Mobile Augmented Reality to Support Basic Education in Mexico

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Abstract
This paper proposes a Mobile Augmented Reality system for Android devices that allows Mexican basic education students to access additional educational content related to their textbooks. The application recognizes the images printed in the book as part of the regular topics and show multimedia content that complement the topics covered in the book.

Keywords
Augmented Reality, Android, Basic Education, Mobile Device

Introduction
The teaching methods are constantly evolving and involve new technologies in these changes. At the beginning of 20th century, movies (recently invented) were adopted as an educational tool for American schools [1]. In the 1990s, with the worldwide adoption of the Web, content on the Internet and digitized communications were well received in education. In the early twenty-first century the great advances in mobile technologies reached have enabled us to make use of technologies such as augmented reality (AR) in educational projects.

The AR mixes virtual features with the real world. As its name suggests, it augments the real world with virtual information [2].

AR, while appeared in the 60s, recently have emerged technologies that allows it to be developed, distributed and used on a large scale. The boom of mobile devices with high processing capabilities and the presence of cameras in virtually all recent mobile devices make a great support for AR applications..

Currently there are several prototypes of AR systems applied to education. Some examples are [3], [4] and [5]. In [6] it is shown an Android application that helps young children learn about the human skeleton.

The prototype presented in this document is intended as a support for basic education students to improve

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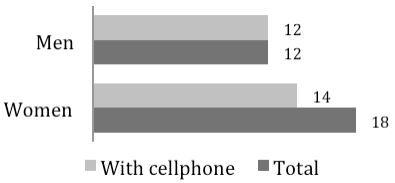

Figure 1. Statistics by genre

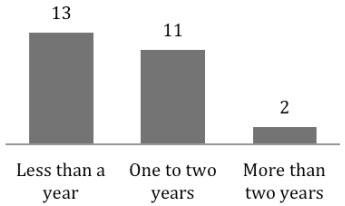

Figure 2. Time of use

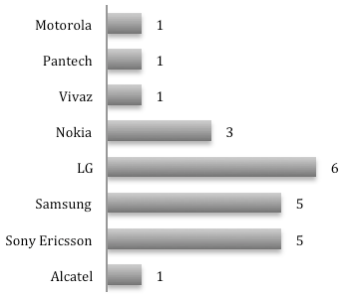

Figure 3. Cell phones brands

the understanding of the topics covered in their textbooks using only their own mobile phone.

Methods

We developed an AR prototype for mobile devices that displays information related to the topics of a secondary education textbook when it is viewed through the device's camera.

We chose an AR development kit to work with. After that, we developed an application that can identify different markers and images and that can display 3D models and multimedia content.

From the textbook we abstract some topics and for the augmented layer we created 3D models and we used some freely distributed (under a Creative Commons license) models. Each one of these models is related to a different marker o2r image.

The next step was to detail the user interface so the user experience of the application was the right one according to the expected users.

To know the context around this subject we made interviews to students in a public secondary school about their cell phones and the use they gave them.

Understanding the students

We interview 30 students, 10 from each grade, randomly chosen from each grade in the school Pablo Latapí in Manzanillo, Colima, Mexico.

Figure 1 shows that 100% of the men and 78% of the women interviewed have a cellphone, which is the 86% of the whole group.

In the figure 2 we can see that of the 26 students that have a cellphone most of them got it within the last two years, which is the time most of them got into secondary school. The fact that a very small minority got it more than two years ago indicates us that is very unlikely to find that the students in lower levels of basic education (primary education) have a cell phone.

In the figure 3 we can see that of the 26 students interviewed that have a cell phone we found that the brand that most people use is LG, followed very close by Samsung and Sony Ericsson. Those three companies made cell phones with Android, the operating system for which our application is designed.

Of the 26 interviewed students that have a cell phone we found that 96% have one with a camera. The camera is the most important element of an augmented reality system and this results indicates us that currently in very unlikely to find a recent cell phone without a camera.

