Geolocation in a Library using Augmented Reality

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Abstract **– Libraries are educational spaces in which it is important to have novel information resources that invite users to delve into them, and consult physical learning resources in an efficient, novel and attractive way. New technologies have entered into different educational environments, which means that Augmented Reality allows the creation of new and attractive digital search environments that help the location of bibliographic material. The RA facilitates this geolocation, since it shows through a digital content the three-dimensional space of the environment, highlighting the categories and classifications of the physical references that are desired to consult, so that the user can locate them quickly and consequently. They can be directed in a relatively short time to the exact location in which the references are.**

Keywords **– Augmented reality, new technologies, digital environments, libraries, computing resources.**

1. Introduction

Libraries have always provided the ideal space to concentrate, first physically and now digitally, comprising a great number of academic references, some even of a unique nature. However, these bastions of knowledge have also had to adapt to the rapid change in new technologies and, of course, to the continuous adjustments in their budgets, that is, to do more with less [32], [28], [1].

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At present, countless cities, universities, libraries, museums, monuments, etc. can be visited from the comfort of a computer, or by means of a mobile device using the Internet connection [29], [20], [13]. At the same time, the search for information in a library has also made important advances: it has gone from being a simple search in a database carried out by a computer, by means of a mobile device, a Global Positioning System (GPS) to physically locate the publication to be consulted [11], [4]. In this sense, the application of Augmented Reality (RA) has proven to be a fairly efficient tool in the search for information in a library. From the point of view of workers, RA systems have managed to reduce time, increase accuracy and produce more reliable book inventories [7]. In the same way, the RA can be used to make a person's visit to a site with these characteristics more attractive [26].

Today, young people have many computer tools that they can use to search for bibliographical references, even from the comfort of their own homes. The adaptation of these generations of students toward new technologies, most of which are based on Internet data search engines, has strong impact on the libraries. However, students visit libraries less and less to consult bibliographic references, and these knowledge niches have gradually become architectural symbols and museums rather than places for bibliographic consultations. It seems that libraries have gone from being mystical places to places that today are only used for guided visits by some primary or preschool students. Nevertheless, it is ironic that new technologies, being the main cause of students who are not visiting libraries so frequently. In other words, new technologies, seemingly contradictory but nonetheless true, are the only ones that could rescue these niches of knowledge precisely from the potential and total abandonment, which is a new chalange in this field of the present time. Without a doubt, the experience of visiting a library is enriching and motivating. However, this experience can be taken to more interesting levels with RA [9]. From the very moment a person enters a library, the experience can become an extremely new adventure [15], [3]. This is because, when codes are implemented in specific places that allow, through a

mobile device, the reading of the AR, then the potential user would be motivated to introduce, know and use the new services and educational environments offered by a place of this nature.

At this point, the following question makes sense: What is the main satisfaction that a person wants when entering a library? The answer is certainly not unique, much less easy to answer. We consider that one of the main satisfactions for a library is to give an answer, in the quickest and most efficient way, regarding the search of some reference that is inside its facilities. If the reference is digitized, it does not take more trouble than performing the search in a database using a computer, and then the result will be immediate. On the other hand, if the reference is physical then the search can be made in a more attractive and novel way for the user through a digital environment shown with RA [10].

In this way, by recognizing that the main problem it faces, a library is the search for a physical reference by a person who has no knowledge of how these references are catalized, then the mobile devices, connected to the Internet, play a preponderant role for the user to carry out the physical location of the reference he wishes to consult. As mentioned above, the RA can serve as a guide to take the user to the reference sought, and not just with GPS technology [24], [12], but in a more interactive, attractive and novel way for the user [31]. Therefore, the RA is seen as an effective tool that favors the creation of new didactic/educational environments that facilitate, in turn, the learning process [21], [17], [8].

