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A Review of Research on Augmented Reality in Education

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ABSTRACT: In education, technology can have impact on students to learn actively and can motivate them, leading to an active process of learning. The research on augmented reality in education is still in a primitive stage, and there is lack of research on the effects and significance of augmented reality in the field of education. Previously in a research it was stated that the problem that technology will create a passive learning process if the technology used does not encourages critical thinking. Although the physical world is 3D, mostly we use 2D media in education. Since it's an introduction, AR has been shown to a good potential in making the learning process more useful and meaningful. This is because its high technology enables users to interact with real time as well as virtual applications and brings pure natural experience to users. Therefore, this concept paper reviews the research that has been conducted on augmented reality.

KEYWORDS: augmented reality, technology, education.

I. INTRODUCTION

The use of AR in education is a crucial topic of research. AR is a new technology which has emerged with potential for application in education. Research on AR application in education is still in a primitive stage, and there is a lack of research on the effects and significance of AR in the field of education. Although the physical world is 3D, mostly we use 2D media in education which is very easy, familiar, flexible, portable and inexpensive. As AR is a static content it does not offer the dynamic content. Otherwise computer generated 3D virtual environment can be used but these scenes requires high performance computer graphics which is too expensive than others. The use of AR has become more approachable as it no longer requires any special equipment and can be used using mobile devices. Many of the people now own mobile devices, and the use of devices has increased, as a result of that enabling greater access to AR.

AR must have three characteristics,

1. Combining the real and virtual world.
2. Having real time Interaction with the user.
3. Being registered in a 3D space.

AR allows the user to see the real world and aim to supplement reality without completely immersing user inside artificial environment.

II. AUGMENTED REALITY

Augmented Reality combines real world and virtual world, boosting the real world with computer - generated virtual objects in real time (M. Sirakaya and D. A. Sirakaya, M. Akçayır and G. Akçayır, R. D. A. Budiman, E. Solak and R. Cakir, X. Wei, D. Weng, Y. Liu, and Y. Wang). In accordance to one of the most commonly accepted definitions, AR is a technology that has three key requirements:

1. Combining of real and virtual objects in a real environment,
2. Coordinating of real and virtual objects with each other
3. Real-time interaction

Examples of mobile augmented reality application include Pokémon GO, which is a location based mobile game that enables users to catch virtual Pokémon creatures around their surrounding area and AR GPS DRIVE/WALK NAVIGATION which provides an AR-powered navigation system [Y. Jain].

A. What is AR?

AR is a stream of research which deals with fusion of reality with computer generated data. It is still in its primitive stage of development and research, possibly by the end of this decade, we will see the first mass-marketed AR System. Augmented reality will definitely change the way we view the world

B. How does it work?

Using mobile application, a smart phone's camera checks and interprets a marker, mostly a black and white barcode image. The software which is used to analyse the marker and is also used to generate a virtual image overlay on the screen of mobile phone is attached to the position of the camera. This means the application works with the camera to clarify the distance and angles the smart phone is away from the marker.

Due to many calculations a phone must do to render the image over the marker, frequently only mobile phones are capable of supporting augmented reality with any success.

III. TECHNOLOGY FOR AR SYSTEM

AR uses hardware technologies like computer generated virtual scenes, 3D objects and interactivity. The devices which are mainly used for augmented reality are displays, computers, input and tracking devices.

Head Mounted Displays

Just like the monitors which allows us to see text and graphics generated by computer, head mounted displays (HMDs) will enable us to view graphics and text created by AR system.



Head Mounted Display

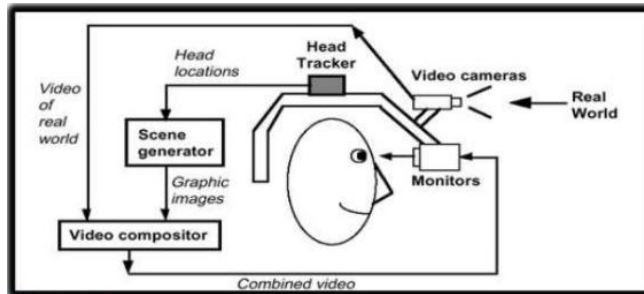
There are two types of Head Mounted Displays:

1. Video see-through display
2. Optical see-through display

A. Video See Through display

Video see through display catches the wearer's surrounding environment, using small video cameras attached to the outside of the goggles to capture images.

