=com_content&view=article&id=84:vao-comecar-as-aulas&catid=1:noticias-recentes&Itemid=1.
75	Universidade Sénior de Assentis		249790401 respostas.sociais@cspassentis.pt http://www.cspassentis.pt/.
76	Formação Ocupacional de Seniores - Vila Nova da Barquinha		969192186 – 91299341 formacao.ocupacional.seniores@gmail.com https://fos.blogs.sapo.pt/.
77	Universidade Sénior da Carregueira - Chamusca		967897323 j.f.carregueira@sapo.pt jfcgabpresidente@sapo.pt https://www.jf-carregueira.com/univ-senior
78	Universidade Sénior de Vila Chã de Ourique		938.361.229. https://www.facebook.com/Universidade-S%C3%A9nior-de-Vila-Ch%C3%A3-de-Ourique-325116371368198/.
79	niversidade Sénior da União das Freguesias da Chamusca e Pinheiro Grande		249760074 geral@chamusca-pinheirogrande.com https://www.chamusca-pinheirogrande.com/index.php?sec=partcc.

80	Academia Sénior da casa do Povo de Castro Daire - apagar		+351 232 388 190 casadopovo.castrodaire@gmail.com
81	Universidade Sénior de Vale de Cavalos		249780167 https://www.facebook.com/valedecavalos.senior.5.
82	Academia Senior da Covilhã	**Castelo Branco**	275336788 academiaseniorcv@sapo.pt. https://www.facebook.com/AcademiaSeniorDaCovilha/?ref=page_internal.
83	Academia Sénior do Fundão		275772436 https://www.facebook.com/academiaseniorfundao2007/.
84	Universidade Sénior de Proença-a-nova		274670000 gap@cm-proencanova.pt www.cm-proencanova.pt
85	Universidade Sénior de Idanha-a-Nova		277202123 geral@filarmonicaidn.com. www.filarmonicaidn.pt https://www.facebook.com/filarmonica.idanhense.
86	Academia Sénior de Belmonte		275 910 111 cmbelmonte@cm-belmonte.com https://cm-belmonte.com/.
87	Universidade Sénior de Oleiros		272.680.130 redesocial-oleiros@iol.pt presidencia@cm-oleiros.pt https://cm-oleiros.pt/en/oleiros.

88	Universidade Sénior Albicastrense - Castelo Branco		936406690 geral@amatolusitano-ad.pt http://www.amatolusitano-ad.pt/.
89	Academia Sénior da Sertã		274600300 geral@cm-serta.pt https://cm-serta.pt/.
90	Academia Sénior de Penamacor		272540200 adraces@adraces.pt https://www.adraces.pt/conteudo/38/39.
91	Academia Sénior de Vila Velha de Ródão		272540200 academiasenior@cmcd-vvr.pt. https://www.facebook.com/academiaseniorvilavelharodao/.
92	Universidade Sénior de Vila de Rei		274890000 cm-viladerei.pt. cpcj@cm-viladerei.pt
93	Academia Seniores de Lisboa	**Lisboa**	211371772 acsslisboa@sapo.pt http://sites.google.com/site/academiaseniores lisboa
94	Clube Universitário Tempo Livre da Amadora (CUTLA)		969383777 info@cutla.pt www.cutla.pt
95	Universidade Sénior de Vila Franca de Xira		219533050 https://www.facebook.com/camaramunicipalvfx https://www.cm-vfxira.pt/
96	Academia dos Saberes de Loures		211150100 geral@cm-loures.pt https://www.cm-loures.pt/

97	Universidade Intergeracional de Benfica - UNISBEN - Lisboa		217145364 http://www.unisben.pt/main_conteudo.aspx?id=13.
98	Academia Sénior da Lourinhã		261414272 / 26146148 https://www.facebook.com/academiasenior.lourinha.
99	Universidade Sénior de Massamá e Monte Abraão		214301313 geral@uf-massamamabraao.pt https://www.uf-massamamabraao.pt/.
100	Portela Sábios - Loures		215938922 secretaria@amportela.pt https://siteamp.wixsite.com/amportela
101	Universidade Senior Unisaber - Lisboa		918924293 usenior.unisaber@gmail.com www.unisaber.blogspot.pt.
102	Universidade Sénior de Manique		21 445 80 94 convivio.manique@gmail.com www.nevesmanique.net
103 104	Universidade da Terceira Idade de Alenquer		263 730 906 presidente.assembleiamunicipal@cm-alenquer.pt http://www.cm-alenquer.pt/#notop.
105	Universidade Sénior na Universidade - Lisboa		217920016 / 21792000 ussaldanha@gmail.com / unidacser@gmail.com. https://unidacser.wixsite.com/unidac.
106	Universidade Sénior Pedro Santarém - Lisboa		218802160 stas@stas.pt https://www.facebook.com/SindicatoSTAS/.

			https://www.stas.pt/index.php?option=com_content&view=featured&Itemid=101&Site=1.
107	Academia Sénior CSP Alverca		219589180 geral@casaspedrodealverca.pt. http://www.casaspedrodealverca.pt/academia_senior.html.
108	Universidade Sénior de Campo de Ourique - Lisboa		213 929 000 ejo.ce@mail.telepac.pt https://www.jf-campodeourique.pt/activities/1/universidade-senior.
109	Academia Sénior da Venda do Pinheiro		219661481 academiasenior.scmvp@gmail.com https://www.facebook.com/cademia.senior.scmvp/ http://www.scmvp.pt/
110	Academia Sénior AISA - Malveira da Serra		214857700 geral@aisaipss.pt https://www.aisaipss.pt/.
111	Academia de Cultura de Vila Franca de Xira		263 276 023 aculvfxira@live.com.pt https://associativismo.cm-vfxira.pt/index.php/academia-de-cultura-de-vila-franca-de-xira/89-associacoes/contactos/contactos-vila-franca-de-xira/841-academia-de-cultura-de-vila-franca-de-xira.
112	ASEGEA- Academia Sénior Estudos Gerais da Ericeira		+351 919 658 083 asegea15@gmail.com https://www.facebook.com/ASEGEA-Academia-Senior-Estudos-Gerais-Ericeira-Associa%C3%A7%C3%A3o-991020814253293/.

