IMPROVING TEACHER-STUDENT CONTACT IN A CAMPUS THROUGH A LOCATION-BASED MOBILE APPLICATION

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ABSTRACT

This paper presents a new mobile micro-broadcast (or near-me) Location-Based Service designed to promote face-to-face communication among users located within a given geographical area such as a University campus. Because the communication services provided are time dependent, the application decides whom to contact based on the geographic distance between the active subscribers of the service and the sender. The paper also presents some preliminary results of prototype evaluation.

KEYWORDS

Mobile computing, location-based services, face-to-face promotion, prototype evaluation.

1. INTRODUCTION

The current increasing penetration of smartphones in our society is a visible and undeniable fact (Canalys, 2012; Ismail & Razak, 2011). According to data revealed by the IDC European Mobile Phone Tracker in Marques (2012), smartphones market penetration may be related to the current capabilities of these "small computers", often nicknamed "pocket computers" (Sánchez *et al.*, 2011). Also according to Sánchez *et al.* (2011), this phenomenon is even more evident in our Higher Education campuses: "The students, due to their age, are the main users and purchasers". This current horizontal increasing penetration of smartphones can also be related to the inclusion of multiple sensors[1]. In this sense, the Global Positioning System sensor (GPS) has become the most used sensor by current mobile services and applications, giving rise to a new category of services commonly called in the literature Location-Based Services (LBS) (Schiller & Voisard, 2004).

1.1 Location-Based Services

Location-Based Services (LBS) were defined by Virrantaus *et al.* (2001) as "services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the terminals". From a more user-centered view, Zipf (2002) defines LBS as "services for mobile users that take the current position of the user into account when performing their task". In 2004, Schiller & Voisard (2004) defined LBS as "services that integrate a mobile device's location or position with other information so as to provide added value to a user". From a more system-oriented view, such services were also defined in 2005, by the international OpenGeospatial Consortium, as services that: "deliver information about location to people who are using wireless, position-aware devices such as cell phones and PDAs. (OGC, 2005) According to Zipf *et al.* (2012), the LBS concept was early proposed in 2002 by Brimicombe as an "intersecting field of various technologies, namely Geographic Information Systems (GIS), Internet, and mobile networks/devices". So,

[1] In http://www.riehler.com/sensors-and-sensors/ by *Asad-Uj-Jaman*

basically, LBS are using the potential and the capabilities of modern mobile devices, positioning technologies and mobile Internet to deliver user value-added information or services based on the user's location. Although LBS seem something completely new and recent, this is not quite true. According to Zipf & Jost (2012), LBS had its origins in 1995 (at the same time as the Internet began expanding at a global level) from a mandate issued by the Federal Communications Commission (FCC) requiring that "… wireless carriers should be able to locate 911 callers within 50m of their location." (VanderMeer, 2002) Regarding Position/Location Data alone, its use started even sooner - in the 1970s. In the first decade, it was just used by the entity that created it, presently the owner of the Global Positioning System (GPS) - the U.S. Department of Defense (U.S. Government, 2013). Since 1980s, several were the industries that, at a worldwide level, have been accessing position data through the GPS.

1.2 The Common LBS Infrastructure

In general, LBS are not "standalone applications but rather services that require some sort of network connectivity" (Zipf & Jost, 2012). This is why any LBS is based on the following four key basic components, or individual elements (Ferraro & Aktihanoglu, 2011): Mobile Devices, Service and Application Providers, Communication Networks and Positioning Component or Service (Figure 1).

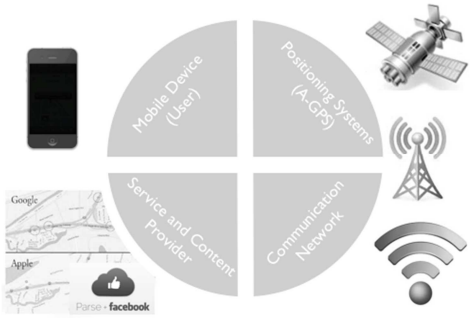


Figure 1. Four key basic components of any LBS

The ability to locate a mobile user or keep track of is one of the most important elements in all the LBS chain. Without this component, the mobile device cannot calculate the user location and, therefore, the LBS will be useless. According to Ferraro & Aktihanoglu (2011), "… it's become more common to be able to determine location via an API (Application Programming Interface) or software component to at least fix an approximate location". In fact, that has been the case with the major current mobile players - Apple with iOS and Google with Android. These mobile players have been providing freely access to their Software Development Kits (SDKs) to any mobile developer, that can now take advantage of the GPS or other location technology and, further more, in conjunction with realistic graphical maps. According to Cruz-Cunha & Moreira (2011), this reality leads to a fact that must be taken into consideration: "… these new mobile devices have become a platform with many possibilities to develop research and implement new kind of LBS".

