Model of Augmented Reality and Pedestrian Navigation about the Territorial Heritage: Design, implementation and evaluation

Jorge Joo Nagata
Grupo GRIAL. Universidad de Salamanca
Plaza de los Caídos, S/N CP 37008. Despacho 3017
Salamanca. Spain.
(34)- 923294400-1303
jorge.joo@umce.cl

José Rafael García-Bermejo Giner
Grupo GRIAL. Universidad de Salamanca
Plaza de los Caídos, S/N CP 37008. Despacho 3017
Salamanca. Spain.
(34)- 923294400-1303
coti@usal.es

ABSTRACT
This research aims to establish the generation and educational effectiveness of a digital learning module, linked to the implementation of Pedestrian Navigation System characteristics and Augmented Reality (AR-PNS), developing training processes linked to spatial information about the historical heritage and cultural, corresponding to the cities of Salamanca (Spain) and Santiago (Chile). The research focuses on two main areas: the first is the design and development of a PNS-AR platform, defining the architecture, functionality, interface and implementation; in a second stage of empirical testing modes, understanding and effectiveness of PNS-AR model created in a context of territorial Situated Learning will develop cultural heritage. Finally, the expected results are building flexible software in a mobile environment that allows the presentation of content on the historical heritage and the determination of its effectiveness in the context of situated learning and mobile.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: *Computer Uses in Education – computer-managed instruction (CMI) – computer-assisted instruction (CAI)*

General Terms
Human Factors

Keywords
Augmented Reality – Mobile Pedestrian Navigation – Mobile Learning – Territorial Heritage.

1. INTRODUCTION
The rapid growth of mobile technology and its capability in data processing, has led to the possibility for users to become lifelong learners where learning processes are no longer temporal and spatial barriers. Recent advances in the technological development of mobile devices makes possible the use of new learning environments-particularly the Mobile Learning or m-learning, in which the interoperability of data and information allow penetration integrate, connect and share various resources for proper identification of knowledge. Thus, an efficient and appropriate interaction between users and machines is the key to systems modeling and digital representation of the territory and its features, creating graphic user interface –GUI– adequate to situated learning in spatial contexts with particular meanings and facts situations. In other hand, due to the increased processing power of the latest mobile systems and the possibility of generating complex multimedia interfaces (particularly focused on the development of Augmented Reality -RA- besides incorporating pedestrian Mobile Navigation Pedestrian Navigation Systems or PNS) in addition to a possible system located multidimensional territorial information systems can be developed in the context of learning located where the user/learner can search and download any materials in its mobile device without time and space limitations, and what more importantly, it would exist a relationship between the learner and their actual territorial context better results in learning. [31][37].

The article is divided into three sections: in first place we will develop the concepts about Mobile Learning, Augmented Reality (AR), Mobile Pedestrian Navigation System (PNS) and Learning Situated. Secondly, we will describe the methodology, focusing in the development and implementation of software PNS-RA, collection of supplementary sources, the design and implementation of the evaluation instruments and the processing and analysis of the collected data. Finally, we will show the expected results.

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2. OBJECTIVES
The research objectives are framed in two contexts that are to be addressed in the study:

2.1 Objectives in the technological context
From the technological context of the research aims to analyze the main tools used in the development of situated learning by PNS-RA in order to have a diagnosis of existing software, its strengths and weaknesses, in addition to its possible development in a context education. We also intend to develop a software module PNS-RA through the frameworks of location, navigation and augmented reality iOS system, allowing the presentation of content on heritage and territory and they are translated into an effective tool for the acquisition processes knowledge in the

context of situated learning with mobile technology. Finally in this dimension we aim to establish the process of building the PNS-RA module using the architectural and technological context encapsulated by programming and customizable iOS system and its development frameworks.

2.2 Objectives for educational dimension

The objectives for the educational dimension are studied and analyzed previous research and developments in terms of the relationship between the PNS-RA and situated learning, determining the lines, features and relevant aspects in its contextualization. In addition we aim to determine the influence and effectiveness of PNS-RA software we created in the context of situated learning through a concrete example of the territory and cultural heritage through usability testing and assessment tools of learning. Finally we aim to identify and understand the experiences gained by users with software developed PNS-RA, where we identify the relevant issues and key factors resulting from usability generated in the educational context of learning over the territory in portability, mobility context.