113	Universidade Sénior São João das lampas		219 618 241 geral@cspsaojoaodaslampas.com http://www.cspsaojoaodaslampas.com/index.php/contacte-nos
114	Universidade Intergeracional do Clube Estefânia		213580427 estefania.clube@gmail.com https://www.facebook.com/clubeestefaniaoficial/?ref=page_internal.
115	Universidade da Terceira Idade do Lumiar		210994199 util.geral@jf-lumiar.pt. https://www.facebook.com/utilumiar/. https://jf-lumiar.pt/util/.
116	Academia Avós em Companhia de Algés		214 102 422 geral@csagradafamilia.pt https://www.csagradafamilia.pt/.
117	Universidade Sénior Tertúlias Sublimes		962383401 tertulias.sublimes@gmail.com https://www.facebook.com/tertuliasublimes/.
118	Universidade Sénior do Mucifal		219292678 Rua da Capela, 16 Mucifal 2705-216 Colares
119	Universidade Sénior de Carnaxide e Queijas, Aprendizagem e Lazer		214173090 atendimentocarnaxide@uf-carnaxide-queijas.pt. https://uscqal.pt/.
220	Academia de Saberes de Bicesse		214601274 https://www.facebook.com/Bicesse-239375879435164/.
221	Universidade da		219231708 / 21926266

	Terceira Idade de Sintra.		actisuti@gmail.com. https://actisuniversidadesintra.pt/.
222	Universidade da Terceira Idade de Torres Vedras		261326244 actividadesenior@gmail.com http://actividadesenior.blogspot.com.
223	Academia Sénior dos Olivais		218520420 academiadosolivais@sapo.pt. https://www.facebook.com/academiadosolivais. www.academiadosolivais.org
224	Universidade Sénior de Mafra		261819711 https://www.faceook.com/usema.mafra/about.
225	Universidade Sénior da Ajuda - Lisboa		218090899 geral@jf-ajuda.pt https://www.jf-ajuda.pt/.
226	Universidade Sénior dos Serviços Sociais da Câmara Municipal de Lisboa		21 844 77 00 geral@sscml.pt https://www.sscml.pt/wp/areasocial/.
227	Universidade Sénior de Queluz		214357666 niversidadeseniorqueluz@gmail.com uniqueluz.pt
228	Academia Cultural Sénior da Agualva - Cacém		219141118 / 92782323 academiasenior.arpiac@gmail.com http://arpiacacademia.no.comunidades.net/
229	Academia Sénior Carnide		217 121 330 anossajunta@jf-carnide.pt. https://www.jf-carnide.pt/.

230	Universidade Sénior de Odivelas		21 934 71 38 secretaria@usenior-odivelas.com. http://www.usenior-odivelas.com/contactos.
231	Universidade para a Maturidade de Santa Maria de Belém - Lisboa		21 362 0004 igrejadebelem@gmail.com https://umbemgeral.wixsite.com/umbem/empreendedorismo.
232	Academia Sénior da Freguesia de Santa Iria de Azoia, São João da Talha e Bobadela		219959444 geral@uf-ssb.pt https://uf-ssb.pt/
233	Academia Sénior ADAS - Lisboa		217820133 geral@adas-br.pt https://www.adas-br.pt/.
234	Universidade Sénior Criar Afectos de Rio de Mouro		216035294 projecto.criarafectos@gmail.com https://projectocriarafect.wixsite.com/uscarm/sobre?fbclid=IwAR0bIWPo2v9Ql3KOhttDZXfjsua3NS3q1BTqsWRlRL2JZHlKSbAEmUezmtk.
235	Universidade da Terceira Idade do Concelho da Azambuja		263 400 473 utica@cm-azambuja.pt https://www.cm-azambuja.pt/servicos/educacao/utica-universidade-da-terceira-idade-do-concelho-de-azambuja.
236	Nova Atena- Universidade Sénior de Linda-a-Velha		214191102 novaatenaa@gmail.com. https://www.novaatena.pt/.

237	Universidade Sénior de Oeiras		211 358 121 geral@usoeiras.pt. www.universidadeseniordeoeiras.pt.
238	Universidade Sénior Intergeracional de Agualva e Mira Sintra		219188540 geral@jf-agualvamirasintra.pt geral@jf-agualvamirasintra.pt www.jf-agualvamirasintra.pt
239	Saber Maior- Universidade Sénior de Santa Maria Maior		213 460 840 empreendedorismo.social@jfsantamariamaior.pt https://www.jf-santamariamaior.pt/sabermaior/
240	Universidade Sénior de Barcarena		214352617 geral@cspbarcarena.pt https://www.cspbarcarena.pt/.
241	Núcleo Sénior da Liga de Algés		214112184 geral@ligadealges.pt https://www.ligadealges.pt/.
242	Universidade Sénior de Marvila (Lisboa)		218310350 info@jf-marvila.pt http://jf-marvila.pt/
243	Universidade Alcântara Sénior		213615200 https://www.facebook.com/uasalcantara/?ref=page_internal.
244	UNIATI		932197199 faleconosco@fev.edu.br https://www.unifev.edu.br/atividade/3150/uniati-universidade-aberta-a-terceira-idade.

245	Universidade Sénior de Sassoeiros		214562959 unis.cfsassoeiros@gmail.com. https://www.facebook.com/clubedefuteboldesassoeiros/.
246	Universidade Sénior Parque das nações		+351 912 766 657 geral@usparquedasnacoes.pt https://www.usparquedasnacoes.pt/.
247	Academia do Campo Grande		217812480
248	Universidade Sénior de Alcobaça	**Leiria**	262 582 510 usalcoa@gmail.com https://www.facebook.com/usalcoa/ http://www.fundacaomariaeoliveira.com/usalcoa.html.
249	Universidade Sénior de Benedita		262920647 usbenedita@gmail.com https://www.facebook.com/usbenedita/.
250	Universidade Sénior da Nazaré		262380924 geral@cm-nazare.pt www.cm-nazare.pt
251	Universidade Sénior de Figueiró dos Vinhos		236559552 secretaria@cm-figueirodosvinhos.pt https://www.cm-figueirodosvinhos.pt/index.php/universidade-senior.
252	Universidade Sénior da Marinha Grande - ASURPI		244567725 asurpi2@gmail.com https://www.facebook.com/asurpi2/.
253	Universidade Sénior da União de Freguesias de Pataias e Martingança		244589068 us.pataias@gmail.com https://uspataias.wixsite.com/uspataias.

