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# Augment Reality in Education System – A Review

*Rozeena*, Sharique Anwar**, Mohd Wasim****

**ABSTRACT**

*The In recent years, our system is more focusing on Augment Reality (AR) to create innovative and advanced education system. As augment reality is coexist system of virtual reality and real world which give instant feedback and more clarification or other hand we can understand it by saying it is layer of virtual objects on real object and run them interactively in real time. The only purpose behind introducing augment reality is to encourage and motivate students towards learning. This paper review will contain various different definition of augment reality on the basis of different review papers, it will also give idea about latest technologies are using in AR, how the changes are occurred from the beginning to now, its current status in education system, how its impact are different from simple learning way of literature or science, its role in teaching, what are its limitations and how it will effect in development of AR, what challenges will occur like availability of adaption . After that we will find out chances of future research in AR for researchers and designers. At last, we can inference by analysing different journal review papers that augment reality is gradually taking place in education system at worldwide*

***Keywords:*** *Augment Reality; Current Status of AR; Development of AR; Challenges of AR; Impact of AR.*

## 1.0 Introduction

As many new and advanced emerging technologies are using in education field for making learning process more easy, interactive and more understandable[1] like ubiquitous learning which is the combination of mobile , embedded computer and wireless computer for learning environment[2]. Mobile learning, multimedia materials, internet, simulation, games, 3D virtual environment and augmented reality which are also another advance learning methods[2], [3]. Research on advanced education are still functioning and their interactive capabilities encourage students as well as teachers to yield positive results and enhance motivation[3].

## 1.2 Definition of AR

Augmented Reality, is grabbing attention these days due to its feasibility with mobile phones and it is the combination of computer vision, computer graphics and image processing which give image-based and location-based information which also enhance students understanding ability and practical skills[2], [4], [5]. Augmented Reality(AR) developed 40 years ago and many research papers are being published since 1990's[5], [6] and in this review paper we have various definition which are proposed after analysing many papers such as augmented reality is coexist system of virtual reality and real world connected with computer-assisted system where information of virtual images are layered on real objects which give instant feedback and more clarification, it also enhance vision, aural and tactile senses [1]–[3], "AR interact users with the virtual images on real objects that are generated by computers "[6], it can be more define in two approaches one is broad approach "augmenting natural feedback to the operator with simulated cues" and another is restricted approach "a form of virtual reality where the participant's head-mounted display is transparent, allowing a clear view of the real world"[1], [7], "augmented reality is broadly as a situation in which a real world context is dynamically overlaid with coherent location or context sensitive virtual information"[8].

The most preferable definition of AR is hidden in these three properties (a) combine virtual and real objects (b) run virtual and real object interactively in

**Sarvottam Institute of Technology and Management, Dr.A.P.J Abdul Kalam Technical University, Uttar Pradesh, India*
***Department of Electronic Engineering, Indian Institute of Technology (BHU) Varanasi*
****Corresponding Author: Department of Electronic Engineering, Lovely Professional University, Punjab, India*
*(E-mail: mohammad.wasim221@gmail.com)*

real time and environment (c) align virtual with real object[9].

## 2.0 Current Status of Technologies are Using for Augmented Reality

As we aforementioned that augmented reality help learners to get authentic exploration by using text, videos and pictures as virtual objects, which are superimposes on real objects.

Augmented reality is used with many technologies and generally its setup consist computers, display, tracking devices, inputs. It use see-through and monitor-based displays, where see-through use at user's view site and display virtual image along with real image. Other, hand monitor–based use PDA, cellphone, laptop as for display[1], [10].

### 2.1 Head-mounted display (HMD)

Head-mounted apparatus is like helmet which consists goggles, internal display, and camera. HMD is example of see-through display which show virtual information onto the real world and it give personal space to user but head-mounted apparatus has its own limitations, user feel burden to wear it for a long time and it is not easy to carry, it does not deal with multi-users, expensive, field of view size is limited, distortion in image can occur[6], [10].

**Fig 1: Man Wearing HMD[11]**

### 2.2 Project Display

Augmented reality can also use with project display, it gives high-resolution and lager display area, interactive to users but lacking of mobility and incompatible with mobile phones, these two are main limitations[6].

