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MOBILE AUGMENTED REALITY AS A VIRTUAL TOUR GUIDE WITHIN A CAMPUS

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Summary

With the constant advance of technology in the world, what some years ago was considered part of science fiction, has begun to become a reality, a clear example is the case of Augmented Reality.

Augmented Reality (AR) is a technological tool whose use is integrated day by day in the fields of education, advertising, entertainment and others [1]. Tourism, being one of the main sources of income for many cities and countries, has incorporated new technologies with mobile AR applications mainly as a tourist guide. Therefore, the present work shows the development of a mobile application (App) with AR as a tool that performs a virtual tour inside the building 36 of the Instituto Tecnológico de Puebla and locates the classrooms, providing guide information regarding its distribution thanks to the design of models in 3rd Dimension (3D); in addition, it visualizes class sched, assigned teachers, subjects, and students enrolled in them by means of a Smartphone or Tablet. This makes it easy to locate students and teachers.

Keyword(s): Mobile application, 3D model, Virtual tour, Augmented Reality.

INTRODUCTION

Augmented Reality began to be mentioned in the early 1990's by implementing a combination of computer-generated images over a user's view of the real world. By 1995 it would be defined more specifically as "augmentation of the real world with synthetic images in a scenario, in which the images are used as a complement to the real world scene". But it would be in 1997 where the following definition would be established: "fusion of a direct or indirect vision of a physical environment (real world), whose elements are combined with digital objects to create a mixed reality in real time; in addition to its current characteristics: combination of the real with the

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virtual; interactive in real time and recorded in 3D [2].

In 2012, the most recent definition of AR emerged, "a technology that allows adding virtual information on reality". According to the mobility of the recording devices and/or displays in AR, they are divided into two types of systems: mobile or spatial. This is where the indispensable use of the Smartphone as a mobile recording device is born.

One of the methods used for the development Augmented Reality (AR) in mobile devices is based on shape recognition. In it, some element such as image, audio, video or 3D models "appears" when the camera of a mobile device or a computer recognizes the shape of the object. By means of markers, images or objects [2].

There are currently many AR applications focused mainly on education at all levels, from preschool to teacher training. Secondly, this technology is used in sales, where the objects being advertised can be modeled before being purchased, such as watches, outerwear and underwear, by downloading the respective application via cell phone or computer webcam [2]. In Mexico, this technology has been poorly exploited. This year, it was a novelty that the Ministry of Finance and Public Credit of the Federal Government presented the verification to validate the 200 and 500 peso bills by using an AR application through a mobile device. And to the amazement of many, it leaves behind the light machines and pens that did the same job, with AR it shows animated objects such as a bell with sound and an eagle flying; all thanks to the reading of the markers configured in each recently issued paper money.

Applications based on "markers", located within Level 1 of AR due to their way of working, parameters and techniques employed. It combines synchronized virtual information superimposed on real-world information and is projected on the screen by the cell phone. The information is captured through an input device, a webcam, to which the markers are shown, which are the black and white patterns that indicate to the system where the previously created virtual image should appear. The mobile device, through a software, presents the associated information and allows, by rotating the markers, to see the 3D image from different angles and appreciate its details [1].

Another of the applications of AR is to perform tours in closed environments allowing to locate in large spaces, prominent sites as developed at the Simon Bolivar University in Barranquillas Colombia. An Android application was implemented that offers the student community more location information by providing the name of places of interest, such as study rooms or the name of each of the offices of the building within the University; in response to the lack of signage used in crowded spaces of people and various functions [3].

Problem statement.

At the Instituto Tecnológico de Puebla, every semester and during the first weeks of the semester, students and teachers waste time locating the classroom where a particular subject will be taught, this can consume considerable time, in addition to the minutes spent moving from one building to another, which can take from 15 to 20 minutes. It is worth mentioning that the educational campus has 53 buildings distributed within 25 hectares.

The phenomenon is greatly exacerbated in new students, who miss the entire class because they get lost in all these buildings. And although there is signage marking an identification number in each building, there is no sequential order.

Will a mobile application be able to quickly display classroom location information to identify where a specific class will be taught?

Is Augmented Reality in a mobile application a novel technological tool that is easy and inexpensive to implement?

Justification.

Substantial lost time is observed at the beginning of classes during the first weeks of each semester, students wandering between buildings asking where classrooms are located, students falling behind in class, teachers teaching in the wrong classrooms, etc.

If software is implemented through a mobile application that significantly mitigates the time required to instantly know the location of classrooms and classes taught daily by teachers to students, it will benefit more than 600 basic teachers and a student population of more than 8300 students at present.

To all the above mentioned, the implementation in the technological community of the present work is justified, whose main objective is:

Design and develop a mobile application with AR to locate easily and virtually, within the building 36 of the Instituto Tecnológico de Puebla the classrooms, teachers assigned to those rooms and students enrolled in the subjects using the development tools Sketchup, Unity and Vuforia.

