*Recommending personalized informative contents on iTV*

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# ABSTRACT

This paper aims to present an ongoing PhD research of the Doctoral Program Information and Communication in Digital Platforms and proposes a context aware recommender system (CARS) of informative contents about Assistance Services of General Interest for the Elderly (ASGIE) [5], for later exhibition on an Interactive TV (iTV) platform. The first phase of this research has been dedicated to assessing the information needs of seniors and designing a proper CARS data model. Future work will involve designing and implementing a prototype for further evaluation in the field with seniors, in the context of the +TV4E project [16]. The intended contribution of this doctoral research is to promote greater autonomy, wellbeing and info-inclusion of seniors through a personalized approach. (mesmo assim parece-me q continua em linha com o q temos falado)

## Author Keywords

Interactive TV; Context-aware; Seniors [às vezes usa elderly]; Info-inclusion; Recommender systems.

## ACM Classification Keywords

H.3.3 [**Information Search and Retrieval**]: Information Filtering.

# INTRODUCTION

Population ageing is a widely known emerging process that has led to significant transformations in developed societies, with implications ranging from labour and financial markets to the demand for new goods and services [17]. This growing senior population often face recurrent scenarios of info-exclusion and low literacy levels [3], which makes them unaware of information regarding public services and policies from which they could benefit.

With specific information needs and increasing free time (specially due to retirement), seniors tend to use the TV as the primary source of information and entertainment [13,14]. Many innovative solutions promoting active ageing and independent living have taken advantage of this familiarity with TV[4]. However, proposing purely creative solutions for iTV is not enough. Rather, it is necessary to develop solutions that overcome the usual drawbacks of technologies already available for the seniors[10], such as usability and accessibility issues. Moreover, considering preferences and contextual TV viewing aspects of target users play a vital role for effective adoption of any technology.

This ongoing PhD proposes to study, characterize, prototype and validate a context aware recommender system (CARS) for suggesting informative contents about Assistance Services of General Interest for Elderly (ASGIE) [5] on an iTV platform. The motivation of this research is to enhance the TV watching experience and promote seniors’ autonomy, wellbeing and info-inclusion by providing personalized high-valued informative contents.

This paper is organized in five sections including this introduction. Related works are described in the second section, while the following section is concerned with the first phase of this research, which consisted of assessing the information needs of Portuguese seniors through interviews, two focus groups and a survey with potential target-users. In addition, this phase included studies on the aspects involved with the CARS data model, such as content metadata, user profiles and visualization context. The future work section briefly frames the next steps planned for the upcoming months, which include designing, implementing and testing a prototype in the context of +TV4E project [16], a two-year action research project conducted at University of Aveiro, Portugal, which introduces an iTV platform to enrich seniors television experience with the integration of informative contents about public and social services. The conclusion summarizes the work done, remaining tasks and future research directions beyond this PhD as well as intended social contributions.

# RELATED WORK

## Active ageing

At global level, between 2000 and 2015, the number of people aged 60 years or over grew by 67 per cent, from 600 million to 1 billion, and by 2050, the global population of older persons is projected to reach 2 billion [17]. Particularly in Portugal, the number of people aged 60 and over in 2016 has already exceeded the number of children, adolescents and young adults (age 24 or younger) [15].

The concept of active aging was created to cope with the emerging demographic changes of the last decades [12]. This concept is not limited to keeping individuals employed or economically active during old age, but comprises a holistic approach that considers a set of factors contributing to seniors’ wellbeing, social participation and autonomy.

Increasing human longevity is, by many reasons, an achieve to be celebrated, but it also raises numerous challenges and concerns for developed societies, as it has significant economic impacts on public health systems (tenho sempre dúvidas sobre este impacto pq ha estudos q demonstram que isto não é assim tão linear: tlvz valesse a pena colocar aqui alguma ref para sustentar isto), retirement systems, etc. In order to follow the European Commission guidelines of sustainable development and active ageing [9], governments have been investing in new communication channels to broadcast information about their actions and programs (e.g. health campaigns, calls for participative budgets, income taxes notifications and laws changing alerts). However, a large part of the population (mostly seniors due to their low literacy levels [3] (isto é em PT ou genérico?) is not reached by these informative contents, since their respective information sources usually require a proactive action such as direct searches in *e-Government* portals. In this sense, many solutions have been developed to promote seniors’ wellbeing and autonomy, such as the following iTV services. [não percebi o sentido desta frase]Eu tb nao

## Interactive TV services

A number of studies emphasize seniors’ high usage and familiarity with TV. In several countries, older people have an average daily TV viewing of 5 hours, and this time tends to increase with age [14]. In the particular case of Portugal, despite the significant changes in media consumption habits in recent years, this device is still in a prominent position as the primary source of information and entertainment [13].

Considering the popularity of TV among seniors innovative solutions to improve seniors’ quality of life have been developed to leverage this device usage and experience [4]. By adding interactivity mechanisms to the traditional television experience, iTV represents an excellent alternative to provide responsive services and applications for seniors. In addition, the high penetration of this technology on a global scale confirms its choice as a valuable medium for broadcasting high-valued information in which seniors may be interested.