**Fig 2: AR on Project Display[12]**

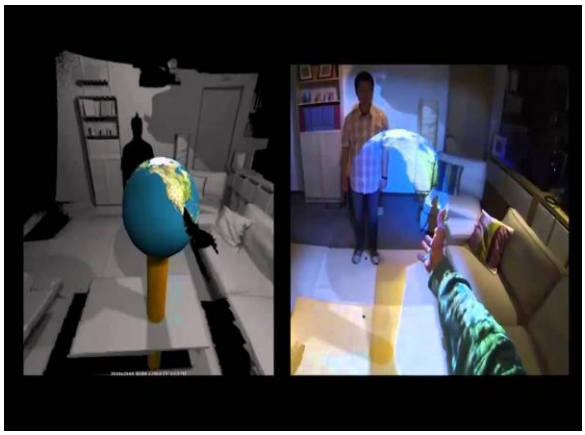
### 2.3 Handheld Displays

Another recent technology is handheld displays. Designers or developers always engage in developing technologies they relate handheld computing devices with augmented reality such as mobile, tablet PCs, UMPC (ultra-mobile pc), PDA ( in AR-PDA, we have AR-PDA setup with camera it send video of real object to AR server and in back AR server give video plus augmentation). Handheld augment reality devices are portable and ubiquitous in nature but we don't get real experience through handled devices because display can distort images and it is handheld devices so, users always have to hold them which is quite irritating[6,10].

**Fig 3:** Augmented Reality with mobile phone[13]

Spatial is also combination of physical objects and computer generated information which display projection such as hologram, optical elements, etc., and another example of a handheld device is pinch gloves which grab virtual images by using pinch gesture[10].

**Fig 4: Spatial Augmented Reality[14]**



**2.4 Conclusion of current status section**

According to Akçayır & Akçayır( 2017), augmented reality with mobile devices are more preferable for learning in comparison to others. It is portable, easy to carry, not too much expensive, interactive etc.

As we aforementioned in the above section that HMD and project display has its own limitation that they are not easy to carry, they are fix for specific task, users feel a burden to carry them for a long time as well as desktop and laptop have same limitation they are not portable and have big size to carry but in case of mobile, it can perform many task along with features of augmented reality unlike HMD, project display. Students can learn anywhere and anytime through augmented reality by the help of mobile devices[6,10,15].

**3.0 Development of Augmented Reality**

Works on Augmented Reality started 40 years back and in this section we will put light on some of them. According to Azuma, 2001 report visualising of 3D graphics through HMD (see-through device) was introduced in Sutherland, 1960s.

Azuma published a survey in 1997, in which definition, problems and development of augmented reality were considered. 90s was the era for augmented reality and virtual reality along with mixed reality (mixed reality= combination of augmented reality of real environment and augmented virtuality of virtual environment) that many workshop, symposium and conference were held 9] and in 1990s first time the scientist from aircraft manufacturer boeing, coined term augmented reality. He developed a AR system which superimposed virtual graphics on real environment display for aircraft electrician[5]. From Milgram,1995 paper we get reality-virtuality(RV) continuum it define an environment where consisting solely of real objects on the left side and consisting solely of virtual objects on the right side combine in same frame and form mixed reality[7].

Other hand Azuma, 2001 also give detailed about progress in development of augmented reality such as Head-worn display, it looks like sunglasses and it worn over head.

This device consist opaque display and virtual image form on display in front of eyes, it also has small size FOV as same in head-mounted display. Many companies developed LCD for head-worn devices [9].

**Fig 5: Head-Worn Display[16]**

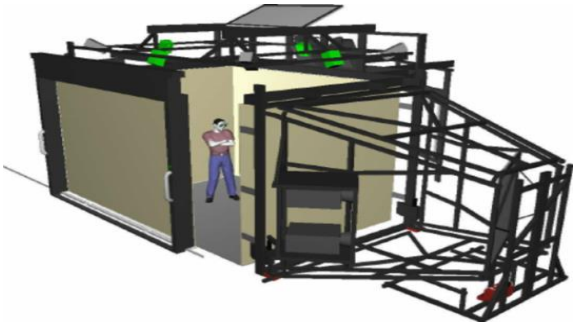
After that virtual retinal display came in market which form images at retina and this device has many plus points it consume less power because of its design here, beams are assembled horizontally and vertically which are scanned by micro electron mirror. Another type of display is Minolta prototype display which consist two prisms at right-angle position and have light weight[9].