2. Materials and Methods.

Search systems

Information systems have transformed the world, so much, and as a consequence today, there are more smartphones than fixed ones. In addition, more and more people have access to the Internet (for example, in the United States of America there are one hundred and twenty-two million people who access the Internet through various mobile devices), which opens up new and multiple possibilities for information systems to use smartphones as an efficient tool [18]. In this context, systems designed to search for information may use these connected mobile devices, the Internet, to locate bibliographic material. This type of avant-garde system must have three fundamental factors of consultation: collection, organization and the use of bibliographic material. These three terms concatenate to achieve a main objective, which is aimed at providing the user with what he or she is looking for, that is, to provide the service of a bibliographic material that is found within a collection, generally among the books, organized in a formal manner. This approach is the basis for implementing a search system in which the RA is superimposed on the fiduciary markers that will be placed from the precise moment the visitor enters the library. That is to say, to provide from the beginning to the users a system that guides them by means of RA, generating an interest for entering the facilities and, at the same time, it serves as a practice for the correct use of the application in the accomplishment of the searches of the requested bibliographic material. In this context, software engineering is of great relevance, since it provides, in addition to integrating all the elements needed for its design, specific guidelines to be followed for the construction of an information search system [5]. These guidelines not only refer to hardware and software, but also involve personnel who cooperate in an organization and whose objective is to obtain the desired result through the interaction between the system and the components that are developed in the interfaces of that system [14].

The Software Architecture

There are multiple styles of architectures for a system [16], but for the type of system that is planned to build, the Model Vista Controller (MVC) is the one that best adapts to our needs. This paradigm of software architecture is useful for the development of systems, in which it is required to provide the end user with an illusion, so that, at the same time, he perceives the existing connection between his brain and memory. This connection (brain-memory) will be perceived simultaneously with the computer processor. The MVC is a software architecture that separates the data of an application, the user interface and the control logic into three distinct components: Model, View and Controller (see Figure 1).

The "view" is the way the user interacts with the software; this interaction basically translates into the system interface and the controller. This scheme is frequently seen in the web applications, in which the "view" is the page that is displayed. It happens, for example, with the code written in html5 or JavaScript, which serves to design dynamic pages and excellent appearance, while the "controller" is the event that is done through the code. Thus, a model can have more than one "view", each one programmed to be displayed by a specific controller. In our system, the "view" makes the program show in the system interface the elements found in the user's imagination, and in our case, the RA associated with what the user is looking for.

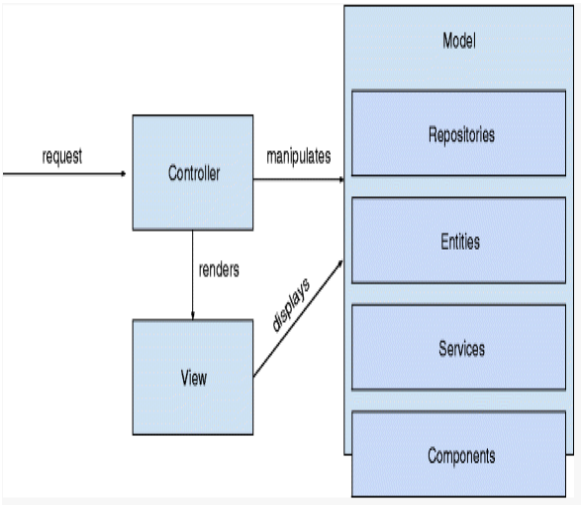

Figure 1. Model View Controller (MVC) [2].

The search functions with an RA-based system can be "triggered" with the use of a camera, which at the moment by detecting the physical face of the user will show the functions on a screen, and the user will begin to visualize the virtual tour of the library, which will be superimposed on physical reality (see Figure 2). In addition, the virtual tour can respond to a query made by the user with some search words, through a database, on the content of books organized by various topics. Subsequently, the RA will be shown each time the user directs his camera towards a point of interest predisposed in strategic places of the library, and it will help the user to move within the route previously designed for the search of the desired reference. That is, from the beginning and each time the user deploys the AR, the system will direct it towards its initial objective (see Figure 3). The way to guide it can be with visual and auditory signals, and the user can move quickly and confidently within the physical space of the library. Furthermore, information display events can be triggered, which is also displayed with RA through programmed points of interest and supported by a GPS system, through which the information will be displayed depending on the location of the mobile device. The information that is emitted will contain the themes of each shelf displayed by the user (see Figure 3).