Some studies (parece redundante) in the scientific literature propose Interactive TV (iTV) applications ranging from medical treatment and cognitive training [4] to socialization [1]. Among these services, the iNeighbourTV [1] stands out, as its development process was based on target users preferences and expectations. In this project, potential target-users took part in the whole development process, in a participatory design approach.

Indeed, considering TV specificities as a medium for presenting contents as well as the user preferences and expectations is crucial for developing a compelling and enriched experience. Therefore, recommended informative contents exhibition should consider the target audience requirements and preferences.

## Personalization and recommender systems

Usually seniors value new technologies based on their practical utility, rather than on just novelty or originality[7]. The more personalized and adapted to seniors needs and preferences, the greater satisfaction and adoption a technology could have. The concept of personalization is defined in three levels [8]: i) contextual (adaptation according to user preferences and context semantics); ii) competency (adaptation based on user’s prior knowledge); and iii) by prerequisite (adaptation according to predefined requirements set by the user).

In the context of this PhD research, the concept of personalization comprehends the selection and suggestion of informative contents supported by recommender systems (RS), which consist of software tools and techniques applied to provide suggestions of items to be of use to a user to support them in various decision-making processes [11], such as what movie to watch, what book to read, what food to eat, etc. These systems are valuable to predict users preferences based on their feedbacks, behaviors, context, and are organized in three categories [11]: (i) content-based; (ii) collaborative; and (iii) hybrid.

Contextual factors may also affect the suitability of suggested items and sometimes are considered during the recommendation process [2]. In addition, a number of applications of Recommender Systems techniques aim at coping with information overload on TV platforms [6].

# AIMS AND OBJECTIVES

As mentioned, this PhD research aims to study, characterize, prototype and validate a CARS of informative contents about ASGIE to seniors, for later exhibition on an iTV platform. In this sense, it aims to enhance the +TV4E [ainda não se explicou o que é o +TV4E – não sera ruído?]ou retirar aqui ou explicar em cima project results by providing a more personalized approach to transmitted informative contents, and thus increase seniors’ autonomy, wellbeing and info-inclusion.

In addition, this research aims to contribute to the growing body of work on Social Sciences by understanding how such CARS may increase seniors’ information and knowledge levels regarding services, activities and programs entrusted to the government (aqui e de acordo com o q falamos, suavizar a questão de elevar niveis de informaçao). Hence, this study investigates the following research question: “*How personalized selection and recommendation of informative contents about ASGIE, delivered through an iTV platform, may contribute to seniors’ info-inclusion and wellbeing?”*

# METHODOLOGHY

## Seniors information needs

To operationalize this research, first it was necessary to characterize the data handled by the CARS, which included categorizing the Services of General Interest (SGI)[[1]](#footnote-1) tailored for Portuguese seniors as well as the information needs of these citizens. This process led to the creation of the concept and taxonomy of Assistance Services of General Interest for Elderly (ASGIE) [5].

In order to consider particularities of Portuguese seniors as well as to establish the validity of the current study, this phase started with a preliminary exploratory approach to gather information about: development and implementation of SGI in Europe and common senior information needs. This approach consisted of a literature survey in international databases, which produced a list of services seniors would be interested in receiving information. This list was composed by 3 categories of services: (a) Healthcare services; (b) Social and financial services, and (c) Local (nearby) services. Though rather incomplete, it already had most of services available to Portuguese seniors, and served as basis for the guidelines and questionnaires used in subsequent steps in this phase.

The process of categorizing the SGI tailored for seniors was a spiral and evolutionary process where the outputs of a given step served as input for the subsequent step to evolve, improve and validate the ASGIE concept and taxonomy. The output of the first step (Semi-structured interview) was a first draft of the taxonomy, while the second step (Focus group with experts in public policies) provided contributions for the composition of a second draft, which in turn was validated through surveys with 25 seniors recruited in the context of the +TV4E project [16].

After the preliminary step of literature review and the application of three different research methods the final version of the ASGIE concept and taxonomy was defined as “services, activities and agreements assumed to be of essential importance to elderly citizen welfare, quality of life and social inclusion, as well as to inform about civil rights and obligation regarding public authorities” [5]. This concept infers that contents often needed by seniors are organized in 7 information domains: Healthcare and Welfare services, Social services, Financial services, Culture services, Security services, Transport services and Local authority services.

