REVIEW ON APPLICATION OF AUGMENTED REALITY IN EDUCATION

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Abstract

In recent years, there has been an increasing interest in Augmented Reality (AR) technology. AR is now an advanced technology foreseen to lead the future trend of computerized technology and it can be widely used in various fields such as education, medical, entertainment, tourism, marketing and advertising. AR is an emerging form of experience in which real world is enhanced by computer-generated content. Nowadays, this technology is widely utilized in the field of education and information. It opens a novel realm for people to learn in an innovative way. Due to an increment of investment and research in AR by several large companies, among them Google, Microsoft, Apple, Samsung and Magic Leap, may benefit a better accessibility in education. AR proved to be useful in educational field by helping people to learn or receive information effectively. Technology now days allow users to see the virtual objects in real world to enjoy and interact with the content through smartphones and tablets in AR-based learning. Its features such as animation, Three-Dimensional (3D) graphics and sound may enhance the user's learning experience by actively exploring the medium. It also helps the students to have a better understanding of the content. The huge beneficial of this technology would make AR as the alternative learning toolsof formal or informal education in near future.

Keywords: Augmented Reality Learning, Augmented Reality, Education, Learning Tools

1 INTRODUCTION

If internet and cell phones are the major technology breakthrough in the late 20th century, then Augmented Reality is the next big thing in the 21st century. Although it is found as early as the 1960s, Augmented Reality just begins to become practical in many fields [1]. People usually relate Augmented Reality to Virtual Reality, but both of the technologies do have major difference. Virtual Reality immerses the user inside a complete virtual environment, whereas Augmented Reality allows a user to see a virtual object in the real world.

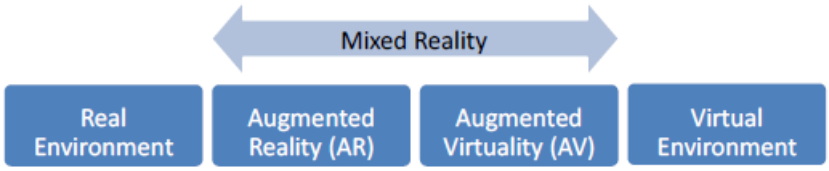

Fig. 1 Reality-Virtual Continuum [2]

Virtual Reality technology totally immerses users in the virtual environment when interacting and completely replacing the real world. On the other hand, Augmented Reality allows users to see the real world while interacting with Augmented Reality interface [3, 4]. User can simultaneously see the

virtual and real objects. Professor Ronald Azuma; as cited by [5, 6] Augmented Reality with these three characteristics:

i. It combines both the real and virtual objects in real environment
ii. It is interactive in real time
iii. It is registered in 3D

Augmenting refers to the aspect of influencing humans' receptors, such as vision and hearing, with additional information. The information is generally produced by computer. Current technology of Augmented Reality only uses displays to overlay and merge the physical information with the digital information. If hearing is to be augmented, then a modified headphone with microphone must be equipped to mix sounds from real-time surroundings with digital sounds. [1]

Augmented Reality have offers the magic of combining both physical world and virtual world and brings applications from the screen into people's hands. It brings everything from various fields (advertising, gaming and education) into an utterly new way, a way which provides a totally new range of user experience.

2 AUGMENTED REALITY IN EDUCATION AND BOOKS PRODUCTION

Researchers have explored the use of Augmented Reality applications within a variety of fields and disciplines, and education proves to be one of the most suitable platforms for experiment. This section provides an overview on how Augmented Reality technology is applied in various educational purposes.