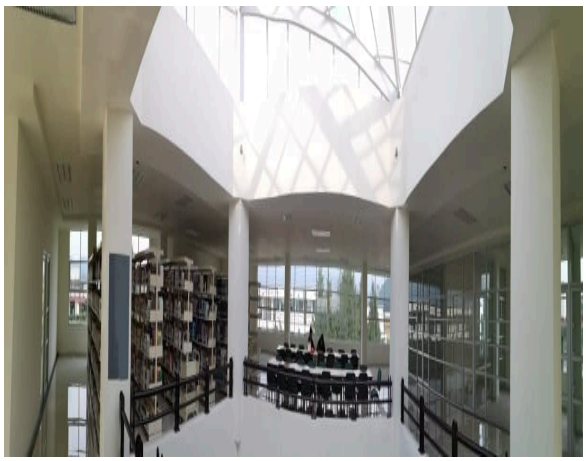

Figure 2. Virtual tour of a library

Figure 3. Point of interest predisposed in a strategic place in a library

Bookmarks and 3D images

The tracking of AR approaches or functions can be based on the location of fiduciary markers or textures of 2D images (see Figure 4), which allows the precise location of the 6-degree freedom camera (6FD) in the coordinate system, allowing the real placement of virtual objects in the real world [25]. In the RA, the marker is used as a trigger, which is activated when detected by a mobile device, and in order to show the user 3D virtual objects or multimedia files [19]. Once the marker has been designed, it is exported as a printed image - this image does not depend on the format – and it is placed in strategic places in the library [30].

Once the markers have been generated, their corresponding virtual models are made to be seen as 3D images [6], which will be superimposed as RA [22]. There are multiple programs for the design of these elements (for example, 3D Max, SketchUp, Blender, K-3D, Zmodeler, AutoQ3D), however, they are not detailed in this article because each design software has different characteristics, and the breadth of the subject is extensive.

Figure 4. Tracking RA approaches through fiduciary markers [27].

3. Results and Discussion

Virtual tour

The virtual tour is an application that is generated using several panoramic images of an installation, in our case a library. These images are integrated into a specialized software, so that the user can make use of the arrow keys, and with that can go virtually to a specific place. The type of software for the creation of RA must be specialized for the solution of this type of problems. RA applications work by association, which in our case will be associated with the marker to show images and broadcast audio or play a multimedia file. Currently the programs that generate this type of applications are simple, and some of them are available for free on the Internet (for example Aurasma, Vuforia, ArToolKit, Layar). If more abstract tours are required, then more specific design programs should be used to help build them (e.g. Panotour, Pano 2VR, Virtual Tour Pro, Tourweaver, 3D Vista Virtual Tour, Vtility).

Prototype construction

The prototype schematizes the actions performed by the user and the way the system acts (reference). Our prototype shows the preliminary version of the system with the characterization and behavior of the modelling, which will serve as a basis for projecting towards the final version. In addition, this prototype is essential since it forms the basis of the real system. For the construction of our prototype, the following actions were taken into account:

a) The Virtual Tour starts at the entrance of the library, here the user can observe the different sections marked with useful points to locate the section of interest (see Figure 5).

Figure 5. Example of a project with RA and virtual tour.

b) The next action of the RA is shown through a virtual tour, which allows the user to navigate through the library facilities, simply by pressing buttons with labels that identify the corridors according to the theme located. This action gives the user a more global perspective of how the library is organized (see Figure 6).

