

Introducing Augmented Reality for Education Purposes

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Abstract— This article is an introduction to Augmented Reality technology for educational purposes whose aim is to provide a superior learning experience. Its main objective is to act as a starting point for anyone interested in researching or using Augmented Reality for educational purposes which can be simply defined as an interactive 3D environment which links physical reality and the virtual world by Radio Frequency Identification (RFID). Augmented Reality will be widely used within the near future. This paper describes many projects of Augmented Reality which support educational projects in both on-line and off-line modes. The paper also includes information of how augmented reality works in different environments. Its future directions and areas requiring further research are discussed.

Keywords— Augmented reality, eLearning, Internet, Mobile phone technology, new media, Virtual reality

I. INTRODUCTION

This article aims to provide background information about Augmented Reality (AR) projects used for educational purposes. It is divided into two main parts. The first part provides detailed information about Augmented Reality. The second details some AR projects for education.

AR technology causes people to feel fascinated from the first time of their involvement. In theory, augmented reality began to be imaginatively invented towards the end of the 1960s [1]. Before outlining a definition of AR, it is necessary to understand the working processes of simple

AR projects. This is because it may be difficult to understand the new abstract ideas regarding the various technologies which work together in an integrated fashion. Moreover, each AR project reflects the definition in its own way depending mainly on the functions, objectives and details of each AR project.

In practice, AR is an innovation that has been invented to serve the human imagination. It has been found that the information on the Internet concerning AR is growing and being expanded all the time. Currently, the new AR projects and the resulting AR reports are being disseminated and shared on the Internet. Many AR projects directly involve computer technology, the Internet and either portable devices or wearable computers or mobile smart phones. Basically, AR has been used widely in many areas such as education, advertising and the print media. Google Trend shows that the average interest level of Internet users around the world towards AR has grown significantly since 2009 (see Fig. 1).



Fig. 1 The average interest level of Internet users around the world in Augmented Reality

The annual report that focuses on modern learning and teaching technologies, namely the Horizon Report which was first issued in 2002 by the New Media Consortium and the

EDUCAUSE Learning Initiative [1] estimated in its 2010 report that simple AR would be widely used for educational purposes within 2-3 years. According to the Emerging Technology Hype 2010 by the Gartner Firm from the United States of America, there were an estimated 1,800 technologies that have been studied. The results found that AR occupies the highest point on the graph [2]. Gartner Firm reported that AR will be widely recognized in 2-5 years from 2010 as shown in Fig. 2 [2].

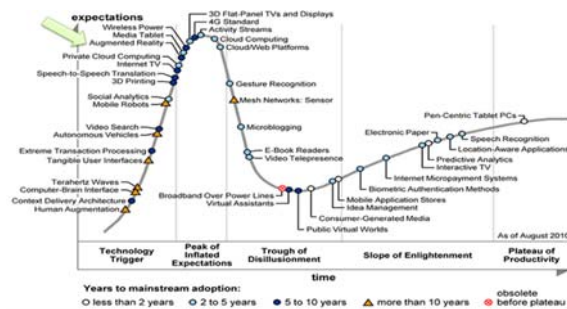


Fig. 2 Emerging Technology Hype in 2010
Source [2]

II. PROCESS OF USING AR

The processes of using AR technology can be explained simply in terms of normal computer technology such as hardware and software. The needed equipment is as follows.

A. Hardware

The hardware consists of two main categories: 1) a computer which refers either to a desktop computer or a handheld computer that connects to 2) a web camera. Please note that it is not necessary to have a three-dimensional video card in the computer. It is recommended to have a speaker connected to the computer in order to play the sound from any multimedia channels of the AR projects. The hardware for AR also includes any smart mobile phone or iPhone which can perform normal functions as a computer and includes a camera able to connect to the Internet.

B. Software

The software is an important tool in displaying AR. It can be divided into two types: 1) a computer connected to the

Internet to demonstrate information through the browser by installing Java Script and Flash Player version 9.0.115 or newer and 2) a computer not connected to the Internet, where there needs to be installed the software able to exhibit AR such as ARIUX, 'AR Player', Unifeye etc..

Not only does the software need to be installed, but also the AR project file is required to be run during the demonstration. In order to demonstrate an AR project, users need to open an AR project file on the computer which has a web camera and software to display AR. Recently, most of the AR companies compile the project into '*.exe' or execute file.

C. Marker

The marker is a symbol printed on any type of material; the symbol is defined by the particular AR project. Some companies also called the marker as 'pattern'. The markers used in the commercial AR projects are unlimited forms. The markers might be a real object or printed in a booklet, book, magazine, flyer, brochure, shirt, skin and so on.