Desired features of the system

In order to make that the AR supports basic education our system must have the next feature:

- *Support different devices.* The system must be able to be used in as many Android devices as possible because there are a very large number of different devices. The idea is that the scope gets to be as broad as possible.
- *Easy to use*. The system must have a very small learning curve and be as easy to use as possible. To achieve this must be properly designed and have gone through the necessary usability testing.

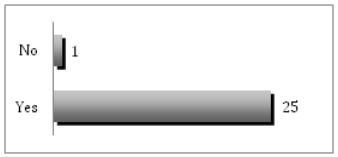

Figure 4. Camera phones

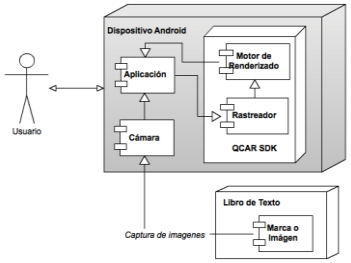

Figure 5. Architecture

▪ *Content created by teachers or by the publisher itself*. The information the system will contain should be complementary to the topics discussed in class by the teachers and truly useful.

Application architecture

To achieve the functionality of the system we propose the architecture shown in figure 5.

In the book is located the marker or the image that is going to be tracked and that is linked with the content from the application. The application gets the information from the image tracked using the device's camera and it sends it to the QCAR SDK's Tracker who interacts with the Renderer.

The Renderer interprets the information from the marker or the image and using some calculations identifies what, where, which direction and how big the content shown will be.

After that the Renderer sends the information that should be displayed to the application so the user can see it and interact with it.

Broadly speaking, QCAR SDK is an intermediary between the operating system and application. In [7] can find more detailed information.

Development

To create the 3D models we used Autodesk 3Ds Max. Also, we used Creative Commons licensed 3D Models from [8].

The content was designed based on unit 5 from the book Historia Universal I by Marialba Pastor [9], which is used in the school Pablo Latapí in the second grade. This unit covers topics of recent decades as the last wars contemporary conflicts, economic and social inequalities in the world and the technological and scientific advances in recent years.

The application was developed using Android SDK. The device used for development was a HTC Droid Incredible with Android 2.3.3 and the Qualcomm Augmented Reality SDK (QCAR SDK).

The development environment used was Unity 3D with the official extension to develop using QCAR SDK.

Results

Now we are going to detail the results achieved with the application development.

In the figure 6 it is shown the design of the application when it displays a 3D model.

In the lower area is shown the zoom controls of the camera. Most of the screen is occupied by the image obtained by the camera in real time. In the book there is a marker that the system identifies and based on a comparison with the database it displays a 3D model that is locally stored.

The model can be viewed from any angle as long as the marker is not completely out of sight of the camera.

Figure 7 shows the video playback. The system searches the marker in the database and gets the video file related to it.

Figure 6. 3D model

Figure 7. Video playback

Figure 8. Audio playback

The video player is shown in the foreground and the user can interact with its controls (volume, pause and full screen). When the user wants to terminate the action he uses the back button included in all Android devices. Once this is done the system returns to capture everything the camera sees while waiting for a marker to analyze.

Figure 8 shows the playback of an audio file recovered from local files. Just as with the video, the player will remain at the forefront regardless of whether the marker leaves the field of view of the camera and regardless of what it can capture. The user can interact with audio controls and timeline of the playback. When the user wants to stop using the application he uses the navigation buttons provided on all Android devices.

Conclusion

Augmented reality is a technology that is in a very immature stage. This is not something negative, in fact, is a stage of discovery and interesting proposals. The problem with this is the acceptance by the major manufacturers and publishers. The success of a system like the one proposed here would depend on the acceptance of publishers who publish textbooks for secondary education, so they add a layer of virtual content to their books. While the technology is not mature enough is hard to get a large publisher to invest money in it.

In this paper we described de development of a mobile augmented reality application for Android devices and the research done to try to prove our hypothesis that augmented reality can be a big support to basic education in Mexico.

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