Handheld system which we earlier mentioned , it consists display and it is portable in nature for example mobile phones, PDA etc.[6, 9, 10].

Projection displays: single room mounted the projector in this virtual information is directly project on object which has to be augmented. It works on CAVE (cave automatic virtual environment) principle where single room overlapped with multiple projectors using surface geometry and image overlap.

The main purpose of projection display is to make it usable for multiple user[9].

**Fig 6: Five sided projection CAVE[17]**



Marker-based AR and Marker less AR: In marker-based AR, register the position of virtual object with help of marker to display it into real world, it is image-based AR. Marker-based AR is compatible with the computing device, marker label, camera and display devices. Other hand Marker less AR identifies location and coordinates of real target object by the help of GPS and GPS provide virtual computer-generated information which are superimposed on them, in short marker less is location based AR [5, 18].

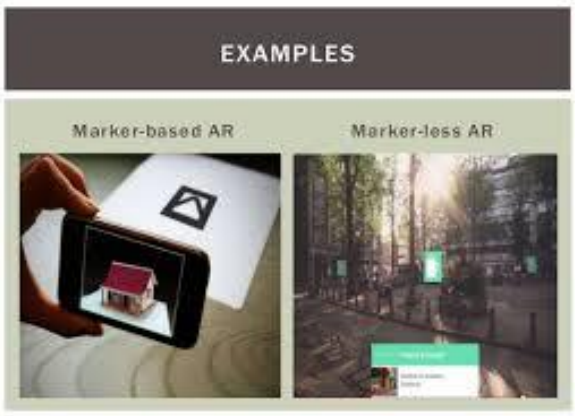
### 3.1 Challenges with AR in education field

In this section we will consider Akçayır & Akçayır, 2017 report, it precisely describe challenges of augmented reality. AR is revolutionary change in education field but still has challenges. First, without proper designing or coding of AR may cause error and obstruct functioning of AR. Students may confuse themselves in its technologies which are complex to understand and use. Its complexity may consume time of students and teachers. As we are following Akçayır & Akçayır,2017 paper for this section it reported that it was difficult to trained AR using group in comparison of non-AR using group[15].

### 3.2 Other challenges

AR application is also location-based application and we get other challenges from Akçayır & Akçayır,2017 is GPS error in AR application and it mislead to recognise location [15]. Augmented reality system has requirements such as display, camera etc., so functioning of AR also depends on them if any of them is defected, may affect its working.

**Fig 7: Marker-based AR vs Marker-less AR[19]**




## 4.0 Impact of AR

### 4.1 AR vs VR

Impact of AR in comparison of VR impact is always better because in VR user cannot experience real world along with virtual it left user with synthetic environment but in AR user can experience both at a time[18].

### 4.2 Impact of AR in education field

Eh Phon et al., 2014 paper consider many examples from different papers to show impact of AR and in this section we will use some them to analyse impact of AR.

#### 4.2.1 Peer and individual reaction on AR-based learning

Here we will conclude how AR-based learning is effective in peer learning and individual learning. In this example, we will see a survey of 96 participants on chemistry learning with and without PMB (Protein magic book) which is an AR application and developed at HIT lab. These participants divided into three sub groups where 44 participants were assigned with PMB and they had to study PMB in pairs, the other 26 participants were also assigned with PMB but they had to study individually and remaining 26 participants were under control group where they studied same thing but without AR. After a survey they got result that show participants who were assigned with PMB but had to study individually performed better in comparison to other groups. Participants who studied PMB in pairs felt high cognitive load. Hence, studies say AR-based learning in aspect peer learning should be more focused[18].