2.1 The House That Jack Built

Augmented Reality has materialized the merging of digital information and physical properties of paper. Leapfrog's leappad is a interactivity book that has the features which enhance the book surroundings, by allowing pen activity on the book. Since then, research has been conducted on integrating sounds and objects into educational books. Finally, the development of 3D model pop-up book is carried out by using Augmented Reality technology. [7]

Project of developing an Augmented Reality-based book has been conducted by Raphael Grasset and co by combining book, standard desktop computer hardware, a multimodal handheld device, tangible interaction devices, and an additional green screen. Their prototype is based on a book named "The House That Jack Built", which has a lot of pictorial elements about New Zealand history and the relationship of Maori and European settlers. The prototype has several key features: background music, 2D animation content, augmentation of surroundings and 3D spatial content. [7]. The House that Jack Built book is usually shown on a table with a pair of speakers for ambient and 3D sound. For visualization and tracking, users can either use an Augmented Reality handheld device with attached camera or a handheld camera manipulated by the user and a computer screen behind the book. The former provides a more personal and immersive experience with the book, while the latter can be used for collaborative experiences and public demonstrations. [8]

Fig. 2 Mixed Reality Book: The House That Jack Built.

2.2 The Haunted Book

Book production using Augmented Reality technology is experimented on poetry book. Augmented Reality becomes the essential part of the poetry book because the integration of real and virtual elements can create the desired atmosphere. The Haunted Book is based on a poem written by Thomas Hood. Augmented Reality technology in the book allows readers to 'walk' through the book and discover the hidden creatures as the narrator tells about The Haunted House. The animation of the creatures in the poem creates a subtle way to enhance the illustrations, making the readers feel staying in the poem universe. The artists used Adobe After Effects to design the animated layers, then only applied them for augmentation. In this work, the poetry book brings a different experience to the readers by bringing them other visions of pictures. In contrary to a normal poetry book which is usually considered as dull and boring, this Augmented Reality-based book gathers more attention from readers. [9]

Fig. 3 The Haunted Book.

Fig. 4 Animated illustrations from The Haunted Book.

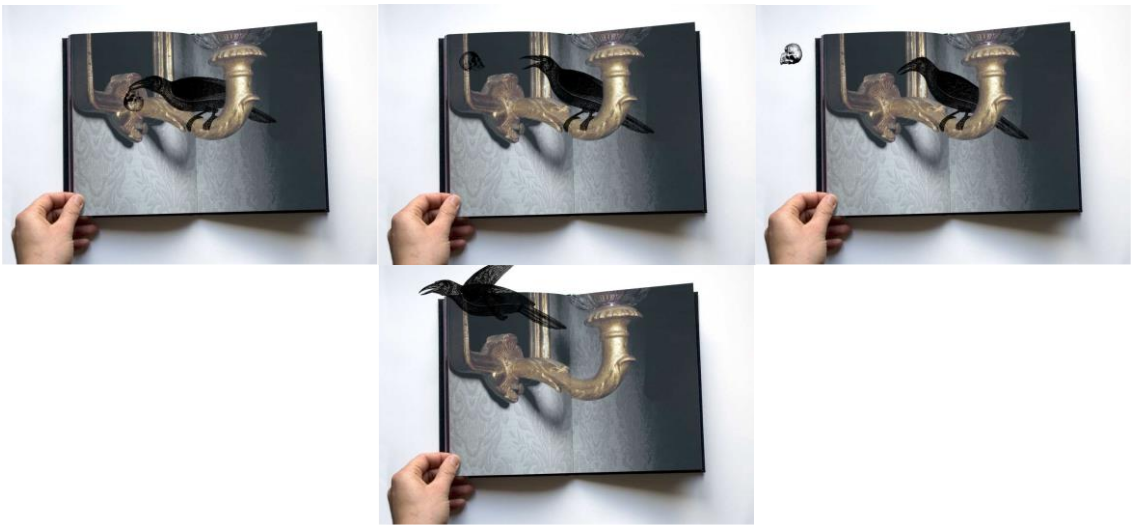

Fig. 5 Example of Animation from The Haunted Book.