On the inside of the display, the video image is played in real-time and the graphics is placed on the video. Video see through systems are conveniently useful when you need to experience something remotely or using an image enhancement system.

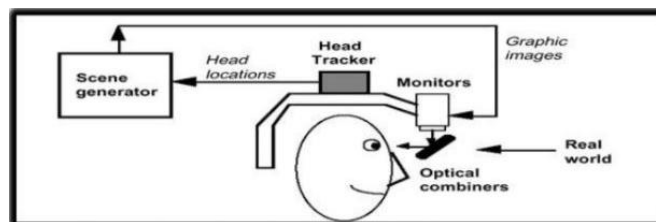


Video See through Display

B. Optical See through Display

Optical-see-through display is not fully released yet. It is supposed to consist of ordinary looking pair of glasses that will have light source on the side to the project image onto retina.

In general a slanted see-through mirror is used for this. This mirror technology allows views of real word to pass through the lens and graphically overlay information to be reflected in the user's eyes.



Optical See through Display

IV. AUGMENTED REALITY IN EDUCATION

Augmented Reality technology is not a new issue. It has been used in fields such as military, medicines, engineering design, robotic, etc (Azuma, Bailiot, Bahringer & Feiner; 2001). AR gives new ways for interacting with physical world and can also create experiences that would not be possible in either a completely real world or in virtual world. Through AR technology, the skills and knowledge which the students develop through enhanced technology learning environment may be developed more effectively.

Augmented Reality can be applied for learning, entertainment, or enhancing user’s perception of and interaction with the real world. User can move around 3D virtual image and view it from any point of view, just like real object. AR provides highly interactive experiences and can generate unique learner activity, interactivity, and a high level of realism. Interaction with the real world is very important in the learning process, and apart from reality, AR is one of the best ways of making this interaction very easy and smooth. Augmented Reality can also be used to enhance combined tasks. It is also possible to develop a new and innovative computer interface that combines real and virtual worlds to enhance face to face as well as remote collaboration. These augmented reality applications are more related to real and natural face to face collaboration than to screen based collaboration (Kiyokawa, et al., 2002).

Another interesting application of this technology is in AR textbooks. This technology allows any existing book to be developed into AR edition after publication. Textbooks will become dynamic sources of information through the use of augmented reality in printed books. In this way the people which don't know much about computer will still have a rich interactive experience.



Author	Advantages of AR
Burton et al. (2011)	Creates a learning experience that is related to the formal classroom, so that students can learn outside of class hours and outside of the school campus limits.
Coffin et al. (2008)	Provide instructors with a way to enhance student's understanding in the classroom by augmenting real props with virtual examples.
Medina, Chen and Weghorst (2008)	Authorizes the view of interactions among amino acids and protein building processes as static 3D or 2D images and 3D dynamic images (animations).
Singhal et al. (2012)	Supports smooth and easy interaction between virtual and real environment and allows the use of a distinct interface metaphor for object manipulation.

Table 1: Advantages of AR

The advantages of augmented reality in education are highlighted above in Table 1 which also indicates that there is high potential to integrate augmented reality in education, especially for subjects that requires the students to visualize.

V. CONCLUSION

This research and review showed in different fields of education shows that AR technology has the potential to be further developed in education. This is because the beneficial uses of AR features are able to involve students in learning processes and helps them to improve their visualization skills. Augmented reality has power to change how we users interact with the computers and smart phones. Through the use of augmented reality, learners interact with the 3D information, objects and events in a natural way. The educational experience provided by Augmented Reality is different for many reasons as Mark Billinghurst (2002) mentioned:

- Support of smooth an easy interaction between real and virtual environments.
- The use of distinct interface for object manipulation
- The ability to change smoothly between real and virtual world

Software and hardware technologies play an important and key role to produce AR applications. There are specialized engineers, who can design different and innovative augmented reality environment. The line between what's real and what's computer generated will be blurred by augmented reality by enhancing what we see, hear, feel and smell in future.

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