254	Academia Sénior do Landal		262 949 730 geral@freguesiadelandal.pt http://www.freguesiadelandal.pt/associativismo
255	Academia Sénior Viver Activo de Leiria		244 839 500 vativo@cm-leiria.pt http://www.cm-leiria.pt/
256	Universidade Sénior Sempraudaz		915090565 sempraudaz@gmail.com https://www.redecultura2027.pt/pt/agentes-culturais/sempraudaz--associacao-cultural.
257	Universidade Sénior de Pombal		236218042 universidadeseniorpombal@gmail.com https://www.facebook.com/Usp-Universidade-S%C3%A9nior-De-Pombal-219589124902144/
258	Universidade Sénior Rainha D. Leonor - Caldas da Rainha		262240000 usrdl.cr@gmail.com. www.facebook.com/universidadeseniorrainhadonaleonor/
259	Universidade Sénior de Peniche		262781030 universidadeseniordepeniche@gmail.com univseniorpeniche.com
260	Universidade Sénior de Alvaiázere		236650710 geral@cm-alvaiazere.pt. presidencia@cm-alvaiazere.pt.

			www.cm-alvaiazere.pt.
261	Programa 6O+ - Leiria		244829400 sa.campus1@ipleiria.pt. 60mais.ipleiria.pt
262	Universidade Sénior de Alfeizerão		262990842 usa@misericordiaalfeizerao.pt http://www.misericordiaalfeizerao.pt/?fbclid=IwAR08iduo833hLwUULM6jGm4FiZIKrZpISnZLOCoWVCIR1YVLVaKUxsxWfnk. https://www.facebook.com/Universidade-S%C3%A9nior-de-Alfeizer%C3%A3o-302538036893018/.
263	Universidade Sénior de Pedrógão Grande		236480020 https://www.facebook.com/universidadeseniorpedrogao/. http://www.cldsviverpedrogao.com.
264	Academia Sénior das Freguesias de Monte Real e Carvide		244612777 https://www.facebook.com/academiasenior.monterealcarvide.1/about.
265	Academia Sénior dos Pousos (Leiria)		244 839 030 No website no email
266	Universidade Sénior da Figueira da Foz	**Coimbra**	233418878/ 233428139 viveralegria.geral@gmail.com universidade.viveralegria@gmail.com. http://viveremalegria.pt/senior/.
267	Universidade do Tempo Livre de Coimbra		239827412 anai.ofci@sapo.pt. https://www.anai.pt/.,
268	Universidade Senior da ADIP - Vila Nova de Poiares		239429000 geral@adip.pt www.adipoiares.org

269	Academia Sénior de Tábua		235410340 E. geral@cm-tabua.pt. https://www.cm-tabua.pt/?lop=conteudo&op=430c3626b879b4005d41b8a46172e0c0&id=cb79f8fa58b91d3.
270	Universidade Sénior de Mira		231480550 gabinete.presidente@cm-mira.pt. https://www.cm-mira.pt/node/665.
271	Clube dos Velhos Amigos		910751263 geral@icreatepoiares.pt http://www.icreatepoiares.pt/
272	Universidade Sénior de Miranda do Corvo		239530150 geral@adfp.pt www.adfp.pt
273	APOSénior - Coimbra		239444783 apojovi.aposenior@gmail.com. http://www.apojoviaposenior.com/.
274	SENIORMOR - Montemor-o-Velho		239 687 250 geral@scmmv.com. http://www.scmmv.com.
275	Universidade Sénior de Penela		239560120&239 569 40 cmpenela@cm-penela.pt https://www.cm-penela.pt/home.
276	Universidade Sénior do Mondego		239098349 geral@adfp.pt http://www.adfp.pt/.
277	Academia Sénior de Seia		+351 913 721 195 academiaseniorseia@gmail.com

		Guarda	http://www.academiaseniorseia.com/.
278	Universidade Sénior de Celorico da Beira		271743827 / 271 747 geral@cm-celoricodabeira.pt. https://www.cm-celoricodabeira.pt/servicos/gabinete-desporto/universidade-senior/.
279	Universidade Sénior de Pinhel		+351 969 550 927 uspinhel@gmail.com. https://www.facebook.com/universidadesenior.depinhel.
280	Universidade Sénior de Gouveia		238490210 geral@cm-gouveia.pt. https://www.cm-gouveia.pt/universidade-senior/.
281	Universidade Sénior do Sabugal		271751040 movimento@cm-sabugal.pt https://www.cm-sabugal.pt/inscricoes-abertas-universidade-senior/.
282	Universidade Sénior de Fornos de Algodres		271701335 geral@apscdfa.pt www.apscdfa.pt
283	Academia Sénior de Meda		279 883 525 geral@cm-meda.pt https://www.cm-meda.pt/academia-senior-de-meda/.
284	Academia Sénior Figueirense		271319000 academiaseniorfigueirense@cm-fcr.pt. https://cm-fcr.pt/residir-2/servicos-municipais/academia-senior-figueirense/#tab-id-7.
285	Universidade Sénior de Miranda do Douro	**Bragança**	273 430 020 geral@cm-mdouro.pt. www.cm-mdouro.pt.