2.3 Augmented Reality Coloring Book

Augmented Reality book not only means for entertainment and visual enjoyment, it also means for users to do interactivity or express themselves. Researchers create a “pop-up book” which children’s drawings and colorings are generated into the design and appearance of the book content. In this project, the book developers aim to introduce a new concept of using users’ interactivity to create the book appearance in real time by coloring book metaphor. Augmented Reality has formed the central focus of a study by Adrian Clark in which the author found that the main contributions of the work are allowing readers to create new book content, detecting and registering a tracking target which may have been modified considerably from the original and creating three dimensional scenes and textured 3D models from the users content in real time. The feedback from the coloring book is encouraging as the simple way of creating artwork is suitable for children. [10]

Fig. 6 Augmented Reality Coloring Book.

Fig. 7 New book content can be created.

2.4 Live Solar System

Live Solar System is an Augmented Reality-based educational tool in astronomy. The book applied the Tangible Augmented Reality approach in the user interface and interaction design. Tangible Augmented Reality is an interface which combines the Tangible User Interface and Augmented Reality Interface. Tangible User Interface, also known as Graspable User Interface, is a user interface in which a person interacts with digital information through the physical environment. It provides a physical interaction by turning physical objects into input and output device for computer interface. Tangible User Interface has limit, it cannot dynamically change an object's physical properties. When users choose an object not matching the desired functionality in a computer interface, spatial gaps happens to exist. This is up to Augmented Reality Interface to support the spatially seamless workspace. With Tangible Augmented Reality, every object is a physical object, allowing users to interact with the virtual objects by manipulating the corresponding tangible objects.

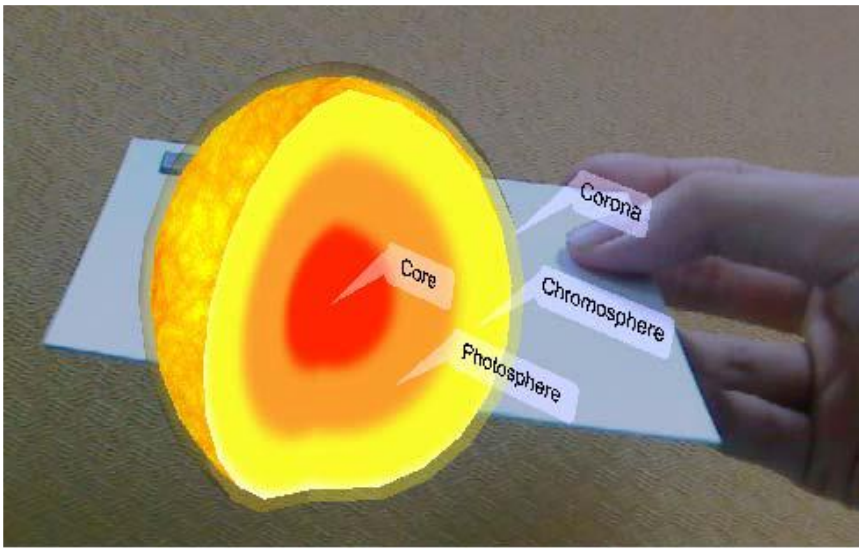

Fig. 8 The sun structure in 3D.

Live Solar System is an astronomy educational tool which contains multimedia elements like video, graphic, text and 3D objects. It is developed based on Form 3 science syllabus, specifically on the topic 'Stars and Galaxies'. Augmented Reality technology allows students to explore the solar system in a more concrete way. Cube was chosen over mouse and keyboard as the physical object for interaction purpose. By manipulating the cube using natural actions such as place, pick or press, users can effectively interact during the Live Solar System exploration. These natural manipulating actions used are similar to the natural and intuitive interaction approaches used by users in their everyday life. This made interaction between users and Live Solar System easy. [11]

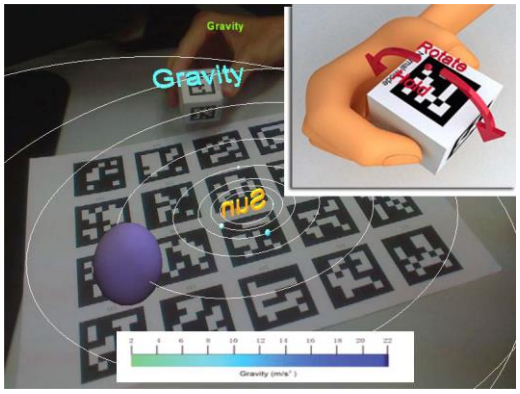

Fig. 9 Changing mode by rotating a cube.