1.3 Some Examples of Location-Based Services

Based on the existing commercial offer in the online Apple App-Store and among research projects in the area, the WIZI SMS LOCATION App and the CONNECTOR (Almeida *et al.*, 2012) Research Project were identified as the most relevant mobile applications, considering the similarities with the goals of the present prototype: the promotion of face-to-face communication between users located within a given geographical area. The analysis made can be seen in Table 1. These two LBS examples have contributed and provided the basis for the implementation of the prototype "I'm on campus and …", as will be seen further on.

Table 1. An excerpt of a checklist of the features/characteristics available on apps similar to "I'm on campus and . . . " (August 2013)

Features/Characteristics	WIZI SMS LOCATION	CONNECTOR
Require registration to work?	NO	YES
Send the current location by	SMS or email	-
Map provided by	Google	-
Context-sensitive help to the composition of the messages?	Just one field-level assistance.	NO
micro-broadcast Time Dependent (near-me notification)?	NO	-
Implemented scenarios:	1. Travel Status	1. Academic Events
	2. Leisure activities plan	2. Status
"Follow Me" background mode (User tracking)	YES	YES
On-App Chat:	NO	Instant Messaging (IM)

1.4 Mobile Developer Platforms Trends

As far as the development of native apps is concerned, according to data revealed by Mobile Vision (2014), both Android and iOS captured "over 94% of smartphone sales in Q4 2013". This data may explain why these two platforms continue to be the prioritized choices for the current mobile developers: "… 84% of mobile developers are now developing for Android or iOS (or both), the two clear winners in the developer mindshare race". This is because, at this point, for many developers the question is not which mobile platform to develop, but rather, which mobile platform to prioritize.

1.5 Face-to-face promotion

To end this first section, related to this research study's context and motivation, one more concept must me addressed. Maybe it can be translated by the following question, suggested by Grossman (2011): "*Is face-to-face learning still important*"? Though, nowadays, there are several technological solutions to overcome the barriers of time and space, when one speaks of Education, several research studies show that face-to-face communication is still the preferred medium over all forms of computer-mediated communication (Daniel Johnson & Sutton, 2000; Hardesty, 2010). As Escotet (2013) contends, maybe because "Education as a general concept" should be neither confused with just "Instruction", nor considered only "teaching or instruction, but social and cultural learning". Therefore, as stated by Grossman (2011), nothing can be compared to face-to-face communication: "communicating face-to-face sends a message before you say a word.

Having outlined the main technologies which were used to prototype a new micro-broadcasting LBS to promote face-to-face learning, as well as having contextualized and presented the main motivations behind this research study, in the next section, the prototype implementation will be described, covering these three main topics: Goals and Target Audience, System's Model and Architecture, and Functional Aspects. Finally, in the last section, usability and preliminary user experience evaluation results are presented and discussed.

2. PROTOTYPE AND EVALUATION METHODS

The "I'm on campus and ..." mobile app prototype was developed in Objective-C for mobile iOS platforms and it uses Parse Cloud as the mobile Backend as a Services (mBaaS).

2.1 The Prototype

2.1.1 *Goals and Target Audience*

"I'm on Campus and …" implements a new kind of LBS that aims to provide some specific communication service support for people interacting in a limited geographic area, such as a Higher Education campus, to

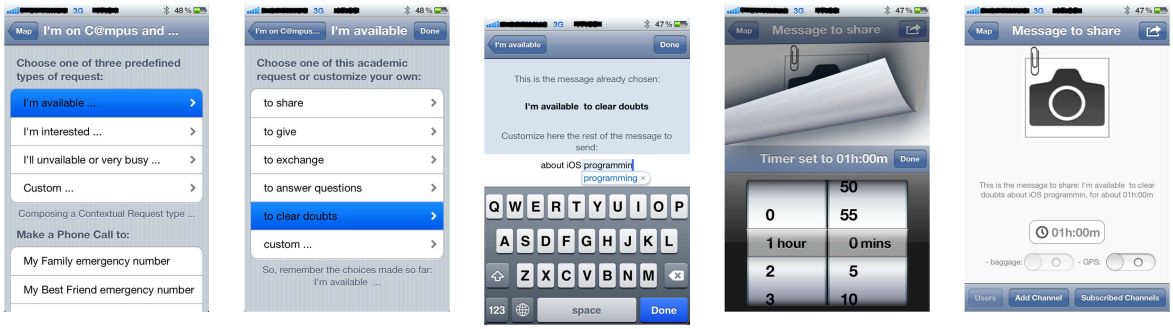
promote face-to-face communication. Consequently, the main target audience will be teachers and students belonging to particular academic campus.