286	Universidade Sénior de Vinhais		273772695 universidadeseniorvinhais@gmail.com. https://www.facebook.com/usvinhais/.
287	Universidade Sénior de Freixo de Espada a Cinta		279 658 160 geral@cm-fec.pt http://www.cm-freixoespadacinta.pt/noticia.php?id=56.
288	Universidade Sénior de Macedo de Cavaleiros		278420420 geral@cm-macedodecavaleiros.pt https://www.cm-macedodecavaleiros.pt/pages/262
289	Universidade Sénior de Alfândega da Fé		279463496 **E-mail:** liga.lacsaf@gmail.com **Direção:** franco.simoes@sapo.pt https://www.lacsaf.pt/.
290	Universidade Sénior de Mogadouro		279 340 700 geral@mogadouro.pt. www.mogadouro.pt
291	Universidade Sénior de Rotary de Mirandela		917130813 usrmirandela@gmail.com https://www.facebook.com/usrmirandela/.
292	Universidade Sénior do Município de Torre de Moncorvo		279200220 geral@torredemoncorvo.pt https://www.cm-moncorvo.pt/pages/848?news_id=538.
293	Universidade Sénior Jerónimo Cardoso - Lamego		254612874 coordenacao.trc@cm-lamego.pt.

		Viseu	http://trc.cm-lamego.pt/agenda/242-coral-da-universidade-senior-jeronimo-cardoso-lamego-convida-o-choral-croq-notes-franca.
294	Universidade Sénior São Pedro do Sul		232720140 geral@cm-spsul.pt http://www.cm-spsul.pt/.
295	Universidade Sénior de Armamar		254 850 800 geral@cm-armamar.pt www.cm-armamar.pt
296	Universidade Sénior de Rotary em Viseu		232436444 usavis.viseu@gmail.com. https://sites.google.com/site/universidadesseniorderotary/usr-viseu.
297	Academia Sénior da Casa do Povo de Castro Daire		232 388 190 casadopovo.castrodaire@gmail.com. casadopovo.castrodaire@gmail.com.
298	Universidade Sénior de Neas		232 941 300 geral@cm-nelas.pt. https://www.cm-nelas.pt/viver/acao-social/universidade-senior/.
299	CSénior - Universidade Sénior de Castro Daire		232371160 geral@cm-castrodaire.pt https://www.cm-castrodaire.pt/index.php?option=com_content&view=article&id=91&Itemid=85.
300	Universidade Sénior de Santa Comba Dão		912061378 * 965709707 * 232098508 tomgradual@hotmail.com https://usscdao.blogspot.com/.

301	Universidade Sénior Infante D. Henrique de Moimenta da Beira		unise.mb@gmail.com
302	Universidade Sénior de Carregal do Sal		926293512 geral@cm-carregal.pt https://www.cm-carregal.pt/pages/821?news_id=368.
303	Universidade Sénior de Vouzela		232740740 geral@cm-vouzela.pt. www.cm-vouzela.pt
304	Academia Sénior do Orfeão de Viseu		232281556 geral.orfeaoviseu@gmail.com. http://www.orfeaodeviseu.com/senior.
305	Universidade Vida Ativa de S. João da Pesqueira - UVA		254489999 uva@sjpesqueira.pt https://www.facebook.com/universidadevidaativa/.
306	Universidade Sénior de Tabuaço		254 001 179 https://m.facebook.com/Universidade-S%C3%A9nior-de-Tabua%C3%A7o-235491480714569/.
307	Universidade Sénior de Ribeira de Pena	**Vila Real**	259490260 usribeiradepena@gmail.com. https://univ-senior-de-ribeira-de-pena1.webnode.pt/.
308	Universidade Sénior do Município de Alijó		259957100 geral@cm-alijo.pt. https://www.cm-alijo.pt/noticia/universidade-senior-de-alijo-ja-arrancou.
309	Universidade Sénior de Murça		259518042 geral@cm-murca.pt

			https://www.cm-murca.pt/frontoffice/pages/681?poi_id=56.
310	Universidade Sénior de Rotary Peso da Régua		254336280 usregua@gmail.com https://sites.google.com/site/universidadesseniorderotary/usr-regua.
311	Universidade Sénior das Terras de Aguiar		259403017 https://www.facebook.com/ustag.terrasdeaguiar/
312	Universidade Sénior de Vila Real		259 042 820 ccr.vilareal@gmail.com ccr-vilareal.pt.
313	Universidade Sénior Rotary de Chaves		276342189 usr@rotarychaves.pt https://sites.google.com/site/universidadesseniorderotary/usr-chaves
314	Academia Sénior de Sabrosa		259 937 120 geral@cm-sabrosa.pt https://www.sabrosa.pt/pages/389.
315	Universidade Sénior de Cerveira	**Viana do Castelo**	251795007 uniseniorcerveira@sapo.pt www.uniseniorcerveira.com
316	Academia Sénior de Viana do Castelo		258819700 academiasenior@cer.pt. www.cer.pt
317	Universidade Sénior de Monção		251649000 usmoncao@gmail.com www.censo.pt

318	Academia Sénior de Caminha		academiaseniorcaminha@gmail.com https://www.facebook.com/ASC-Academia-S%C3%A9nior-de-Caminha-1009831292531865/.
319	Universidade Sénior de Braga		253273165 info@ecgcoop.org. www.atlascoop.net
320	Academia de Cultura de S. Miguel de Refojos (Cabeceiras de Basto)		253663382 servicoatendimentounico@cabeceirasdebasto.pt https://cabeceirasdebasto.pt/outros-menus-contactos.
321	Universidade Sénior de Cabeceiras de Basto		253663382 servicoatendimentounico@cabeceirasdebasto.pt https://cabeceirasdebasto.pt/outros-menus-contactos.
322	Universidade Sénior de Vieira do Minho		253649270 geral@cm-vminho.pt. https://cm-vminho.pt/universidade-senior-de-vieira-do-minho-comemorou-sexto-ano-de-vida/,
323	Universidade Sénior ANP - Braga		253209590 jne@dge.mec.pt. www.anprofessores.pt
324	Universidade Sénior de Moreira de Cónegos		253585955 sec101@cjsj.pt http://www.cjsj.pt/.
325	Universidade Sénior de Santa Maria de Braga		253086210 info@ecgcoop.org https://ecgcoop.org/universidade-senior-de-santa-maria-de-braga/.

