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Envisioning Augmented Reality: Smart Technology for the Future

Poonsri Vate-U-Lan, Ed.D.

College of Internet Distance Educationg

Assumption University of Thailand

poonsri.vate@gmail.com

Abstract— This article presents the important foundation of Augmented Reality (AR) technology. Its main objective is to envision the past, present and future of Augmented Reality technology. Augmented Reality technology especially on the mobile device will be widely used in the daily life in the near future. In order to comprehend foundation of Augmented Reality, this paper has been categorized into three sections: 1) comparison of Augmented Reality and Virtual Reality (VR) 2) understanding Augmented Reality hype cycle and 3) facts about Augmented Reality. Its future directions and areas requiring further research are discussed.

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

I. INTRODUCTION

This paper focuses on basic knowledge and information about Augmented Reality (AR) which will be universally used in the future especially on mobile devices. Augmented Reality has various levels of application. It is fundamentally an engaging technological process of combining live video with computer-generated data and visualizations at one level. At another, it is using technology to import computerized graphics against a real environment background. Those fortunate enough to see the film Avatar in 3D would have witnessed parts of this film incorporating a real background with superimposed computer-generated images overlaid on it, merging the two “dimensions” or “realities”. The level of AR describes in this article has been started from basic to advance. The general definition of

the AR technology involves the exhibit and manipulation of 2D and 3D objects. The real images or 3D and the text of AR application appear on the computer screen when the camera device installs the software by capturing the marker through Radio Frequency Identification (RFID) [1]. The marker is simply a symbol of a graphic printed on paper or similar material.

The main objective of this paper is to present the brief history, outline current development and envision the future of AR technology. The first section compares AR and VR while the second section includes the fact about AR hype cycle. Then, the last section includes the facts about AR technology which is soon to come on stream.

II. COMPARISON OF AR AND VR

Both Virtual Reality (VR) and AR were created in the 60s. They are older than or nearly as old as the entire computer graphics field itself [2]-[3]-[4]-[5]. AR is ‘the virtual augmenting the real’. Augmented virtually is when ‘the real augments the virtual’ [6]. The popularity of VR increased dramatically when the Second Life bloomed and the Multi User Virtual Environments (MUVES) emerged as the new kind of web browser.

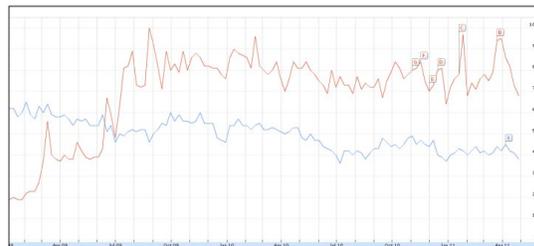


Figure 1. Comparison of Augmented Reality and Virtual Reality by Google Insights for Search

According to data on Google Insights for Search (Figure 1), from 2009 AR has become a more common topic in both search volume index terms and news reference volume than VR. This result seems to reflect the ubiquitous growth of mobile technology as well as featured camera technology and the ease of touch screen mobile phones with Global Positioning System (GPS) such as the iPhone and Android phones as the main factors in the development of AR projects. AR will be widely used for educational purposes within 2-3 years as reported by the 2010 Horizon Report, an annual report on modern learning and teaching technologies. This report was first issued in 2002 by the New Media Consortium and the EDUCAUSE Learning Initiative [7].

In order to produce the AR projects for specific purposes, there are many aspects that require consideration and planning. The computer technology is the main part but levels of AR technology have needed to be explained to the stakeholders involved which was explained through the Augmented Reality Hype Cycle which is a graphic representation of the maturity and adoption of technologies. The hype cycle evolves and provides over time an accurate source of insight to manage AR deployment within the context of a specific goals [8].