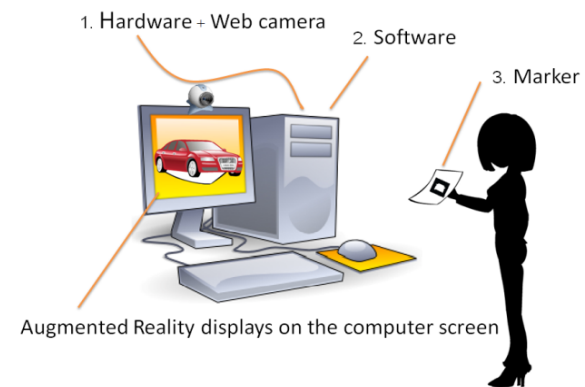


Fig. 3 Augmented Reality processes of a computer

The set-up for a simple AR project is shown in Fig. 3, that is, the AR project will be demonstrated on the computer screen when 1) the hardware such as a computer is already connected to a web camera 2) the software that displays particular AR projects and the AR projects file are both installed on the computer and 3) the marker is displayed to the front of web camera. Then, the AR

project is displayed on the computer screen. Simulations in different situations are illustrated in the following figures.

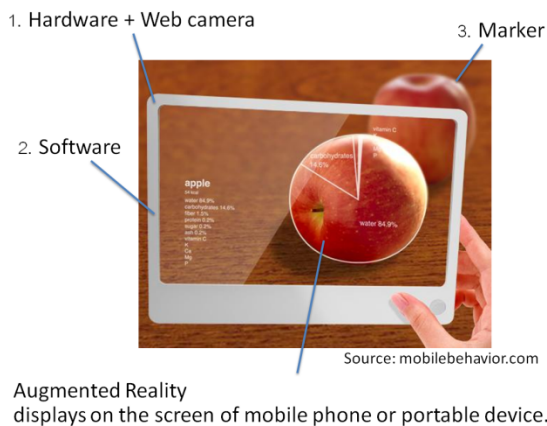


Fig. 4 Process of Augmented Reality on a portable computer

The set-up of an AR project on a portable computer is shown in Fig. 4, that is, the AR project will be demonstrated on the portable computer screen when 1) the hardware such as a portable computer has a camera 2) the software that display particular AR projects and the AR projects file are both installed on the computer and 3) the marker has been captured in front of a camera. Referring to the Fig. 4, the marker is the real object that is an apple. The AR project augments detail of nutrition information of an apple on the computer screen.

III. DEFINITION OF AR

The idea of Augmented Reality started with the desire to present more information about an object on the limited space of the board. Tom Caudell invented the first AR projects in 1960 [1]. It is crucial to review the definitions of AR from many projects and then summarize them into a general definition as described below.

The Human Interface Technology Laboratory (HITLab) at the University of Washington in Seattle defined Augmented Reality as “The use of transparent Head Mounted Displays (HMDs) to overlay computer generated images onto the physical environment. Precisely calibrated, rapid head

tracking is required to sustain the illusion.” [3].

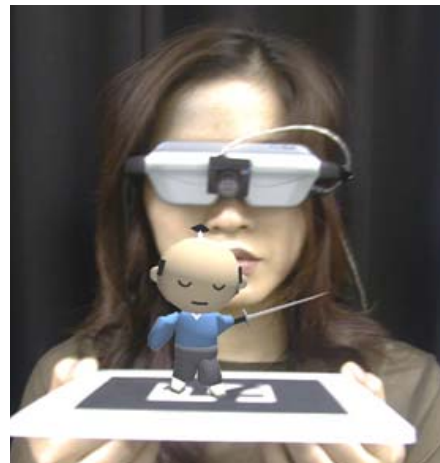


Fig. 5 Using Head Mounted Displays for Augmented Reality Source [4]

EON Reality Inc, an Interactive 3D and Simulation-Based Learning Software provider for business and education based on Virtual Reality technology, defined Augmented Reality as “an interactive 3-Dimensional environment that blends with our physical reality; the capability to link the virtual world with the physical world through for example a “superman vision” where a video image is superimposed with a 3-Dimensional environment model of the same environment and adding hidden information accessible from sensors like Radio Frequency Identification.” [5].

One definition of AR by an academic is “live or direct view of a physical real-world environment, in 3-Dimensional whose elements are augmented by virtual or computer-generated images” [6].