326	Universidade e Academia Sénior de Amares		253782589 universidadeseniordeamares@gmail.com. https://www.facebook.com/universidadeseniordeamares/.
327	Universidade Sénior de Esposende		939106737 Geral@Esposende.org Geral@Esposende.eu www.EsposendeUniversidade.pt
328	Universidade do Autodidacta e da Terceira Idade de Guimarães		253 421 200 | F 253 515 134 geral@cm-guimaraes.pt. https://associativismo.guimaraes.pt/associacao/1620/unagui-cooperativa-social-e-cultural-de-guimaraes-crl/quem-somos.
329	Universidade Sénior de Celorico de Basto		255361403 uscbasto@gmail.com https://www.facebook.com/UniversidadeSeniorCeloricoDeBasto/.
330	Clube Sénior de Famalicão		252374480 geral@associacaogeracoes.com http://www.associacaogeracoes.com.
331	Universidade Sénior Renascer - Guardizela		252906277 centrosocialguardizela@gmail.com https://centro-social-de-guardizela.webnode.pt/valencias/universidade-senior/.
332	Academia Sénior de Nespereira		253567155 www.csnespereira.com. https://csnespereira.pt/.
333	Universidade Barcelos Sénior		+ 351 253 101 248 barcelossenior@gmail.com http://www.barcelossenior.pt/.

334	Universidade Sénior D.Dinis de Joane - Vila Nova de Famalicão		252 922175 geral@atc.pt4 https://www.atc.pt/
335	Universidade Sénior Teófilo Braga de Guimarães		252922456 ustb.caisa@gmail.com. https://coopcaisa.wixsite.com/ustb.
336	Instituto Sénior de Braga		253137350 geral@institutosenior.pt. https://www.facebook.com/InstitutoSeniorBraga
337	Academia Sénior de Gaia	**Porto**	223700390 asg@scmg.pt https://www.facebook.com/AcademiaSeniorGaia
338	Instituto Sénior da Fo		226181643 institutoseniordafoz@gmail.com https://www.facebook.com/Instituto-S%C3%A9nior-da-Foz-1137653432935390/.
339	Prosénior, Universidade Sénior de Paços de Ferreira		255147062 https://profisousa.pt/contactos/. www.profisousa.pt
340	Universidade Sénior Eugénio de Andrade		228318210 info@portoccd.org http://portoccd.org/1528
341	Clube Sénior d'O Tecto - Vila do Conde		252661374 geral@otecto.org. https://www.otecto.org/.
342	Universidade Sénior Florbela Espanca		229388613 usflorbelaespanca@gmail.com www.usflorbelaespanca.org

343	Universidade Sénior de Amarante		255 420 233 universidadesenior@cm-amarante.pt. https://www.facebook.com/universidadeseniordeamarante/.
344	Universidade Sénior de Rotary em Matosinhos		229514220 **geral.usrm@gmail.com** https://sites.google.com/site/universidadesseniorderotary/usr-matosinhos.
345	Academia Sénior de Vilar de Andorinho		227820631 geral@jf-vilardeandorinho.pt. http://www.jf-vilardeandorinho.pt/instituicoes/.
346	Universidade Sénior do Coronado - Trofa		229829818 gip@viladocoronado.pt. http://www.viladocoronado.pt/index.php/junta-de-freguesia/servicos/383-servicos.
347	Universidade Sénior de Vila das Aves		web@jf-viladasaves.pt presidente@jf-viladasaves.pt. https://www.jf-viladasaves.pt/contactos/.
348	Universidade Sénior Olival Social - Gaia		227 652 206. olivalsocial@gmail.com. www.olivalsocial.com.
349	Universidade Sénior de Rotary de Valongo		224222808 usr.valongo@gmail.com. https://sites.google.com/site/universidadesseniorderotary/usr-valongo.
350	Universidade Sénior Ativa		938890475 universidadeseniorativa@gmail.com https://universidade-senior-ativa.webnode.pt/

351	Universidade Sénior do Flor de Infesta		229027221 florinfesta@gmail.com. https://flordeinfesta.pt/. https://www.facebook.com/flordeinfesta/.
352	Academia Sénior da Sabedoria de Canelas		914167064 mfl1948@hotmail.com. http://academiassss.blogspot.com/,
353	Academia Sénior de Vilar do Paraíso		227116168 geral@csspvp.org. http://www.csspvp.org/.
354	Universidade Sénior de Marco de Canaveses		255 530 248 info@cm-marco-canaveses.pt https://www.cm-marco-canaveses.pt/viver/educacao/universidade-senior/.
355	Universidade Sénior de Rotary de Paredes		929267394 usrparedes@netcabo.pt https://sites.google.com/site/universidadesseniorderotary/usr-paredes.
356	Universidade Sénior Experiências e Saberes (Maia)		39768129 uses.arcnse@gmail.com. https://www.google.com/search?q=Universidade+S%C3%A9nior+Experi%C3%AAncias+e+Saberes+(Maia&oq=Universidade+S%C3%A9nior+Experi%C3%AAncias+e+Saberes+(Maia&aqs=chrome..69i57.699j0j4&sourceid=chrome&ie=UTF-8.
357	Associação Sénior da Foz Vita Vivet		+351 22 618 1643 institutoseniordafoz@gmail.com

			https://www.facebook.com/Instituto-S%C3%A9nior-da-Foz-1137653432935390/.
358	Universidade Sénior Intercultural para a Terceira Idade - Porto		222 083 409 www.atlascoop.net no email and web is not working
359	Universidade Sénior do Rotary em Felgueiras		922176724 usafelgueiras@gmail.com http://usafelgueiras.blogspot.com/.
360	Universidade Sénior de Gondomar		224830023 geral@uf-gvj.pt. http://www.uf-gvj.pt
361	Universidade Sénior de Penafiel		255094131 adiscrep@adiscrep.org. www.adiscrep.org
362	Universidade Sénior Ocupacional da Lixa		255491368 CPOVOLIXA@GMAIL.COM. http://www.casadopovolixa.pt/social/usol.
363	Universidade Sénior de Ermesinde		932953158 agorarte07@gmail.com use.agorarte@gmail.com http://agorarte.pt/.
364	Universidade Sénior do Autodidacta de Lousada		255813258 https://www.facebook.com/usalou/.
365	Universidade Sénior de Avintes		227841763 acma_avintes@hotmail.com https://www.acmavintes.pt/
366	Universidade Sénior de Rio Tinto		224890287 geral@cm-gondomar.pt