III. AUGMENTED REALITY HYPE CYCLE

The history and future of AR is explained through the Augmented Reality Hype Cycle. The AR Hype Cycle has been presented in the format of the technology availability model using the Gartner Hype Cycle as a model. AR development moved to the fore through technological creativity and the force of computer and Internet technology. The crucial element that triggered AR projects into practice has been the integration of demand, creativity and the knowhow from AR technology. In order to categorize levels of AR, the Gartner Hype Cycle has been used as a model [9]. Figure 2 reveals four levels of AR: level zero - physical world hyperlinking, level one – marker based Augmented Reality, level two - markerless

Augmented Reality, and level three - Augmented Vision [4]. Based on Figure 2, the levels of AR can read from right to left, level zero - physical world hyper linking, encompassing the oldest form which was a way to link the physical world to the virtual world [9].

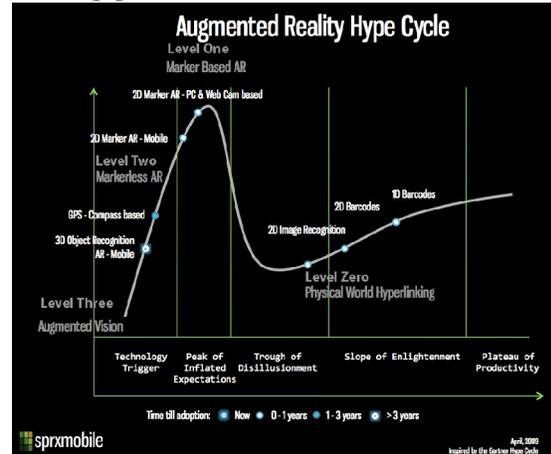


Figure 2. Augmented Reality Hype Cycle Adapted from Source [4]

- **Level Zero - Physical World Hyperlinking**

This is the simplest AR that did not engage users with real time rendering and display of graphics. This level of AR was the most developed and the adoption of this level zero happened in 2010. This zero level included: 1Dimensional bar code which was the identifier as registered in the database (Figure 3), 2Dimensionals Quick Response-codes (QR-codes) which was a specific matrix barcode (Figure 4), readable by dedicated QR barcode readers and camera phones, and the last of this group – 2Dimensionals image recognition which is popular on mobile applications to recognize a company logo or film poster (Figure 5) [9]-[10]. The main reason that supported the level zero adoption was an availability of software both generating and reading the 2D code which freely services on smart phones.



Figure 3.1Dimensional bar code, Source [11]



Figure 4. 2Dimensionals Quick Response-codes



Figure 5. 2Dimensionals image recognition, source [10]

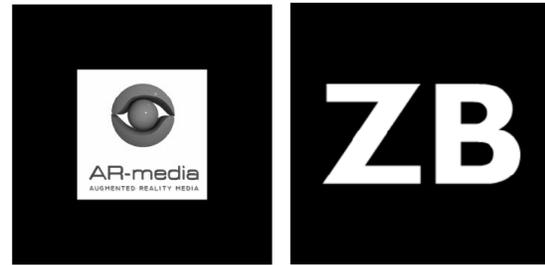


Figure 6. Simple marker, source [12]-[13]



Figure 7. 3D recognition marker, source [14]

- **Level One - Marker based Augmented Reality**

Marker based Augmented Reality occupies the highest point on the graph. The simple marker referred to the black and white square image that needed to be printed out and held in front of the web camera in order to augment a 3D animation (Figure 6) [9]. The marker based AR is the most exciting innovation for an amateur user since it is fascinating to see 3D objects superimposed on the marker [1]. The cooler marker was a 3D recognition when the camera captured the recognized physical objects such as an apple, or a chair and then with the focus maintained on the object to augment a 3D animation (Figure 7) [9]. The marker enabled real time processing of ‘reality’ and subsequently real time rendering and display of graphics and the 3D model on top of its reality. This level one marker based AR became ubiquitous in 2011 in both online and offline mode. The main reason in support of this level one was due to it providing the increased opportunity of production which offered both free and open source code along with “fancy” or elaborate commercial software. Moreover, its popularity became realistic since AR technology can be viewed through the Adobe Flash Player. Another reason why the marker based AR became popular is the promotion of AR Game uses for commercial products.

