

Augmented Reality Based E-Learning Applications



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INTRODUCTION

Today, rapid developments in technologies have remarkable impacts on humankind's modern life. Especially positive changes enable people to perform their activities via more effective, efficient or faster ways, and adapt themselves to the changed conditions of the world. Furthermore, changes also allow employing newer approaches, methods or techniques to improve whole life standards. As a result of this 'butterfly effect', almost every field in the life encounters with changes and improvements.

When the current situation is examined further, it can be said that developments and improvements within electronics, multimedia-based technologies, and also computer technology have an important role on determining trends in the modern life, and changing forms of the communities. Nowadays, one of the most remarkable trends is supporting the 'real life' via 'digital' approaches. In the context of the approach, advanced applications, which ensure a stable connection between the 'real world' and the 'digital world', are designed and developed. In other words, 'a bridge' is created between the reality and the virtuality. Thanks to this approach, people can enter to 'digital - virtual environments', in which they can experience some real-world based actions. In this sense, the idea of creating a digital world for simulating dynamics of the real life has caused to the introduction of the term: Virtual Reality.

Virtual Reality has allowed people to take active part in different kinds of digital worlds. It is also important that this approach has given a chance to improve standards of the real life by employing digitally designed environment - application based solutions. In time, some needs for newer approaches combining dynamics of both real world and the virtual world have also appeared. Thus, a newer approach enabling people

to take advantages of these two different worlds have been introduced. Because of improving real-world based dynamics via virtual dynamics, this approach has been called as 'Augmented Reality'.

Augmented Reality (AR) has many advantages that allow designing and developing more effective solutions for improving life standards. Because of this, AR is employed in a wide range of fields, in order to provide solutions, or innovative applications. Education is one of these fields in which the AR related applications are performed widely. More specifically, the 'e-learning' technique in education is one of the most popular application areas for today's AR oriented solutions. In this sense, usage of AR applications within teaching and learning activities has become an improving trend with the popularity of especially mobile devices. Because of this, many research studies have been performed in order to examine effects of the AR on 'teaching' and 'learning' (Yuen *et al.*, 2013).

Objective of this article is to explain some recent works on AR-based e-learning applications, discuss about contributions of these works to the e-learning processes, and express some ideas about potential future works. In this context, the article will introduce the basics of the AR technique and focus on its connection with the e-learning technique. Following, it will provide an introduction - analysis approach on some recent e-learning applications performed via AR. Next, a brief discussion on contributions of the related works to e-learning processes will be provided, and finally, the article will discuss about future directions about the related subject scope. As general, the article is an essential reference as a brief analysis on recent literature regarding to AR based e-learning applications. Furthermore, it is also an objective view for potential application trends in the context of AR based e-learning solutions.

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BACKGROUND

Augmented Reality

Briefly, Augmented Reality (AR) can be defined as some kind of ‘hybrid’ environment, in which virtual elements – objects are added to the real environment (Milgram, & Kishino, 1994; Azuma, 1997; Zhou *et al.*, 2008; Falconi, 2010). In this sense, AR is an effective approach to combine advantages of both reality and the virtuality. In the literature, AR is also known as a supportive approach for the reality (Azuma, 1997). Additionally, AR can be also be defined as a ‘mixed reality’ between the real world and the virtual world (Milgrami & Kishino, 1994). Figure 1 represents a schema pointing the location of AR between the reality and the virtuality.

AR is an important multimedia technique, which is based on employing digital information with live multimedia objects or any environment in the real time. The AR and its application based approaches have been very popular among different fields and em-

ployed within multimedia based systems or platforms to provide highly interactive, effective using solutions for different fields like education, health, economy, military...etc. Because of its interactive aspects and adaptive structure to the real time environments, there is a remarkable effort on performing scientific research studies, which try to provide practical, fast solutions for real-world based problems. Figure 2 shows some images from recent works on AR (Azuma *et al.*, 2001).

E-Learning and Augmented Reality

Education is one of the most important fields, in which the AR technique is successfully employed. At this point, AR is widely used to perform more effective and efficient e-learning based learning-teaching activities. AR approach is an important and remarkable factor that improves the effectiveness of the e-learning technique. It can be expressed that the combination of the AR and the e-learning is positively affected the process of learning and teaching, by improving many aspects like interactivity, productivity and applicability.

Figure 1. Augmented Reality and its location between to the reality and the virtuality

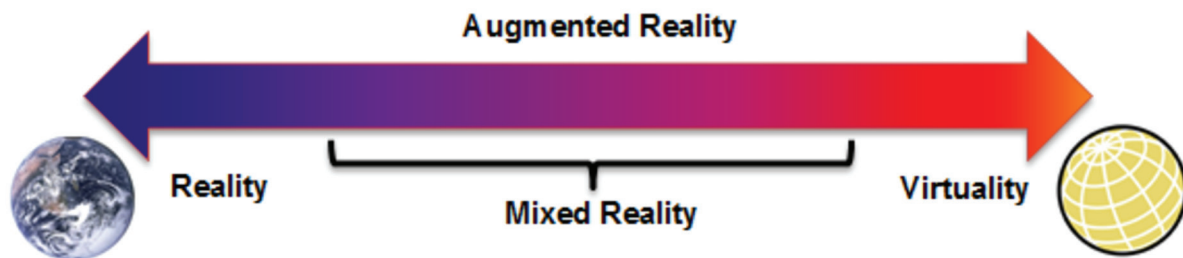


Figure 2. Some recent works on AR (images from Azuma *et al.*, 2001)



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