METHODOLOGY USED AT DEVELOPMENT

Figure 1 below shows the process graph, which illustrates the main activities that were carried out to develop the mobile application with augmented reality. The sequence of the activities in the graph indicates the order in which they were carried out, starting from the identification of buildings to be modeled to the testing of the application.

Process diagram for the development of the App with AR.

Identification of the buildings to be modeled

As a first activity, the identification of the buildings to be included in the mobile application is considered, the areas and their physical characteristics such as dimension, size, color and textures are recognized, so that the 3D modeling is as close to reality as possible [4].

3D modeling of buildings

There are a variety of tools that allow 3D modeling, however, *Sketchup* is a very intuitive software, so no advanced modeling knowledge is required; *Sketchup* presents for modeling, an axonometric perspective of 3 axes X, Y, Z Figure 2).

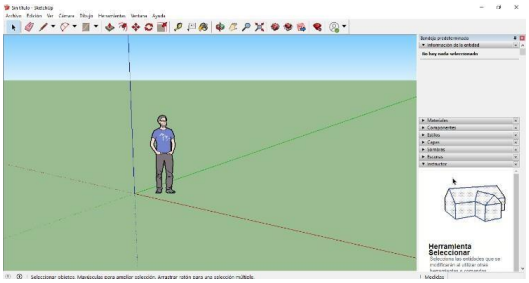

Figure 2. Axonometric perspective in Sketchup.

In addition, it has a rendering plugin (*Vray*) that allows the developer to add effects such as lights and shadows to the modeling (Figure 3), order to provide the user with a design much closer to reality.

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Figure 3. Vray in Sketchup.

Creation of target images

One of the ways with which augmented reality can be realized [5], is that 3D modeling is linked to targets (or also called markers) [6], for this case the targets are images (Figure 4). These targets [7] can be created in any type of software that allows exporting images [8].

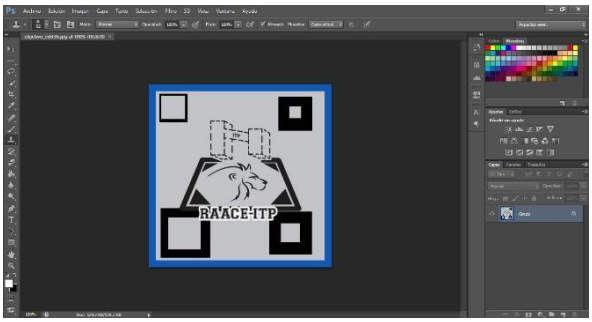

Figure 4. Creation of objectives.

Linking the target to the database

Once the objectives are finished, next step is to link them to a , using Vuforia, which is a tool integrated in the Unity platform.

Unity is a multiplatform development application, which among many other utilities stands out for being a software to create video games.

To use Vuforia, it is necessary to register on the site and enter a license key (Figure 5), then a database file is created (Figure 6).

data where the created target is included for later downloading (Figure 6).

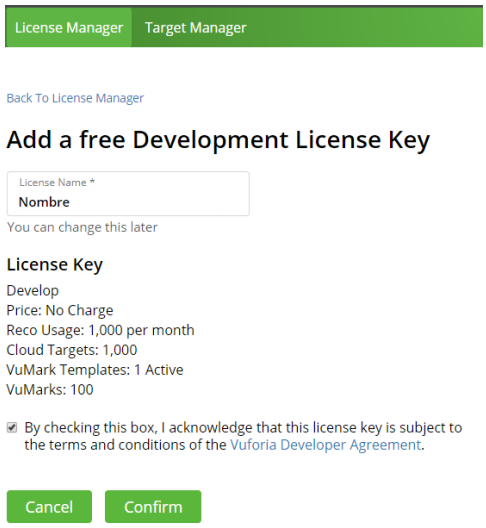

Figure 5. Vuforia license key creation.

Figure 6. Download of the including the target image.

DB import and installation with App development software

Once the database is downloaded from the Vuforia website, it is imported into the App development software.

In order for Unity to detect the downloaded file it is important that, during the download process, the development platform is in use. In the window the files it contains are displayed (Figure 7), among them the name of the file we gave to our target image must be found and once we verify that everything is correct, we proceed to import it.