According to Wheeler, a lecturer in the Faculty of Education, University of Plymouth, Augmented Reality is when people interact with computers by using objects in the physical world [7]. Wheeler proposed a diagram of the “Virtuality Continuum” which he adapted from Nijholt and Traum (2005) (see Fig. 6). The real world is on one site and the virtual world is on another site; when both worlds merge together it is ‘mixed reality’. Augmented

Reality is ‘the virtual augmenting the real’. Augmented virtually is when ‘the real augments the virtual’ [7].

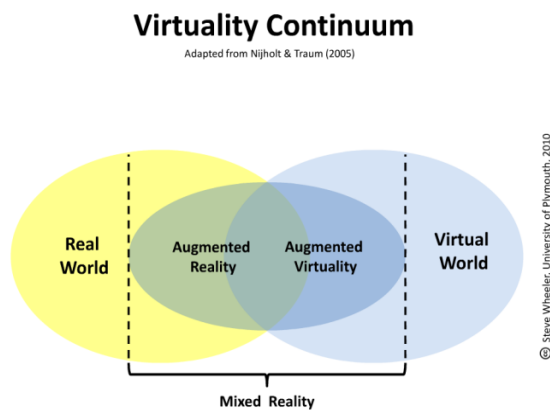


Fig. 6 Virtuality Continuum
Source [7]

Therefore, information about the meaning of Augmented Reality has been gathered - its concise definition can be *Augmented Reality is the display and manipulation of 3-Dimensional objects or multimedia or a movie that show up at the same time that the reality on the computer screen appears when the camera of the device which installs the software captures the marker through Radio Frequency Identification (RFID).*

IV. EXAMPLES OF AR FOR EDUCATION

AR projects have been created and used to be of benefit in many sectors, especially for education. This section presents some AR projects for educational purposes. AR technology has extended the potential for teaching and learning in amazing and achievable ways.

A. AR Surgical training

The AR Surgical training project uses AR to simulate human organs (Fig. 7). The project was designed to use multiple markers, head mounted displays, a camera and sensors altogether at once. The AR starts when the camera captures the markers, and the augmented reality will demonstrate through the head mounted displays together seeing the real objects. The results of this

project are far beyond a computer simulation program since the users can use their hands to physically practice on the reality; they do not use a mouse to click or function.

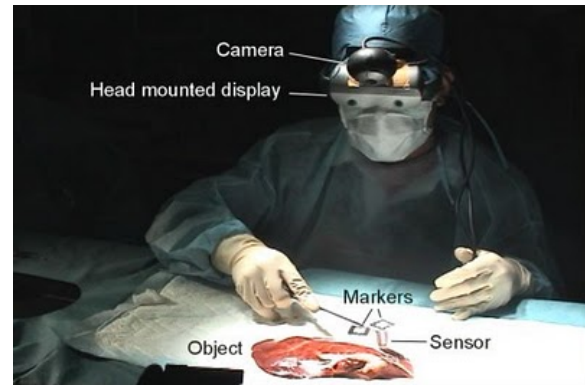


Fig. 7 AR Surgical training
Source [8]

B. AR Orthopedic Course

The marker-less AR project for teaching an orthopedic class (Fig. 8) is the project that has been designed to use a real human organ as marker. The Augmented Reality will be presented on the computer screen, when users present their limbs such as an arm in front of the web camera. The project in the classroom simply amazes since interaction between users and computer is simple and effective. The potential of this AR project is not only to creating student interest but also to increase retention of the information.



Fig. 8 AR Orthopedic Course
Source [9]

C. AR for BMW

The Bavarian Motor Works (BMW) company has created speech recognition AR project in order to demonstrate how to

assemble the parts of a motorcar. They aim to train staff and have utilized the innovation to convince customers they are the leader of high quality services and technology. The AR training has definitely benefited the company. This AR project has also represented the way to apply and design AR technology to suit the conditions of the real needs which are working in the open area such as the garage environment and have no available hand to function the mouse.



Fig. 9 Augmented Reality for BMW
Source [10]

Referring to the above examples, AR has been created by the imaginations of people, and AR has benefited many projects, especially in education.

V. CONCLUSION

AR can be used as an innovative technology integrating actual reality and virtual reality. This article described in a general way augmented reality, the process of using AR, definitions of AR and examples of AR projects for educational purposes. This is to introduce AR and to present the capabilities of the new computer technology and for improving learning materials. The research and development of AR for education is in very high demand because of the capacity of the technology to create a learning environment almost 'miraculous' in its dimensions.

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