			https://www.riotinto.pt/index.php/28-textos/30-universidade-senior.
367	RUTIS Porto		96142549 porto @ rutis.pt http://porto.rutis.pt
368	Academia Sénior de Pedroso e Seixezelo - Gaia		227842106 geral@pedroso-seixezelo.pt http://www.pedroso-seixezelo.pt/
369	Instituto Cultural D. António Ferreira Gomes		226 102 831 icafg@icafg.pt www.icafg.pt
370	SER+ Universidade Sénior		965965470 ser.mais.us@gmail.com https://sermais.com.pt/.
371	Academia Sénior do Centro Social da Paróquia da Areosa		225404721 cspa-areosa@sapo.pt http://www.centrosocialareosa.pt/academia-seacutenior.html.
372	Universidade Intergeracional de Ramalde		226165690 geral@fcd-porto.pt http://jf-ramalde.pt/p1289-inaugurada-a-uifp-universidade-intergeracional-fernando-pessoa-pt,
373	Academia Sénior do Orfeão da Madalena - Gaia		227130440 orfeaomadalena@gmail.com. https://sites.google.com/view/orfeao-da-madalena.
374	Universidade Sénior CES Pedras Rubras		224 051 772 info@viver-a-aprender.com. https://www.viver-a-aprender.com/.

375	Universidade Sénior Mutualista		222087520 geral@abfamiliar.pt https://www.abfamiliar.pt/universidade.html
376	Academia Sénior de Serzedo e Perosinho.		227620007 geral@jf-serzedo.pt https://serzedoperosinho.pt/index.php/servicos/academia-senior.
377	Universidade Sénior Consuelo Vieira da Costa (Porto)		229768133 geral@fundacaoconsuelovcosta.pt https://fundacaoconsuelovcosta.pt/
378	Instituto Sénior da Misericórdia de Ovar	**Aveiro**	256582682 geral@scmovar.pt https://www.misericordia-ovar.pt/centro-comunitario-2/.
379	Universidade Sénior de Oliveira de Azeméis		256673081 usoazemeis@gmail.com www.usoa.pt
380	Universidade Sénior do Rotary Club em S. João da Madeira		+351 919 591 110 un.sen.sjm@gmail.com https://www.facebook.com/Universidade-S%C3%A9nior-do-Rotary-Club-de-S-Jo%C3%A3o-da-Madeira-1742818352605253. https://sites.google.com/site/universidadeseniorsjoao/.
381	Universidade Sénior da Curia		231 510 730 geral@cm-anadia.pt https://www.cm-anadia.pt/pages/695.
382	Universidade Sénior de Castelo de Paiva		255696034 https://www.facebook.com/Universidade-Senior-de-Castelo-de-Paiva-

			449849958550395/about/?ref=page_internal.
383	Universidade Sénior de Águeda		234698053 geral@acsagueda.pt https://www.acsagueda.pt/pt_pt/universidade-senior-de-agueda.
384	Universidade Sénior de Rotary em Estarreja		966046368 universidadestarreja@hotmail.com. https://sites.google.com/site/universidadesseniorderotary/usr-estarreja.
385	Universidade Sénior de Cacia		964319426 usidec.idecacia@gmail.com. https://sites.google.com/site/usidec/support-staff.
386	Universidade Sénior de Albergaria-a-Velha		234520196 geral@cm-albergaria.pt https://www.cm-albergaria.pt/visitar/o-que-fazer/agenda-proximos-eventos/todos-os-eventos/evento/grupo-de-cavaquinhos-universidade-senior-de-albergaria-a-velha-musica
387	Academia de Saberes de Aveiro		234108360 aveiro@academiasaberes.com. www.academiasaberes.wixsite.com/aveiro
388	Universidade Sénior S. João da Cruz		+351 930 420 410 usenior@iesjc.pt https://usenior.iesjc.pt/.
389	Universidade Sénior de Espinho		227323647 use.geral@gmail.com. https://www.facebook.com/universidadeseniorespinho/.
390	Universidade Sénior de Santa Maria da Feira		256372920 seniorfeira@sapo.pt

			www.seniorfeira.pt.
391	Universidade Sénior de Vale de Cambra		256 284 710 casadoprofessorvc@gmail.com. https://www.facebook.com/cpusvc/. www.casadoprofessor.pt.vc
392	Universidade Sénior de Vagos		234795851 universidadesenior@neva.pt www.neva.pt/usv
393	Universidade Sénior do Centro Social Paroquial da N S da Nazaré - Gafanha da Nazaré		234 367 066 alexandre.cruz@ua.pt. http://convidasaberes.blogspot.com/p/contactos.html
394	Universidade Sénior de Oliveira do Bairro		234745284 unisob@sapo.pt http://unisob.pt/.
395	Universidade Sénior CADES (Mealhada)		963 872 417 geral@solidariedadecades.com. http://www.solidariedadecades.com/index.php?paggo=infor.php&menu=101.
396	Universidade Sénior de Esmoriz		+351 932 925 134 usesmoriz@jf-esmoriz.pt. https://www.facebook.com/universidadesenioresmoriz/.
397	Universidade Sénior do Rotary Club em Sever do Vouga		https://sites.google.com/site/universidadesseniorderotary/usr-sever-do-vouga. Isabel.tavares.60@gmail.com.
398	ASARC - Academia Sénior de Arouca		256941249 asarc2020@gmail.com. https://www.facebook.com/asarc2020/.