2.1.1 *System's Model and Architecture*

Like any LBS, as it was stated before and illustrated in Figure 1, the "I'm on campus and ..." follows a client-server architecture comprising the "standalone application" (the iOS client mobile app) and "*some sort of network connectivity*" (Zipf & Jost, 2012) to be able to deliver the whole package of functionalities proposed: (1) *The Mobile Device* - any iOS mobile device (iPhone, iPod Touch or iPad) where the app must be downloaded and installed from the App-Store. (2) *The Communication Networks* - the existence of any network connectivity supported by the iOS device (3G/4G or Wi-Fi).(3) *The Positioning System* - the A-GPS is the location embedded engine/sensor present in the iPhone or iPad 3G/4G. (4) *The Service and Application Provider* - Parse was the mBaaS chosen. For the present research purposes, the Basic Free Plan is being used.

2.1.1 *Functional Aspects*

The communication services provided by "I'm on Campus and …" are context-based and both context- and time-dependent, and include the possibility to offer or request specific support from active subscribers located within a specific geographic range. One of the key features of this App is a context-sensitive help to the composition of the messages. Therefore, the App offers to the user field-by-field assistance. Currently, the options available include the following scenarios: (1) The possibility to express availability for some specific activity to be performed at a specific location during a specific time frame; for example, Figure 2 shows a professor notifying near-localized students of his/her availability to provide some academic support. (2) The possibility to notify other users of specific interest; for instance, this may be used for a student to let his/her classmates know that he/she is interested in getting in contact with colleagues keen to play chess in the next 3 hours and that they can meet at the cafeteria. (3) The possibility for a professor to notify his/her students or colleagues that he/she will be very busy during the next hour and would appreciate not to be disturbed within that time frame.



(a) I'm available … (b) to clear doubts … (c) … (d) for about 1 hour … (e) Complete message

Figure 2. Field-by-field context-sensitive aids to compose a "I'm available . . . "-type message: I'm available to clear doubts about iOS programming, for about 01h:00m

2.2 The Evaluation Methods

The prototype evaluation ("I'm on Campus and . . . ") is being carried out in two different stages. (1) In the first stage, related to the evaluation of Usability and User eXperience aspects, tests were carried out in a controlled environment, a lab and several offices, according to the availability of the participants. An option for a qualitative study was based on the idea that, as Nielsen Norman Group states "... you don't have to measure usability to improve it"; "it's enough to test with a handful of users and revise the design in the direction indicated by a qualitative analysis of their behavior" (Nielsen Normal Group, 2006).

(2) In the second stage, a User eXperience field trial is being conducted at the Viana do Castelo Polytechnic Institute (IPVC) Campus. The focus of this study is the usefulness of the service and the

consolidation of the preliminary User Experience results obtained in the first stage. The methodology approach is also being a qualitative study.

According to Nielsen Norman Group (2000), with a sample of 5 users we can achieve 85% of Usability Problems. This is why we invited two groups of 4 users each - one formed by 4 students and another composed by 4 teachers, to a total of 8 users for the first stage. The option by these two kinds of profile were based on the fact that they are the main target audience of the service provided by the App, with aims to promote the face-to-face interaction between these two major groups in a Higher Education campus. The instruments to collect the data in this evaluation phase were the following: (1) A survey questionnaire to be filled out by the participants during the Usability tests. (2) Three iOS Devices, two with the "Display Recorder" app to record on video the entire user interface interactions and, simultaneously, the audio from verbalized thoughts, doubts and comments, according to the 'Think Aloud Protocol'. (3) An observation Checklist to be filled out by the researcher during each session to assure a rigorous data registration. The evaluation tests were performed with each participant individually and always in the presence of the researcher.

3. USABILITY AND UX FIRST RESULTS

The data collected in the first section of the survey questionnaire has the main goal of revealing the most relevant usability problems. It was filled out by a sample of 8 users and where each user performed the following 5 practical scenarios: (1) User sign-up, user log-in and user localization; (2) I'm on campus and I am driving to Aveiro in about 30 minutes and have space for 2 passengers with baggage; (3) I'm on campus and I need a ride to Porto for 1 person with baggage, in about 2 hours. (4) I'm on campus and I'm available to clear doubts about iOS, for about 3 hours; (5) I'm on campus and I'm interested in forming a study group on iOS programming, for about 1 hour. The second section of the same survey questionnaire, filled out at the end of each usability session, has the main goal of catching the preliminaries evidences about the User eXperience.

