Augmented reality research and applications in education

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Abstract

Augmented reality technologies undertake focus role which provide opportunity to harmonize the earthly reality with virtual field and evaluate their integral elements. The very first examples of augmented reality applications are viewers on the head, simulators, wearable tools, pocket PCs, desktop PCs and cameras which are integrated externally but augmented reality applications have gain a great acceleration by developing technologies such as internet, becoming popular for the mobile devices and their mobile applications accordingly and especially by the appearance of the smart wears and increase on their functions. Augmented reality applications that are often used in defence, industry, medicine, trade and entertainment are now started to be used in the education. Augmented reality applications achieve deep learning of the systems or objects which are hard to learn by attracting attention and cares of the students by providing their different views during teaching and learning process. Also these applications supports students to use their creativity by expanding their imagination. Especially if we consider today's students are digital natives (Y and Z generation) who grow up in the multimedia world and inside the technology, it is a reality that augmented reality applications which have rich content in the learning-teaching environments can have a role that increase the motivations of the students instead of a classic course book. In the light of these information, in this study the research and application samples of augmented reality which is now used widely in teaching and learning process the effect of augmented reality on teaching and learning is handled.

Keywords: Augmented reality, augmented reality applications in education

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1. Introduction

One of the most interesting visual technology that has gained acceleration recently in the world is Augmented Reality (AR) technology. There are various definitions of augmented reality by different researchers in the literature. According to Milgram et al. (1993), augmented reality (AR) is a live and interactive environment constituted with adding objects on real image taken from camera. According to another definition, AR enables users to see the world as developed, enriched or augmented by adding text, picture, sound etc. on real image spontaneously (Gonzato et al., 2008). According to Azuma (1997), augmented reality is a derivative of virtual reality. In other words, AR's are virtual environments in which existing reality is supported rather than the reality is formed all over. When the definitions in the literature are examined, augmented reality reflects enriched real worlds constituted with virtual objects.

There are research reports revealing the future of augmented reality as well. For instance, The New Media Consortium (NMC) regularly investigates and reports technologies which will emerge in the forthcoming years in the field of educational technology every year since 2004. In the Horizon report published by NMC in 2008, it was predicted that AG technology will be one of the technologies which affect education in the near future. It was also expected that AR will play an important role in education conducted with wearable technology since 2013 and mobile devices since 2010. Apart from these, AR projects are supported within the scope of FATİH project by TÜBİTAK BT0103 as it is seen in Call for Human Computer Interaction. According to this, it can be stated that the use of AR in the moderate and long run will become more prevalent. AR applications will be standardized and they will effectively take part in our lives both through smart phones and tablet computers. For instance, we will be able to find out which houses are for rent or for sale by turning our cameras to apartments, read the comments related with meals of a restaurant by scanning it through an AR application (Cakal and Eymirli, 2012). Our lives would be facilitated with AR applications which involve such many innovations.

2. Augmented Reality Applications From Past to Present

As in many other technologies, augmented reality applications are based on military technologies. AG technologies emerged through HUD (Head-up display). This technology has begun to be used with eye glasses integrated into the helmets used by infantry and screens in front of combat aircraft pilots in cockpit. Tom Caudell developed a technology to place cables of Airbus in 1992 and proposed the term "Augmented Reality". Then, first examples of 'augmented reality' were discovered in SIGGRAPH activity in 1999. Sony exposed a game named as AR-based Eye of Judgement for Ps3 in 2007 and Wikitude published Augmented Reality Guide in 2008. This application on G1 Android phones is accepted as one of the most important steps about AR developments. When 'Augmented Reality ToolKit' was moved into Adobe-Flash environment in 2009, applications with quite extensive content have begun and web applications have also begun to support AG technology. Developing Applications brought softwares handling AR alone and then turned into separate application softwares. When the history of augmented reality is considered based on years; (Institute of Víctor M. Arbe Bremen Cervantes Library «Gonzalo Rojas» March, 2013)

1960: Detector, Morton Heiling

1973: First mountable head screen (HMD= Head Mounted Display)

1985: First augmented reality laboratory (Immersive/Interactional)

1990: Virtual Reality (Jaron Lanier)

1992: Augmented Reality (Tom Caudell)

1994-99: First RA Systems (KARMA 1994 and ARToolkit, 1999)

2000: First augment reality played with mobile devices

2008: Wikitude: Augment reality scanner

2009: Initiation of Standardization operations

2013: Google is in the process of commercializing RA eye glasses.

3. Components Playing Important Role in The Spread Of Ar

The primary factors which led AR to be more prevalent today are;

- Major advances in mobile devices,
- Easy and fast download and application of digital information into mobile devices,
- Simplification of technical requirements for augmented reality experience,
- Persistence of Internet connection

(Institute of Víctor M. Arbe Bremen Cervantes Library «Gonzalo Rojas» March, 2013).

4. Types of ar And Common Areas of Usage

Types of AR are geographical positioning, objects situated in reality and interactive augmented reality applications. When common areas of usage are examined; military, medicine and health, tourism and travel, marketing and sale, public services, plays, social interaction, industrial usage, education and culture are in the most important place. Apart from these areas, one of the most salient usage is Gamification with Augmented Reality. Gamification which is mentioned in many social media campaigns and used in locally based applications has attracted attention of many people today. AR. Drone.Parrot is an example for augmented reality-based games. In fact, this was only a remote-controlled flying toy; but it has gained popularity with a dimensional change based on AR application. The application can be controlled through iphone. When the application is uploaded, camera on the AR.Drone.Parrot is reflected to iphone and it creates a feeling as if we are in the toy in cockpit. Besides, it provides accurate augmented reality environments to us through blast effects and arm management. When examples of AR applications in education are considered, it is seen that there are applications such as Complemental and Supprtive Curriculum (hybrid books, educational cards etc.), Guidance and Introduction (handbooks), Plays (plays designed to develop arithmetic skills), Educational Trips (zoo, museum etc., application areas) and Practice (Cetinkaya and Ekçay, 2013).