Figure 6. Example of a virtual tour through RA.

c) Subsequently, the search system guides the user through the use of his mobile device. The user will only have to focus the camera of his mobile device towards the markers that were previously strategically placed inside the library. This will be the virtual tour, and it will allow the user to be

guided to the exact location in which the query he made, at the beginning of the search system, is physically located (see Figure 7). In this action the RA is shown through three-dimensional images and a multimedia file, the latter will advise the user by means of indications. We will mention a few of them: "continue to the right" or "continue straight". Of course, a very important factor for the success of the virtual tour will be the speed by which the data is transmitted [23].

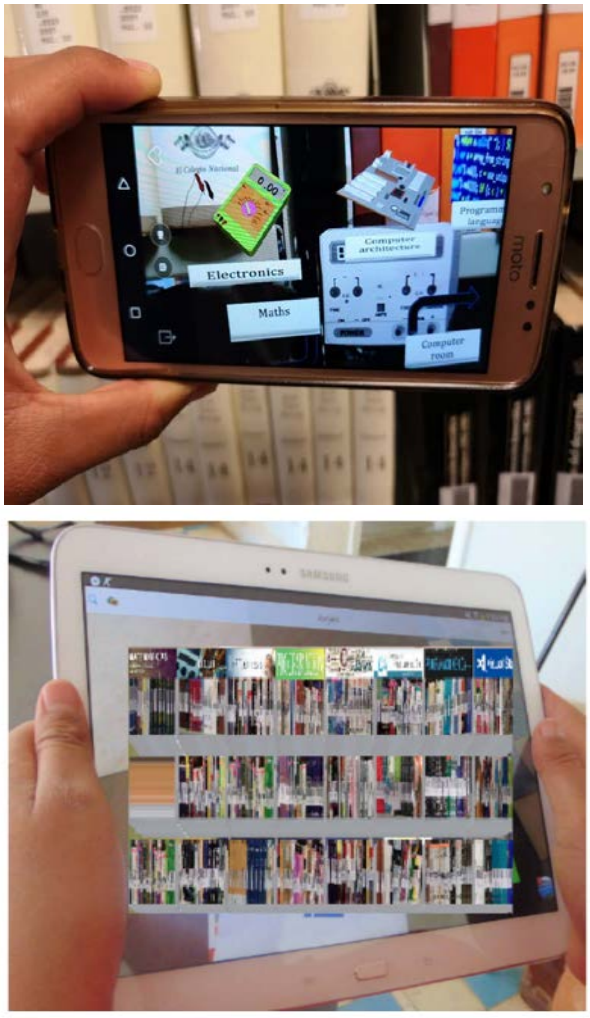

Figure 7. Virtual tour through RA using strategic markers.

4. Conclusions

The RA is applied in multiple areas of knowledge, and it is precisely in the so-called information systems in which it has a wide perspective to detail queries that can be used, in turn, to show results classified according to the various input parameters. The central idea of this work is that the proposed system should have the capacity to generate broad expectations of use, among which is to encourage and motivate users to visit and enter the libraries and, consequently, that this RA system arouses the interest of visitors through new and innovative services offered in all sections that make up a library. Of course, this new technology will depend on the level of economic investment in order to make it more attractive and interesting.

RA is a novel (and quite inexpensive) way of observing and appreciating things, as it adds multiple advantages to the current static reality. This process undoubtedly enriches and transforms the structures of thought, which causes people to radiate their imagination with multimedia elements that shape and complement the real elements. Traditional information systems are enriched with this type of additional technology (RA), since by making their management more efficient it is expected to continuously motivate software engineers, and develop, implement or improve this type of models. Systems focused on the search for information, where AR is implemented, are valued more, because they show information through different cognitive models, such as visual, auditory and kinesthetic. In addition, search systems based on AR, such as the one proposed in this work, will also serve as a support to the staff that attends the libraries. It can either replace a human guide, or resolve in a minimum time any type of questions that users pose at the time. With a view to the future, we consider that this search system, based on the RA, could be implemented and approached from several perspectives, that is to say, the central idea is that it should be the starting point for generating new and innovative search and location alternatives in diverse sectors, such as universities, museums, sports stadiums, archeological zones, self-service stores or tourist attractions.

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