399	Academia Sénior da SCMAH (Angra do Heroísmo)		295204840 https://www.facebook.com/academiaseniorscmah.
400	Universidade Sénior da Madalena		292628450 scmmadalena@mail.telepac.pt. https://www.facebook.com/SCMMadalena/. http://www.scmmadalena.pt/.
401	Universidade +Sénior		292648200 Not avaiabale
402	Universidade Sénior de Ponta Delgada	**Açores**	296 652 056 useniorpdl@gmail.com. https://www.facebook.com/UniversidadeSeniordePontaDelgada/.
403	Academia do Oeste - Ilha Terceira		295206540 academiaoeste@cpsbit.com https://www.facebook.com/academiaoestecpsb.
404	Universidade Sénior de Santa Maria Maior - Funchal	**Madeira**	291226683 E. stamariamaior@gmail.com. https://www.jf-stamariamaior.pt/index.php?option=com_sppagebuilder&view=page&id=9.
405	Universidade Sénior do Funchal		291 211111 cmf@cm-funchal.pt. http://www.funchal.pt/.
406	Universidade Sénior de Porto Santo		291980500 unisenior.portosanto@gmail.com. https://www.facebook.com/adfelicitatemuniseniorpxo/.
407	Universidade Sénior de S. Vicente (Madeira)		291846853 universidadeseniorsv@gmail.com

			https://www.facebook.com/Universidade-S%C3%A9nior-S%C3%A3o-Vicente-105581115130561/.
408	Universidade Senior de Machico		291 965 648 presidente@jf-machico.pt secretaria@jf-machico.pt www.jf-machico.pt.
409	Universidade Sénior de Câmara de Lobos		291628063 uni.senior.cl@gmail.com. https://www.facebook.com/Universidade-S%C3%A9nior-de-C%C3%A2mara-de-Lobos-360493180708424/.
410	Universidade Sénior da Ribeira Brava		291952548 geral@cm-ribeirabrava.pt. http://www.cm-ribeirabrava.pt/cmrb1/areas-de-intervencao/educacao/universidade-senior/.
411	Universidade Sénior Gonçalves Zarco (Madeira)		291701700 ebsgzarco@madeira-edu.pt. https://www.ebsgzarco.pt/.

Annex 2. Questionnaire

Cenários comunicacionais para a promoção do bem-estar físico, psicológico e social dos seniores

Este questionário enquadra-se numa investigação subordinada ao tema "Cenários comunicacionais para a promoção do bem-estar físico, psicológico e social dos seniores", realizada no âmbito do doutoramento em Informação e Comunicação em Plataformas Digitais, da Universidade de Aveiro e Universidade do Porto, do estudante

Imran Khan, e sob a orientação cientí ca de Ana Carla Amaro e Lídia Oliveira O

questionário pretende a recolha de dados que permitam compreender:

1. Em que medida cenários comunicacionais suportados por tecnologia podem promover ou facilitar a interação do sénior com a família, amigos e vizinhos, consolidando ou alargando os círculos sociais;

2. De que forma cenários desta natureza podem promover ou facilitar o acompanhamento médico do sénior por equipas especializadas;

3. Que vantagens e desvantagens são percecionadas pelos seniores na utilização de cenários desta natureza;

4. A predisposição e justi cativa dos seniores para a adoção ou não adoção destas soluções.

O questionário é anónimo, assegurando-se a con dencialidade dos dados recolhidos, que serão utilizados unicamente para ns académicos, cumprindo com o estabelecido no Regulamento Geral Sobre a Proteção de Dados Pessoais.

.

A participação é voluntária e o participante pode retirar-se da investigação em qualquer momento. Garante-se o acesso de todos os participantes aos resultados da investigação, através de correio eletrónico e se esse interesse for manifestado através do e-mail imran10111@ua.pt.

---

* Required

1. Declaração de consentimento informado *

Check all that apply.

☐ Declaro ter lido e compreendido a informação acima e aceito participar neste estudo, permitindo a utilização dos dados que forneço, de forma voluntária, con ando em que apenas serão utilizados para esta investigação e nas garantias de con dencialidade e anonimato que me são dadas pelos investigadores.

Dados pessoais

Por favor, selecione as opções que descrevem a sua situação pessoal.
Os dados servem unicamente para a caraterização demográ ca dos respondentes.

2. Género: *

Mark only one oval.

- [ ] Feminino
- [ ] Masculino
- [ ] Other: _____

3. Idade: *

Mark only one oval.

- [ ] 55 - 59
- [ ] 60 - 64
- [ ] 65 - 69
- [ ] 70 - 74
- [ ] 75 - 79
- [ ] 80 - 84
- [ ] 85 - 89
- [ ] 90 - 94
- [ ] 95 ou mais

4. Nível de escolaridade (concluído): *

Mark only one oval.

- [ ] 1º ciclo do ensino básico (4ª classe)
- [ ] 2º ciclo do ensino básico (6º ano)
- [ ] 3º ciclo do ensino básico (9º ano)
- [ ] Ensino Secundário (12º ano)
- [ ] Licenciatura
- [ ] Mestrado
- [ ] Doutoramento

5. Situação face ao emprego: *

Mark only one oval.

- [ ] Ativo
- [ ] Desempregado
- [ ] Reformado/Aposentado

6. Com quem vive: *

Mark only one oval.

- ◯ Sozinho
- ◯ Com o companheiro(a)/esposo(s)
- ◯ Com os meus lhos
- ◯ Com os meus netos
- ◯ Com outras pessoas numa instituição de acolhimento senior
- ◯ Other: _____

7. Da lista abaixo, por favor selecione as tecnologias que possui para uso pessoal:

Check all that apply.

- [ ] Computador
- [ ] Tablet
- [ ] Telemóvel básico
- [ ] Telemóvel do tipo smartphone
- [ ] Pulseira biométrica Other:
- [ ] _____

Visualização de vídeo ilustrativo

Para uma melhor compreensão da solução comunicacional que se propõe, foi desenvolvido um vídeo, que tem uma natureza meramente ilustrativa do modo de funcionamento dessa solução. Antes de responder ao questionário, por favor proceda à visualização do vídeo abaixo.

O vídeo também pode ser visualizado clicando aqui https://youtu.be/kLuvZJP-uck.

http://youtube.com/watch?v=kLuvZJP-uck

NOTA
Ao longo do questionário a solução tecnológica que está em avaliação é designada por sistema.

