

Chapter 32

Augmented Reality as a New Media for Supporting Mobile–Learning

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ABSTRACT

Combining mobile technologies with Augmented Reality (AR) has recently enabled the ubiquity of AR technologies in our everyday life. We believe that the use of augmented reality will change significantly the teaching activities by enabling the addition of supplementary information that is seen on a mobile device. This chapter presents the most popular augmented reality applications and we select AR eco-systems to be used in daily teaching activities which are user friendly, do not require programming skills and are free. Different augmented reality technologies are explored in this chapter. It is presented the creation of two novel augmented reality books. One developed with teachers and students. Another book that was developed for increasing the interest of reading for children that is being used by storytellers. Several examples are also presented that are used in educational activities, from kindergarten, elementary, secondary schools and university, to improve reading, comprehension, learning of music and better understand the drawing of orthographic views.

INTRODUCTION

In the near future, eventually everyone will have a smartphone or a tablet. This allows greater interaction of the individual, not only with the content and the resources offered by the network, but in

particular with other users. Mobile computing devices allow an exponential expansion of social and participative Web technologies.

These mobile devices are cheap but quite powerful, making them appropriate to display additional information that augments reality. Us-

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ing affordable smartphones or tablets, teachers can write educational activities with augmented reality (AR) that students use in the classroom or at home to improve learning. Information and communication technologies contributed to significant changes in the process of teaching and learning (Fernandes and Ferreira, 2012). We think that now augmented reality will contribute with many changes in teaching allowing the visualization additional information on smartphones or tablets.

Our main research question is to find out if available AR technologies are easy to use by teachers in the classroom for learning? There are many AR applications available. The most popular augmented-reality eco-systems will be explored. We studied AR systems that can be used in daily learning activities. Such AR eco-systems are *user friendly*, since they are going to be used by teachers that in general do not have programming knowledge; and *open source* or *free for non-commercial*, without any type of watermarks.

Researchers are enthusiastic about using AR in teaching and learning (Kesim & Ozarslan, 2012) to improve student satisfaction and help in knowledge comprehension (Di Serio, Ibáñez & Kloos, 2013). In this chapter, we also want to show AR application examples in education. In this way, this chapter also presents several educational activities and a novel AR book created using free AR tools that do not require programming knowledge to be used by any teacher. We discuss different AR eco-systems and show the most appropriate for each particular educational activity presented in this chapter covering *k-12* teaching. Marker-based and markerless AR technologies are presented to show how we can create learning activities to visualize augmented information like animations and 3D objects that help students understand the educational content.

AUGMENTED REALITY

Augmented Reality applications display information that is synthesized in order to help us better understand the real world. The real images are displayed together with 2D or 3D computer generated images in real time and interactively. In this way, the user interaction is improved and more natural enhancing its perception of reality.

Virtual and real worlds systems can be combined in different ways. Based on the *Virtuality Continuum* taxonomy scheme concept developed by Paul Milgram and Fumio Kishino (1994), Augmented Reality applications are closer to the real world.

A commonly accepted definition for Augmented Reality is the one proposed by Ronald Azuma (1997) that identifies three features that must be accomplished by an AR system:

1. Combine real and virtual;
2. Interactive in real time;
3. Registered in 3D.

We can identify two categories of Augmented Reality systems: *geo-base* and *computer vision* based. Geo-based applications use the mobile's GPS, accelerometer, gyroscope, and other technology to determine the location, heading, and direction of the mobile device. In the direction in which the user is looking, the augmented computer-generated images are displayed together with the real images. Some problems and research questions are to be solved. One of them is the lack of precision in the GPS coordinates obtained with the mobile devices that makes it hard the presentation of overlay data.

The other category includes the computer vision based applications. These systems are sup-

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