- **Level Two - Markerless Augmented Reality**

Markerless Augmented Reality is almost at the peak of inflated expectations; it has started in 2010. This markerless AR can work isolated from any recognition as marker based required. The main factor driving the popularity of markerless AR was GPS and its compass which is common in smart phones. The AR application on the phone recognized the position of GPS followed by capturing the direction based on the compass, then augmenting the 3D or information on the screen correctly (Figure 8). The markerless AR using GPS still has some challenges to overcome since GPS is probably only accurate to within 9 meters (30 feet) and does not have enough accuracy indoors, although improved image recognition technology may be able to help [15].



Figure 8. Markerless using GPS recognition, source [24]

• **Level Three - Augmented Vision**

Augmented Vision, which is at the start of the graph, existed only in the laboratory [9]. In 2009, Babak Amir Parviz from the Human Interface Technology Center, University of Washington, invented the special contact lens (Figure 9) that introduced the AR technology into the human eye [16]. The lens used sensors and wireless technology to allow bionic eyesight. People who wore this AR contact lens were able to monitor their heart by making use of tiny circuits and Light-Emitting Diode (LEDs) [16]. The result of the first Augmented Vision product will revolutionize medical science in many aspects. The example of simulation for a user who wears Augmented Vision will see more information of any object already programmed as revealed in Figure 10. This idea of Augmented Vision has been presented before the complete technology was developed and appeared in the fantasy film “The Terminator”. Augmented Vision was in high demand to be developed and researched not only in the academic field but also in other fields especially commercial entertainment.

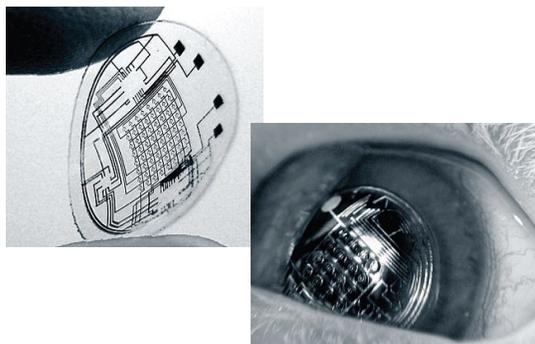


Figure 9. Augmented vision, source [16]



Figure 10. Envision of computing, source [17]

The AR hype cycle explains the levels of AR technology as a flow from the beginning of the development through to imminent development. The factor increasing the growth of AR is its ease of use.

IV. FACTS ABOUT AUGMENTED REALITY

AR is in high demand not only for educational purposes but also has become important for strategies in advertising and marketing. The commercial software of the AR creator is very advanced but definitely expensive. This has become an obvious obstacle given the very few open sources available. Thus, two main concerns when constructing AR projects are: 1) the need of an expensive budget to deal with numerous technical complexities involved in the long process of production and 2) the development and planning of a quality analysis phase to ensure an acceptable quality level and a return on investment [18].

The potential of AR technology to influence people’s behavior as shown in the research that about three quarters (74%) of parents who experienced a toy demonstration via AR considered buying the product but less than half (45%) who viewed the 2D paper-based demonstration considered buying the same product [19]. AR technology has been used to support marketing in various ways and the most popular is an integration of AR technology on brochures (Figure 11).

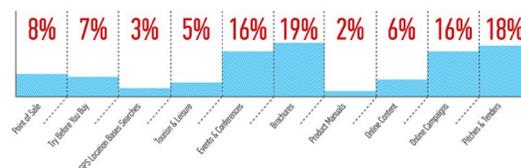


Figure 11. How AR is being used, source [20]

V. CONCLUSION

AR technology will be used to contribute to smart innovation projects in the future because of its potentials and fascination. The usefulness of AR technology encourages researchers and programmers to create innovative products which should make life more interesting in the future.

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