1. Interação social com a família e amigos

Na lista de a rmações abaixo, assinale o grau de concordância que melhor corresponde à sua opinião.

8. Agrada-me a ideia de usar um sistema que me permita contactar, por vários * meios (voz, vídeo, mensagens...), a minha família e amigos.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

9. Concordo com a ligação das minhas redes sociais (facebook...) ao sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente

Não se aplica ao meu caso

10. Entusiasma-me participar em atividades de grupo online via videoconferência (ginástica, dança...), ligando a câmara do meu dispositivo (telemóvel, tablet, computador...)

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

11. Agrada-me que o sistema permita a organização de grupos para realizar * atividades (por exemplo, convidar os amigos para uma caminhada no sábado à tarde).

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

12. Agrada-me criar agendas partilhadas para combinar atividades sociais (jantares, passeios...) com os meus amigos e familiares.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

13. Gosto da ideia de, em vez de ver televisão e filmes sozinho, o poder fazer * acompanhado por outras pessoas, ainda que cada um esteja em sua casa.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

14. Se desejar, dê-nos a sua opinião sobre formas adicionais de o sistema promover a interação com a família e os amigos:

2. Acompanhamento médico

Na lista de a rmações abaixo, assinale o grau de concordância que melhor corresponde à sua opinião.

15. Utilizaria uma pulseira para medição de dados relativos à sua saúde (tensão arterial, batimento cardíaco, nível de oxigénio, etc.) *Mark only one oval.*

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

16. * Saber que o meu médico recebe um relatório com dados relativos à minha saúde tranquiliza-me.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

17. * Considero útil poder consultar os registos dos meus dados de saúde (tensão arterial, batimento cardíaco, nível de oxigénio, etc.).

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

18. Aprecio a ideia de usar uma pulseira com sistema de alarme para situações de emergência (quedas, doença súbita, etc.).

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

19. Entusiasma-me a ideia de usar tecnologia (uma pulseira, uma aplicação de * telemóvel, a televisão...) que me estimule a fazer atividade física.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

20. Considero útil que o sistema (através da pulseira, da aplicação de telemóvel, * da televisão, etc.) me alerte para a toma dos medicamentos ou marcações de consultas.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

21. Agrada-me a possibilidade de poder conversar com o meu médico e/ou equipa de enfermagem de acompanhamento através do sistema (por exemplo, por videochamada).

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

22. Tranquiliza-me saber que o sistema envia um alerta ao meu médico caso * exista uma alteração grave nos meus dados de saúde (tensão arterial, batimento cardíaco, nível de oxigénio, etc.) *Mark only one oval.*

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

23. Agrada-me a ideia de, caso me sinta desorientado/perdido, o sistema permita partilhar a minha localização com os meus familiares ou amigos.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

24. Considero útil que o sistema saiba qual a farmácia de serviço na minha localização, permitindo identificá-la no mapa e ligar diretamente para ela. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

25. Se desejar, dê-nos a sua opinião sobre formas adicionais de o sistema promover a interação com o seu médico e/ou equipas de saúde de acompanhamento:

_____

_____

_____

_____

_____

3. A sua opinião sobre vantagens e desvantagens do sistema

Na lista de a rmações abaixo, assinale o grau de concordância que melhor corresponde à sua opinião.

26. Agrada-me que o sistema integre numa única aplicação uma variedade de funcionalidades (interagir com os familiares e amigos, interagir com as equipas de saúde, organizar e participar em atividades, etc.).

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

27. Tranquiliza-me o facto de o sistema restringir, com toda a segurança, o acesso * aos meus dados pessoais. *Mark only one oval.*

- Concordo inteiramente Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso
-

28. Tranquiliza-me poder personalizar níveis de privacidade, definindo quem pode * ver os meus dados e partilhas.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

29. Agrada-me poder definir de que forma cada amigo e familiar pode comunicar comigo através do sistema.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

30. Considero fundamental poder desativar algumas funcionalidades do sistema * sempre que desejar.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

31. Preocupa-me que outras pessoas possam vir a ter, indevidamente, acesso aos * meus dados pessoais registados no sistema.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

32. Preocupa-me que o sistema faça uma monitorização permanente das minhas interações sociais e dados de saúde.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

33. Se desejar, descreva outras vantagens e desvantagens que considera poderem existir no sistema:

_____

_____

_____

_____

_____

4. A sua predisposição para vir a usar ou não um sistema desta natureza

Na lista de a rmações abaixo, assinale o grau de concordância que melhor corresponde à sua opinião.

34. Usaria o sistema porque ajudaria a melhorar o meu bem-estar físico. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

35. Usaria o sistema porque ajudaria a melhorar o meu bem-estar psicológico. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

36. Usaria o sistema porque ajudaria a melhorar o meu bem-estar social. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

37. Não me sinto confortável em centralizar num sistema digital dados de natureza privada e, por isso, não usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

38. Usaria o sistema para ter uma interação mais assídua e direta com os meus familiares e amigos.

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

39. Dou privilégio aos contactos presenciais e, por isso, não usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

40. Uma interação mais assídua e direta com o meu médico gera-me um sentimento de segurança e bem-estar e, por isso, usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

41. Através do sistema poderia conhecer pessoas novas, alargando o meu círculo social e, por isso, usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

42. Já uso outras plataformas para assegurar os contactos sociais com amigos e familiares e não estou disposto a mudar, por isso, não usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada Discordo
- Discordo inteiramente
- Não se aplica ao meu caso
-

43. Poder participar em grupos de atividades (dança, ginástica, culinária...) melhoraria o meu nível de interação social, promovendo o meu bem-estar e, por isso, usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

44. Não sou um utilizador hábil de tecnologia e, por isso, não usaria o sistema. *

Mark only one oval.

- Concordo inteiramente
- Concordo
- Sem opinião formada
- Discordo
- Discordo inteiramente
- Não se aplica ao meu caso

45. Se desejar, descreva outros motivos para usar ou não um sistema desta natureza:

O preenchimento do questionário terminou.

Agradecemos a sua participação!