3. THEORETICAL CONTEXT

The theoretical context of the research is part of the technological areas of PNS and AR, developing training processes related to land information on the historical and cultural heritage. The design of the representative model that results in the software and the empirical contribution of the study aims to obtain evidence about the display modes, presentation and adaptation for users, which would achieve a process of mobile learning and situated having as context defined, a territorial and thematic heritage framework. As territorial representation is a fundamental requirement in the development of the user interface and the display of the data in the context of PNS-RA, the findings may have a significant impact on the final design of the learning module.

3.1 Augmented Reality (AR) in process of Mobile Learning (M-Learning).

Augmented reality technology enables the combination of real-world physical and virtualized representation of the phenomena displayed. This representation is complementary to the actual observation of phenomena where the user holds implicit control interactivity information and viewpoints presented in the digital resource [6][7][10][15][25][32].

This combination of digital virtual objects in a physical-spatial environment allows users to visualize abstract concepts, experience events and situations that are impossible from the exclusive domain of the real world [4][14][27].

3.2 Mobile Pedestrian Navigation System (PNS)

The Pedestrian Navigation Mobile is a user-device process where the navigation is done in the context of human scale (1:1) assisted by different sensors and mobile tools where data are combined as digital mapping, landmarks and points interest, a navigation system and routing. This system requires more complex representations and algorithms for the generation of adequate experience, due to the scale and representation of information [8][18][23][37][38].

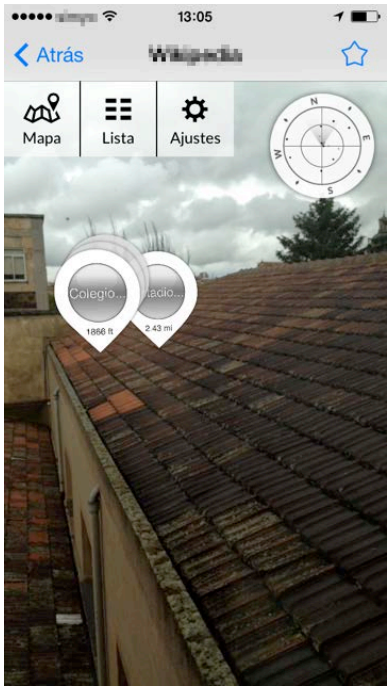

Figure 1. Augmented reality about the territory

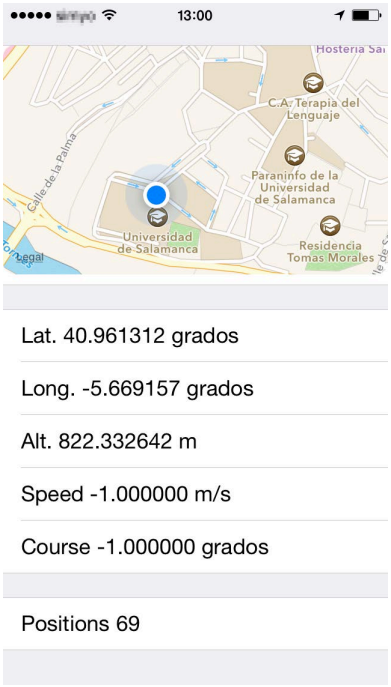

Figure 2. Mobile Pedestrian Navigation System in iOS

The pedestrian navigation applications are implemented by independent software that runs on a mobile device. Using own mobile sensors, and GPS and complemented with the multimedia capabilities of the device tool, you can begin a process of navigation, information currently visited territory. This permits the acquisition of three spatial levels of knowledge: reference medium; territorial sequence of knowledge by routes; survey and

contextual knowledge in a general spatial framework [23] [34][36][39].

3.3 Educational context: learning situated

From the educational context, establishing Situated Learning as knowledge acquired in a real context, being more practical, meaningful and applicable to problem solving, maximizing the effects of learning about direct teaching situations [2][12][29][33]. In addition the meaning of learning is deeply rooted in this situational context in real life-which in this case correspond to the territory and its elements, there being a sense of learning without a particular context and/or practical [26]. Besides, the learning situated emphasizes two important principles in educational processes: the first is regarding the integration of learning with practice and meaningful context; and the second is regarding the collaborative and social learning through tools presented in virtual [31].

4. METHODOLOGY AND RESEARCH DEVELOPMENT

In the development of research and theoretical approaches considering both as technical aspects related to implementation, we have proposed four major methodological areas, which range from architecture and software development, ending in collecting data and empirical statistical analysis of the functionality and usability. It also takes into account the aspects related to the query from secondary sources and the theoretical background to enable the achievement of the objectives and framework for the development of research.

The methodological framework is established by the type of action research to develop the essential phases: observation of the problem; interpretation, evaluation or analysis; and troubleshooting or implementing improvements [5][20][24].