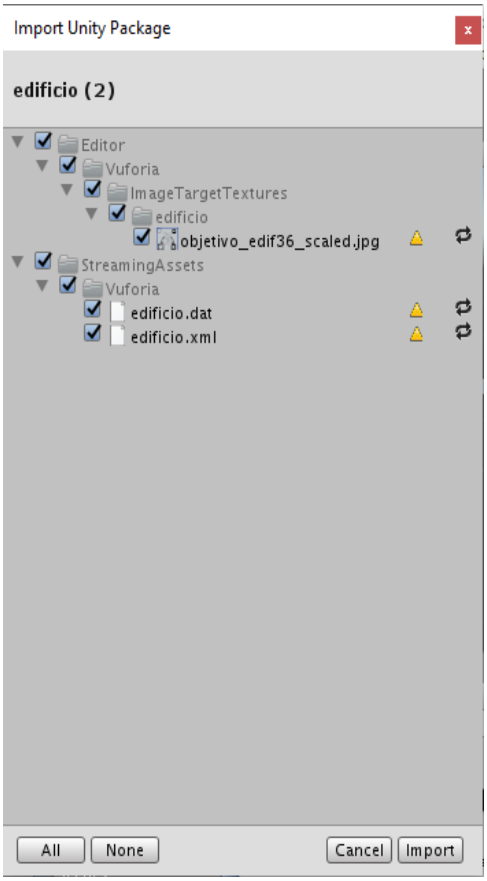

Figure 7. DB import to Unity.

Import of 3D modeling into the App development software

To add the 3D modeling to the project in Unity, it must be exported with an fbx or 3ds modeling extension from *Sketchup and* just drag it from its location to the *Assets* section in Unity.

In order to use the camera of the mobile device as a lens that recognizes targets or markers, it is important to select the target as an "Image Target" type from Unity.

App export to mobile device

Unity, being a multiplatform development environment, allows exporting projects to different types of systems, whether computers or mobile devices, and also different versions of the systems (Figure 8).

Figure 8. App export.

Below are the execution windows obtained from the finished and initially proposed application, where you can see the visualization of the information of the teachers assigned to the Users2 classroom on the first floor of building 36 and linked to a 3D model allowing to locate the group of students enrolled in that timetable.

Once the application is installed on the mobile device, the relevant tests are performed, in this case the connection to the server where the school database is stored with data on teachers, class schedules and classrooms (Figure 9), as well as the presentation of the modeling (Figure 10).

Figure 9. Display of classroom and teacher information in the App.

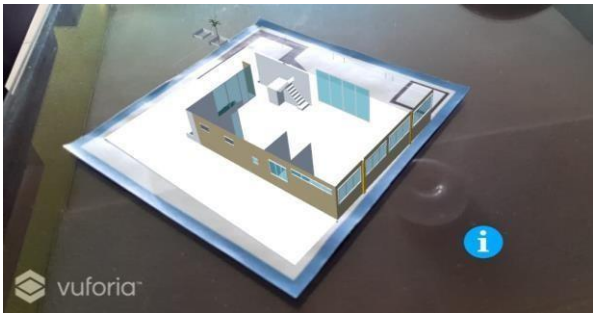

Figure 10. Visualization of the 3D modeling.

Discussion and analysis of results

The mobile application developed in this work was successfully tested within the student community, particularly new students in the current semester and during the first week of the beginning of the school year at the Instituto Tecnológico de Puebla. It was received with excellent comments and acceptance

According to the software satisfaction survey, the following benefits are shown:

- The installation of the app on the Smartphone was quickly downloaded to the memory and
- The software response time was 45 seconds.
- 9 out of 10 participants felt that it was easy for them to identify their classroom,
- 60% reduction in unpunctuality of teachers and
- The number of students who were not on time was reduced by up to 40%.

Remarks, any student or teacher reassignments and/or updates are not submitted because this application's database is not connected to the campus information system after the close of enrollment and student load adjustment period during the elective school year.

The current issue, with the dizzying technological evolution that allows the availability of mobile devices with increasingly greater functions and at more competitive costs, making possible the integration of these devices to a wider public [11]. The use

The demand for augmented reality systems will increase exponentially due to the low cost of cell phones in the very near future [12].

In the short term, the discussion should be directed to include knowledge for the development of applications with emerging technologies in optional subjects within the curricula in higher education, graduates would invariably have cutting-edge tools to generate applications in them, specifically with Augmented Reality. And not leave this growth only to foreign companies and the few large consortiums in our country.

CONCLUSIONS

Once the development of the mobile application with Augmented Reality using Sketchup for the 3D modeling of the building 36 of the Instituto Tecnológico de Puebla was finished, and the image was linked to the database through Unity and Vuforia to the Smartphone, it allowed to quickly identify the classes in the classrooms assigned to teachers and students.

All this supports that the application achieved the objectives initially set.

This emerging technology is a very fertile field currently little exploited, provides great opportunities for growth because, today, there are very few applications with Augmented Reality in Mexico. They should be largely exploited in innovation research in the coming years and young communities of developers, driven by competition from countries that are promoting the market for AR apps.

To generate this type of simple but efficient apps with this technology, there are several free or low-cost tools for their development that require basic knowledge in graphic design, programming and database management [13]. As a support in obtaining design skills, several texts are currently published on the tools for

applications with augmented reality as was not presented in previous years.

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