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IERI Procedia 2 (2012) 802 – 807

Procedia IERI

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2012 International Conference on Future Computer Supported Education

Design and Development of an Interactive Augmented Reality Edutainment Storybook for Preschool

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Abstract

This paper presents the development of an engaging method for learning numbers via a highly interactive edutainment children storybook based on augmented reality technology and an old folklore story. Augmented Reality (AR) refers to the merging of synthetic sensory information into a user's perception of a real environment. AR enhances the view of the real world by augmenting the real environment with virtual objects to provide additional information to the users. In the current context of an AR storybook, the view of the physical book (or the real world) is enhanced using virtual objects (3D models, animations, text, and sounds) viewed over a computer display device. This paper describe the development of an interactive graphical user interface (GUI) design for providing an augmented reality book enhanced story reading & learning experience. It also highlights the design of an interactive physical book interface design of the augmented reality book. Findings from an initial observational study of the prototype are also presented.

Selection and peer review under responsibility of Information Engineering Research Institute

Keywords- Augmented Reality,interactive storybook, edutainment, preschool storytelling

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2212-6678
doi:10.1016/j.ieri.2012.06.174

1. Introduction

Early literacy education is important for children as it establishes the foundation of reading and writing skills which is essential for future education. Furthermore, it can help in development of children's emotion, thinking and language (Chew and Ishak, 2010). Literature program In preschool is mainly aimed to create the positive attitude towards literature (Chew and Ishak, 2010). Several study showed that the attitude of study towards literature impact on the lifelong sources of emotional and cognitive enrichment. Furthermore, the old folk stories tend to disappear among children of the newer generation. Including the old folk as a literature lesson for preschool is one way to revive the traditional storytelling. Encouragingly, the study by Chew and Ishak revealed that Malay folk can be immersed into preschool teaching and learning (Chew and Ishak, 2010).

Traditional storytellings use physical books which allow many interactions and sensory feedbacks between reader and the book such as speech through the narration, vision through pictures and touching through the turning and pointing at the pages (Zhou et al., 2008). However, reading book can be a monotonous activity as actions are usually descriptive based and illustrated through static graphics. The electronic book (e-book) which was introduced later provides various types of media supported and lively characters through animation. Many researches showed that with the use of e-book can grab the users' attention and the users can be more motivated. But, the user interaction is limited to the use of mouse and keyboard to control the book (Zhou et al., 2008).

Augmented Reality (AR) is a promising technology where by the virtual information can be viewed as co-existing with the real environment. These unique features could be used to enhance a physical storybook by augmenting the book pages with the graphics, animations and audio. Integrating AR concept into a physical book will converts a static story reading experience into a dynamic, fun and interesting reading experience for the children. Besides reading, AR allows user to interact with the physical book through the use of markers, thus introducing a new learning experience that is motivating, engaging and fun (McKenzie and Darnell, 2004).

Based on an observational study by Dünser and Hornecker, they found out that the choice and nature of the story affect the engagement of the children (Dünser and Hornecker, 2007) A survey done by Chew and Ishak, 2010 indicates that "Sang Kancil and the Crocodiles" is the most popular and suitable Malay folklore for early childhood education. The popularity of Sang Kancil (mousedeer) is indicated by numerous tales which portray the wisdom of Sang Kancil in overcoming much bigger and fiercer animals (Chew and Ishak, 2010). The study also stated that the Malaysia folk should be made into a "big book" for early childhood education (Chew and Ishak, 2010). Furthermore, the study also indicates the potential of Information and Communication Technology (ICT) in enhancing and promoting the traditional folklore stories (Chew and Ishak, 2010).

Engaging students in the learning process can translate into greater learning (Beeland, 1990). Researchers have shown that an interactive learning environment can turn passive students into active learners that are fully engaged (Moore et al., 2007, Dunfresne et al., 1996). As such, many researchers have explored and showed the usefulness of various technologies, particularly ICT, in creating an interactive, interesting and engaging learning environment (Beeland, 1990, Monahan et al., 2008, Davies, 2002, Johnson et al.,1998). In this paper, we present the use of augmented reality to develop an engaging method for learning numbers via a highly interactive edutainment children storybook. A popular Malay folklore called "Sang Kancil and the Crocodiles" was selected as the story for the book. This paper is organized as follows; related work on AR book will be presented in section 2 while the design of interactive interface of the proposed AR book will be presented in section 3. Section 4 highlights the results of an observational study on the prototype. The paper concludes with recommendation for future work in section 5.