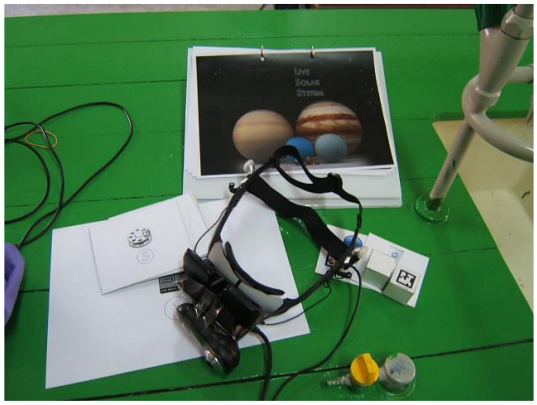

Fig. 10 Live Solar System Hardware Components.

2.5 English Language Teaching 3D Pop-up Book

This research focuses on using storytelling as a teaching technique in an Augmented Reality 3D Pop-up Book. The Pop-up Book acts as a tool for teachers to deliver the story from a children's book, 'The Seed Shooting Game'. The purpose is to conduct English language teaching to young children. The 3D Pop-up Book integrates the knowledge with interesting storytelling techniques and colorful cartoons. This project is proved to be a successful one as test results shows that almost 88% students think that storytelling enhances the learning environment. [12] However, the Augmented Reality development part was handled by a third party Augmented Reality creator.

Fig. 11 Multimedia Augmented Reality 3D pop-up book.

3 COMPARISION OF APPLICATIONS OF AUGMENTED REALITY

The review highlights the usage of Augmented Reality technology in various kinds of educational tools. The development of Augmented Reality book different methods and the outcome is also different according to their creativity of presenting the Augmented Reality book. For example, the Augmented Reality book for Live Solar System and The House That Jack Built are using too many hardware and devices in order to see the virtual object. It makes the whole reading process become complex. In a 2012 study from Google and the University of Basel, researchers found that users will judge a website's aesthetic beauty and perceived functionality in 1/20th – 1/50th of a second. The judgments are made so quickly that they become instinctual rather than mental process. Psychologist named this phenomenon as cognitive fluency. Cognitive fluency is how human feel about taking in new information. It's the subjective experience of the ease or difficulty of completing a mental task. If something looks easy, then human will automatically assume that it is simple. This is why Augmented Reality-based book (a new product in the market) should be made simple to attract people's attention. When people feel the thing easy, they will try learning it. Some of the application do not provides interaction, animation and sound features. While some of the application requirement of hardware is complex and not portable, and 3D model is not vivid and interesting enough.

4 CONCLUSION

Education and learning perhaps have many ways. From past printed reading until on-screen reading, the main objective is providing a good way of learning. Although there are benefits from each of the different aspects, individual habits or comfort towards reading matters is more concern in choosing the way of learning. Augmented Reality is a new way of learning method [4]. Augmented Reality technology allows architect to make actual-size modifications building, children to interact with the various kinds of animals, medical treatment for doctor to view ultrasound images. These superimpose virtual images in real life helps builds the 3D visions which people can't see in life. Augmented Reality book is like an ordinary book. Readers flip through pages for learning the content. However, if the reader looks at the pages through an Augmented Reality display, they see 3D virtual models appearing out of the pages [13].The 3D virtual models is animated and associated with sound, users can interact with the pop out 3D virtual models. The features of augmented reality book such as simulation, animation, 3D graphics and sound provides a more interactive and interesting learning experience [14]. Since Augmented Reality allows pop out 3D virtual models, user can interact and see the structures of the models, this gradually reduce the limitations of conventional educational media [14].

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