4.1 Development phase and implementation of software PNS-RA

We will build a PNS-RA application using the XCode 5.0 software and the development languages Objective-C and Cocoa Touch, complemented with the implementation of the respective frameworks for the generation of software in a mobile environment iOS [1][3][9][21][22]. For research is considering the development of a structure and architecture that is oriented to encapsulation and inheritance code, identifying strengths and opportunities in a highly dynamic and changing environment [13]. In addition, the thematic of territorial heritage will be implemented through the main iconographic places in the cities of Salamanca, Spain, and Santiago de Chile taking into consideration the creation and implementation of the respective multimedia elements: CAD and spatial models, photographs, reviews text, audio and / or video. These are functional and thematic value added that we establish as disseminate knowledge through this tool. The result of this phase corresponds to the generation of a PNS-RA software on territorial equity in the context of mobility and location that gives the iOS system.

4.2 Collection of supplementary sources, study documentation, experiences and generate the theoretical basis

In this phase we will make a collection of information necessary for theoretical contextualization of research, studying experiences and practices related to the proposed project. The information we have classified and structured so as to allow a clear interaction with content and tools generated in the previous section, including the conceptual and methodological definition and how the issues of software development, PNS, RA, addresses and territorial heritage situated learning. The product obtained in this phase is the development and theoretical context of the research resulted in a report summarizing the relevant aspects investigated.

4.3 Design and implementation of the evaluation instrument

Because the research design is set in a descriptive and correlational context [20] that is still the main tool we have used for the data collection software developed. The measurements we will do the respective acquisitions by making mobile computing system: in the background in relation to the implemented interface, consultations, connectivity used, transferring data, etc. Measurements in foreground refer to a survey of users of the PNS-AR software, in order to obtain information on usability, perception and learning process received. For two dimensions we will build a suitable instrument to the respective assessment specialists. The sources used to measure the effectiveness will be in a real educational context: college students with relevance to territorial and heritage topics; and secondary students with plans and programs that include the concepts addressed in the tool. In a complementary way the methodology of the case study will be used [40] in order to understand the context and meaning of the educational experience through tool implemented using in-depth interviews with relevant actors, formal documentation and use of content from other related sources (social networks, forums). The results will serve as input for the development of the next phase of research.

4.4 Processing and analysis of data collected

After obtaining the basic information, we will proceed to the processing of data obtained through Google Earth 7.0 and ArcGIS 10.2 softwares for developing spatial models of representative [11][17][28]. Then we will enter and will encode the values of the questionnaire in the SPSS 20 program for statistical analysis. The main dimensions of the instrument are intended to measure are: descriptive statistics, correlations, mean comparison and classification by conglomerates. For qualitative analysis of data (in-depth interviews) of this case study the software NVivo 10 is used in order to facilitate data processing [40]. The results will be interpreted and analyzed in the context of research, establishing educational dimensions, characteristics of the learning patterns of usability and relationships of information structure developed in an atmosphere of situated learning and mobile learning [16][19][30].

4.5 Expected results

As research results we hope to build a customizable software under the modular structure and the area of mobility, navigation and virtual interaction (PNS-AR), which allows the optimization of all the components system, facilitating and enhancing your digital construction. This would result in benefits in the development of improvements and optimizations according to the progress and necessary requirements as outlined instrument for an informal learning environment, digital mapping (spatial-location) and the territorial and heritage information within the mobility and portability offered by the iOS mobile system.

In parallel, and from the educational dimension, it is possible to argue that the developed tool (PNS-AR program on an iOS mobile environment) have greater effectiveness in the field of education,

compared to similar methodologies and usual tools: books, maps and direct instruction. The use of this tool is developed within the context of mobile and situated learning, establishing that it is a suitable method for the acquisition of spatial-heritage knowledge within a framework of portability that mobile devices provide.

5. CONCLUSIONS

The generation of software PNS-RA with the thematic of territorial heritage is a new training modality in context with Mobile Learning and Learning Situated. This technology allows for greater ease of content delivery and greater efficiency in personalized learning processes.

This research has a strong emphasis in technological aspects and pedagogical elements, allowing develop a continuous improvement of each element involved in the PNS-RA system (heritage content, implementation in iOS, portability, educational process).

Finally the mobile learning and situated learning are educational events that are having a major impact in the development of mobile technologies (3G and 4G lines, cellphones, smartphones and tablets). The personalization of content and process in areas such as the PNS and territorial heritage virtualization allows an improvement in the learning process and the incorporation of cultural identity locally.

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