2. Related Work

One of the earliest works in this area is introduced by Billinghurst et al. known as a "MagicBook" (Billinghurst et al, 2001). The MagicBook allows the seamless transition between reality and virtuality (Billinghurst et al, 2001, Grasset et al., 2008a, Grasset et al., 2008b). Users can read the book as they read a normal book. However, when user views the book through handheld display they can view the co-existing of 3D model over the real book. Furthermore, user can switch into the immersive virtual world to view the 3D more clearly. The invention of MagicBook inspired many other works in different context such as biochemistry (Medina et al., 2007), science learning for the deaf students (Mohd. Zainuddin et al., 2010), geometry (Kaufmann and Schmalstieg, 2002) etc. However, most of AR book is using the physical book as the container of the markers (Grasset et al., 2008a) The effective of pictures and text are still lack of study.

Dünser and Hornecker, 2007 conducted an observational study on reading an AR book of children age 5-7. They explore the effectiveness of AR book as an instructional tool. The research found out that children can learn quickly on how to interact with the system. The 3D animation and physical interaction create a playful learning environment. However, some technical problem also presented (Dünser and Hornecker, 2007).

3. Interactive Interface Design

In developing the AR storybook application, the prototype concept can be presented as shown in figure 1.

Fig. 1. Augmented Reality book based application set up

Figure 1 explains briefly how AR works. Four main components in order to set up AR application are required which are camera to capture the real environment and track the position, computer and display devices to display the augmentation, AR book and markers as a physical interaction devices. Marker refers to the black and white square picture. Each 3D character was assigned to each marker.

There are three main display methods for AR application which are using Head-Mounted Display (HMD), HandHeld Display and through the use of spatial display such as monitor based display (Bimber and Raskar, 2005, Bilber and Raskar, 2006). This prototype is using spatial display through monitor based because desktop display allows wide range of display and interaction space as compared to other display methods.

Compared to traditional book, AR Book needs some initial setup before usage. Thus, to reduce the learning curve for user as well as to increase the interactivity between user and book, we focus our designs on two main parts of the book. First, is the design of physical book itself and secondly is the design of graphical user interface that is the view of the book on the monitor.

3.1. Physical Book Design

As a study by Grasset et al. the richness and aesthetics of the pictorial content of the physical book also playing an important role as it is first impression to grab the user's attention (Grasset et al., 2008a, Mohd. Zainuddin et al., 2010). Furthermore, it can also be used to integrate the meaningful text and information into it.

The natural interaction of the user to physical book should be presence in AR book as it aimed to enhance the traditional book, not to replace it entirely. Hence the normal interaction such as pointing, turning of the page can be supported. While using AR book, new type of interaction can also be enhanced. Tangible User Interface (TUI) used to describe the interaction of user to the system by using natural mean of interaction such as pick up, pointing etc. or by using the physical object. To add value into learning, the magic wand has been designed to work together with the book. The magic wand is designed to be easy to hold and interact. The user just needs to use magic wand to point at the marker so that the animation and 3D model of respective markers will show. Figure 2 shows the design of the book and magic wand.

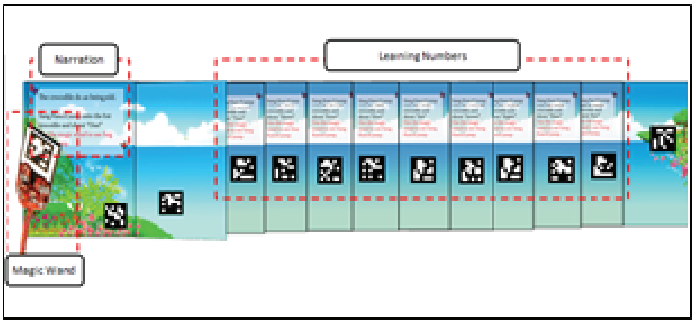

Fig. 2. Design of the physical Sang Kancil and the Crocodiles book

3.2. Interactive Graphical User Interface Design

Most of AR application on concern on the physical interaction design, less of the work focused on the Graphical User Interface (GUI) which is equally important. Like most of other virtual and electronic book, the mouse can be used to control and navigate the virtual object besides using magic wand. Figure 3 shows the sample of user interface design for Sang Kancil book.

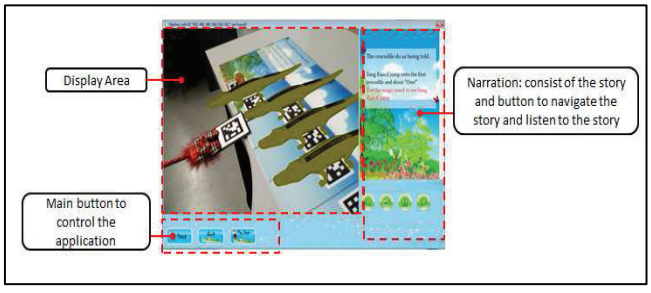

Fig. 3. Interactive Graphical User Interface.