#### 4.2.2 Impact of AR system with teaching

AR system with teaching are more focused project these days. System of Augmented Reality for teaching (SMART) surveyed on 54 2nd grade students about different modes of transportation and types of animals. They used basic equipment AR marker, a laptop, a web camera and a large projector for whole class. They divided students into two groups, one group were under control group where they followed traditional teaching method and another group used SMART system for learning and the result they got was in favour of SMART system. Now we can inference, that SMART system is more preferable for teaching rather than traditional, it interact or influenced students[18].

#### 4.2.3 Impact of AR in learning on the basis of feedback timing

Above two example precisely described effect of collaborating AR with teaching and now we have another example which shows effect of game-based AR on the basis of feedback timing. Here, two experiments were conducted among small grade students with game-based AR to explore animals and their living environment with the help of AR marker and a wooden board. First experiment was consider 22 children(age, 5-6) and they used collaborated AR game-based system where system was designed for giving instant feedback at any time. Second, experiment were consider 36 children (age, 3-5) and they also used collaborated AR game-based system, in this version system were designed in that way where feedback can give after the completion of game. This experiments result show that game-based AR system has positive impact on learning but instant feedback system will be more interactive[18].

#### 4.2.4 Impact of AR-supported simulation in physics learning

AR-supported simulation tools proved itself better tools for developing skills. Here, we will study result of comparison between AR-supported and non-AR supported session in physics learning where AR mobile system were used to simulate elastic collision. In AR-supported session mobile phone were used to display the simulation of collision of two 3D virtual objects where students were allowed to give the value of mass and velocity and non-AR supported session was based on traditional teaching method. Finally, these session summaries that AR-supported simulation gave the better result in comparison to non-AR supported learning method. It enhance the capability of understanding, develop skills and encourage students[18].

#### 4.2.5 Impact of AR learning system with interactive agents

In this example Eh Phon et al., 2014 described the impact of interaction between AR learning system with interactive agents. According to Oh & Byun, 2012 survey which was conducted for analysing students' interest with interactive agents over book.

They developed augmented scene where flower gardening was used as interactive agent over physical book with simulation factors and students had to use this factors for accomplishing the task. 15 students were participated (age, 8-13) and according to their reaction this survey concluded that AR learning system with interactive agents will more helpful for solving task, it increase capability of understanding and interest of students, give clear explanation and it has positive aspects in future[18,20].

### 5.0 Augmented Reality as future aspects

Augmented Reality is vast and research on its still going on. Mental modals, spatial cognition, situated cognition and social constructivist learning will be more useful in future research of AR[5].

The problem occurred due to designing and technical error is should overcome in future research such as GPS error, size error or any designing error. Sometimes using augmented reality on devices is difficult, it is because may be users are unfamiliar with usability of devices and defect in devices may also cause error in augmented reality. In future usability of augmented reality should be improve [15]. Future research should consider development of technologies (HMD, vision glasses) for augmented reality, so we get more and effective devices which are easy to use and carry[1, 15].

More studies are still needed on effects as well as relation of AR application with supportive learning (ubiquitous learning, collaborative and informal learning), development of location based AR application and multi-sensory devices with AR application.

Future research on AR should also consider moral studies that how AR can help child with special

needs, student from poor family, how AR engage students with learning, how students always remain motivated as well as satisfied during studies with AR application and not get distract due to augmented features[15].

**6.0 Conclusions**

After analysing many review papers we can inference that augmented reality has advantages as well as limitation but in learning field it has very good impact as we mentioned in impact section. Many survey shows that learning with AR application encourage students and also give instant feedback which enriches their capabilities, they can experience real world along with virtual world. In future if augmented reality overcomes all its limitation which aforementioned in challenges and future aspects section, then it will be a revolutionary change in education system.

**Nomenclature**

| | |
|---|---|
| AR | Augmented Reality |
| VR | Virtual Reality |
| PDA | Personal Digital Assistant |
| HMD | Head-Mounted Display |
| PMB | Protein Magic Book |
| 3D | Three-Dimensional |
| GPS | Global Processing Unit |
| SMART | System of Augmented Reality in Teaching |
| FOV | Field Of View |

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