## Recommender system data model

Recommenders’ efficiency depends heavily on descriptive attributes of both users and items to be recommended. So, beyond categorizing the informative contents (recommended items), it is also necessary to define further aspects to be considered by the recommendation algorithm, such as user and contextual characteristics. So, the personalized recommendation will be based on a data model composed by three information strands (Figure 1):

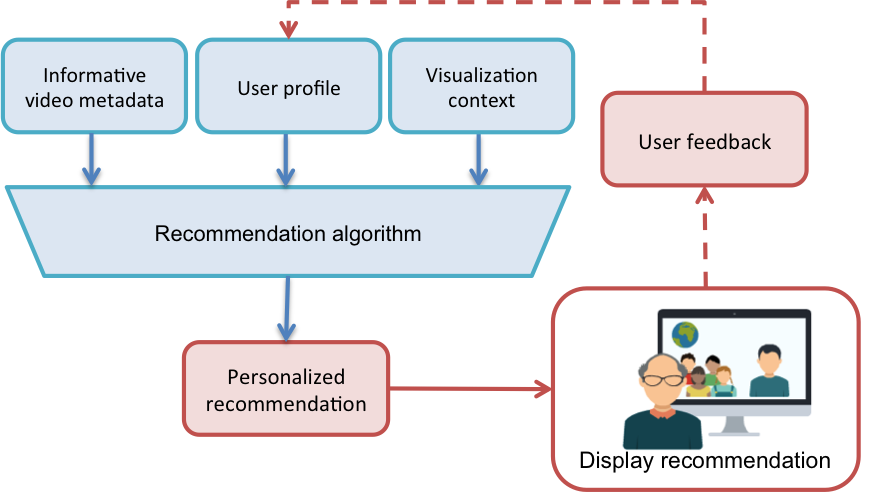


Figure 1. Information strands used by the CARS algorithm and user feedback.

* **Informative videos metadata** (ASGIE information domain, descriptive text, geographical area extent);
* **User profile** (gender, age, history and preferences regarding the informative videos);
* **Visualization context** (moment on linear TV programming, geographic location and suggestion intrusiveness [não percebi]).

Figure 1 shows how the three data strands of information are submitted to the **Recommendation algorithm** to generate the **Personalized recommendation**. In addition, **User feedbacks** will contribute to a dynamic profile construction, and will be gathered in two different ways: (i) Implicitly, during the whole television experience, to understand the viewers’ behaviour with respect to the informative videos (e.g. if skipped or fully presented); and (ii) Explicitly, in questions made after informative videos presentation, to verify the perceived relevance and utility of suggestions.

Providing information to seniors is the main requirement for this study and finding out the proper timing to do this is a key challenge, as good or bad timing may determine the openness of the users to receive the information provided. Also, finding a good balancing between showing the informative contents directly and sending notifications with call-to-action requests is vital for a compelling user experience. In this framework, visualization context aspects will be considered in two moments: (i) to pre-filter selectable items (filtering out geographically irrelevant contents); and (ii) to post-filter the most suitable moment for suggestions (e.g. time of day, day of week, point in linear programming etc.) and to decide if the suggested content must be immediately presented or a call-to-action notification should be shown on the screen corner prior to the content exhibition (suggestion intrusiveness).

# FUTURE WORK

With 16 months left in this PhD project, the doctoral research is now moving away from designing the CARS for ASGIE contents to implementing and testing a prototype in the context of +TV4E project [16]. By adding CARS tools and techniques to this project, the main goal for the second phase of this PhD is to validate in a real-life environment the personalized approach to the informative contents suggested to seniors during their TV viewing experience, according to their preferences and contextual aspects.

A Case Study method is being considered to operationalize the second phase of this research to account all the activities, events and issues of the CARS prototype in a qualitative approach. This prototype will be developed in a collaborative way, with the support of experimental groups also recruited within the +TV4E project. Afterwards, the prototype will be submitted to field tests in the seniors’ domestic environments. During the field tests, data will be collected and analysed based on (i) user diaries and (ii) semi-structured interviews to find out adequate answers to the research question previously stated. [e nos logs de visualização também?] se é qualitative é dar enfase as interviews

As the Recommender data model is already defined, on the second phase of this research project, a proper recommendation algorithm will be then selected to be used in the prototype implementation. A hybrid approach is being considered to avoid usual problems of using purely content-based or collaborative filtering algorithms, such as cold-start and sparsity [11]. Also, by adapting recommendations to specific contextual situations it is expected to generate more relevant content suggestions. Finally, pre-processing techniques, training strategies, performance metrics, as well as iTV platform’s overall scalability, delays, and load aspects will be considered.

## CONCLUSION

This document describes an ongoing PhD research, and describes some of the results already achieved as well as the upcoming works towards validating a CARS for ASGIE contents in a Case Study approach. When finished, this work will lead to writing a thesis describing the whole process of studying, characterizing, prototyping and validating such CARS.

Working in the context of +TV4E project presents unique opportunities to conduct this research in a relevant, real-world environment, which might not otherwise be possible. This research is inserted in the qualitative paradigm, since it aims at understanding, interpreting and describing phenomena involving consumption of personalized recommendations of ASGIE informative contents on an iTV platform. However, an interesting future research direction would be extending this study with a quantitative follow-up to provide usage metrics, and thus create evolutions of the Case Study. [e aplicação a outras geografias?]e enventualmente com outros publicos?

Finally, the intended social contribution of this doctoral research is to promote seniors’ autonomy, wellbeing and info-inclusion through a personalized approach.

## ACKNOWLEDGEMENTS

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Acrescentar o +TV4E

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1. These services were formerly referred as *public services* by the European Commission [↑](#footnote-ref-1)