From the first section, the data collected provides some evidence about (1) **Task efficacy** - all the tasks were successfully completed as requested; (2) **Interface validation** - although some usability issues were detected, in terms of "Easy to Use", we think they are not so critical that justify a new version of the app to move to field trial (real usage scenarios tests).

Table 2. Usability and User eXperience (UX) data collected from a sample of 8 users: value 1 corresponding to "I strongly disagree" and value 5 "I strongly agree"

A_i - Affirmation i with $i \in [1-15]$	1	2	3	4	5	$\bar{x}$	σ
A_1. It was simple to use the app.	0 - 0.0%	0 - 0.0%	1 - 12.5%	2 - 25.%	5 - 62.5%	4.5	0.76
A_2. I managed to achieve the desired goals with the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35
A_3. I used the app effectively.	0 - 0.0%	0 - 0.0%	0 - 0.0%	2 - 25.0%	6 - 75.0%	4.8	0.46
A_4. I think that I need to know more about the app to use it in an efficient manner.	1 - 12.5%	1 - 12.5%	0 - 0.0%	4 - 50.0%	2 - 25.0%	3.6	1.41
A_5. It was easy to learn using the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	3 - 37.5%	5 - 62.5%	4.6	0.52
A_6. The app does not need more help messages.	1 - 12.5%	2 - 25.0%	0 - 0.0%	3 - 37.5%	2 - 25.0%	3.4	1.51
A_7. The app. provided me the proper feedback to my actions.	0 - 0.0%	1 - 12.5%	1 - 12.5%	1 - 12.5%	5 - 62.5%	4.3	1.16
A_8. I felt that when I make an error, the app allows me to easily and quickly recover from it.	0 - 0.0%	1 - 12.5%	2 - 25%	0 - 0.0%	5 - 62.5%	4.4	1.06
A_9. The app provided me all the information that I needed.	0 - 0.0%	1 - 12.5%	0 - 0.0%	3 - 37.5%	4 - 50.0%	4.3	1.04
A_{10}. The information in this present app is clear and organized.	0 - 0.0%	0 - 0.0%	2 - 25%	2 - 25%	4 - 50.0%	4.3	0.89
A_{11}. The app has basically the functionality that I expect from an App of this category.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35
A_{12}. The app allowed me to explore functionalities by trial and error.	0 - 0.0%	0 - 0.0%	1 - 12.5%	1 - 12.5%	6 - 75.0%	4.6	0.74
A_{13}. Overall, I'm very satisfied with the app.	0 - 0.0%	0 - 0.0%	0 - 0.0%	2 - 25%	6 - 75.0%	4.8	0.46
A_{14}. I'll use this app in the future.	0 - 0.0%	0 - 0.0%	0 - 0.0%	3 - 37.5%	5 - 62.5%	4.6	0.52
A_{15}. I consider this app very useful and I'll recommend it to my friends.	0 - 0.0%	0 - 0.0%	0 - 0.0%	1 - 12.5%	7 - 87.5%	4.9	0.35

From the second section of the survey questionnaire, the data was summarized in Table 2 and provides evidence about (1) **Learning Time and Efficiency of Use** ("Easy of Use") - related to Learnability, Effectiveness and Efficiency quality metrics - the majority of users declared that the interface interaction was very simple to use, very easy to learn and very efficient; (2) **Memorability and User Errors** - related to Help and Feedback, Error Recovery and Information Over-load quality metrics - some users declared that they need some more help and feedback messages; (3) **Subjective satisfaction** - related to Satisfaction, Future Interest and Usefulness quality metrics - all users confirmed the usefulness of this new micro-broadcast LBS in Campus scenarios and also declared their future interest in using the app.

4. CONCLUSION

Despite the relevance of these evaluation activities, it is important to underline that these tests were made in a controlled environment - a laboratory. So, a field trial was required in order to provide further evidence about: (1) What are the most frequently used scenarios and under what circumstances the app is mostly used? (2) With which perception each user stayed in terms of qualities, gains and weaknesses of the app? (3) Finally, with which perception each user stayed in terms of control, privacy and safety when using the app? Although these tests are still underway in ESTG/IPVC campus, we are confident that with the accomplishment of these field trials we will understand more in-depth the real interest in having this kind of new mobile micro-broadcast, or near-me, Location-Based Services in a campus. More precisely, with real usage scenarios tests we are very convicted that we can achieve a better understanding of how much this new mobile service will develop and facilitate the interrelationship and interaction between users located within a given geographical area, and how useful it will be to have a service of this kind on a campus to promote face-to-face learning.

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