5. Usage and Importance of Ar in Education

It should be noted in today's world that students are digital generation which has grown up in multimedia world and become integrated with technology. Digital natives who are today's youth defined with various terms such as Y and Z and being distant from materials with rich content in education-teaching environments would cause a decrease in their interests and motivations towards lectures. Using lecture books in tablets electronically is a common situation in order to eliminate this negativeness. Apart from this, enriching classic lecture books might be an applicable method especially through hybrid lecture books. Hybrid lecture books are resources which can be integrated into augmented reality applications through adding QR codes in classic lecture books. Students can reach to the content embedded in codes at environments outside school by using a mobile device which has a barcode reading software through these square codes used in printed materials. Especially, we can frequently observe solution videos embedded in QR codes with test questions in exam preparation books (Cinar, 2014).

When we look at the examples of applications developed with using AR technology; Billingham, Kato & Poupyrev (2001 cited in Somyurek, 2014), developed an application named as “Magic Book” and designed a learning environment which enriches text-based books with virtual animations. Researchers benefitted from augmented reality technologies in this study. Seo, Kim and Kim (2006) emphasized that AR applications facilitates kinesthetic learning by internalizing body movements and senses since it provides direct interaction with education material. Di Serio, Ibanez and Kloos (2013) examined the effect of AR applications on motivations of students at elementary school level in Spain and revealed that AR increase the attention, interest, trust and satisfaction of students towards lectures. Abdusselam and Karal (2012) observed that attention span of the students are shorter in traditional class and laboratory environments and their interest get distracted easily; however AR environments increase the attention span of students since the device is intertwined with technology, it makes abstract concepts more concrete and facilitates comprehension. Cinar (2014) used “At the fair” chapter in English lesson at 6th grade elementary school level in order to prepare and apply an AR-supported book chapter based on expert opinions. The researcher prepared a hybrid AR-supported book with text and visuals in order to view the content related with this topic in an enriched manner both visually and aurally. As a result, it was revealed that experts found some characteristics of the book as sufficient and open to development. It was also revealed that an experimental study is needed in order to figure out the real effect of the material. Cakir and Tan (2015) investigated the effect of applying AR technology developed to enrich and activate education and teaching environments on students’ academic achievement and motivations. In line with the aim, a semi-experimental study at university level was conducted. 60 university students participated in the research. English words were presented in an environment developed based on AR technology to the experimental group; lectures were presented with traditional methods to the control group. As a result, the statistics of the achievements of students from the experimental group which used AR technology were significantly higher than control group students which used traditional methods. Furthermore, this study figured out that motivations of students who were taught the lessons with AR technology were high. Another finding of the study showed that use of AR technologies in foreign language word-teaching positively affects students’ performance.

Yuen and colleagues (2011, cited by Cetinkaya and Akcay, 2013), stated that AR has an application area in teaching and learning environments and remarked the advantages of AR as follows;

3-dimensional use of visual objects in AR applications attract the attentions of students, increase their participation and motivates them. Besides, it enables them to reveal different perspectives about topics.

It enables to teach experiments which are difficult to conduct in real world and topics which are expensive and difficult to explain. It provides a realistic simulation environment to present astronomy, geography, chemistry, physics etc.

AR improves the collaboration between student-teacher and student-student by facilitating collaborative environments.

AR applications enable students to develop their creativity and imagination; it can be applied for learning, fun and educational fun through increasing their interaction with the real world and their perceptions about the world.

Students can receive individualized education based on their speed in AR applications in which virtual educators are used.

An original learning environment can be created appropriate for various learning styles.

In order to obtain accurate information and inferences, AR environment applications enable to understand, examine and realize these information better by presenting innovations to learning environment.

According to Hsiao and Rashvand, 2011; Kerawalla et al. (2006), AR learning environments constitutes in-depth learning among students through evaluating system or objects which are very difficult to learn from different perspectives by attracting the students' interest and attention in learning and teaching process. According to Hamilton and Olerewa, (2010), AR applications provide learning environments appropriate for students' learning speed and styles. It enables objects which can not be created in the real world to become three-dimensional objects (Shelton and Hedley, 2002; Yuen et al, 2011). Klopfer and Yoon (2004) revealed that AR applications motivates students to use their imagination and creativity.

6. Conclusion and Discussion

AR applications play a crucial role in gaining desired behaviors in learning and teaching process since students are in an interactive and collaborative environment, they learn through doing and experiencing, it helps students to develop positive attitudes towards lectures and it enables students to reveal different perspectives about topics. When the future of augmented reality is considered, it was predicted that AG technology will be one of the technologies which affect education in the near future and it was also expected that AR technology will play an important role in education conducted with wearable technology since 2013 and mobile devices since 2010 in the Horizon report. Apart from these, AR projects are supported within the scope of FATİH project by TÜBİTAK BT0103 as it is seen in Call for Human Computer Interaction.

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