The graphical user interface can be divided into 3 main areas which are the display space, main button and the narration spaces. The display space is where the user can view the 3D model and animation of the story. The main button is used to control the application such as to start, quit and refresh the application. The narration space provides the story. User can use the button to navigate the story as well as listen to the story. This is also aimed to help the students in learning on how to read.

4. User Feedbacks

User feedbacks were informally gathered from visitors during an exhibition. Visitors who tried the application were from different background and age range. Generally, the technology of AR surprised the users and grabs their attention. Excited parents and young children were among those who tried the application. Observations of their facial expressions and their reactions when using book indicate the potential of AR as an entertaining and engaging tool for learning. Most of the parents asked about the commercial version of the application whether the application is available at the moment in the market. The magic wand which was used to initiate virtual objects and animation was a hit among the children; some use it to interact with the virtual object such as hitting the virtual crocodile.

Based on the user feedback, more animation and effect are needed to improve the interactivity to the system. Observation of users' interaction shows that the interactive physical book and markers are used more often as compared to the interactive graphical user interface.

Fig. 4. User interacting with Sang Kancil and the Crocodiles book during exhibition.

5. Conclusion and Future Work

The design of physical book and graphical user interface is important to increase to grab the students' attention as well as increase users' participation or interaction. The design of an edutainment book has been presented. The prototype was developed by using the emerging technology of AR and based on the most popular Malaysian folklore story, Sang Kancil and the Crocodiles. Children are not only can enjoy the folklore, they can also learn about numbers throughout the story. The formal user evaluation will be conducted based on the prototype by using the target users which are preschool children and parents as a future work. With the use of AR technology, it aims that learning on numbers and reading folk story will be more interesting activity

Acknowledgements

This project is developed using an STIRF fund from Universiti Teknologi PETRONAS. It was initially developed as a final year project by Naret Mohsa-nga.

References

[1] Beeland. W. D. Student Engagement , Visual Learning and Technology : Can Interactive Whiteboards Help ? Learning. 1990.
[2] Bimber, O., & Raskar, R. Spatial Augmented Reality Merging Real and Virtual Worlds. A K Peters Wellesley Ltd., Massachusetts. USA, 2005
[3] Bimber, O., & Raskar, R. Modern Approaches to augmented reality. In international conference on computer graphics and interactive techniques, ACM SIGGRAPH 2006 Courses Boston, Messachusetts.
[4] Billinghurst, M., Kato, H., and Poupyrev. I. The MagicBook: a transitional AR interface. In Elsevier Computers and Graphics , 2001, pp. 745-753
[5] Chew, F. P., and Ishak. Z. Malaysia folk literature in early childhood education. In world Academy of Science, Engineering and Technology 66, 2010. pp. 557-563
[6] Davies, C.H.J. Student engagement with simulations: a case study. Computers & Education. Volume 39, Issue 3, November 2002, Elsevier Science. Pp. 271–282
[7] Dufresne, R. J. Gerace, W. J. Leonard, W. J. Mestre J.. P and Wenk. L. Classtalk: A Classroom Communication System for Active Learning. Journal of Computing in Higher Education, 7, 1996. pp. 3-47
[8] Dünser, A., and Hornecker. E. Lessons from an AR book study. In ACM TEI'07 pp. 179-182.
[9] Grasset, R., Dünser, A., and Billinghurst. M. Edutainment with a Mixed Reality book: a visual augmented illustrative children's book. In Advance in computer entertainment technology 2008, Yokohama, Japan. ACM, pp. 292-295.
[10] Grasset, R., Dünser, A., and Billinghurst, M. The design of a Mixed-Reality Book: is it still a real book? In IEEE ISMAR. 2008, 15-18 September, Cambridge, UK. Pp. 99-102.
[11] Johnson, A., Roussos, M., Leigh, J., Vasilakis, C., Barnes, C., Moher. T., (1998) The NICE Project: Learning Together in a Virtual World. Pp. 1-8.
[12] Kaufmann H., and Schmalstieg, D. Mathematics and Geometry in Education with Collaborative Augmented Reality. In ACM SIGGRAPH 2002 Conference, New York. 2002. pp. 37-41
[13] McKenzie, J., and Darnell. D. The eyeMagic book. A report into Augmented Reality Storytelling in the contect of a children's workshop 2003. New Zealand Center for Children's Literature and Christchurch College of Education, 2004.
[14] Medina, E., Chen, Y. C., and Weghorst. S. Understanding biochemistry with Augmented Reality. In C. Montgomerie & J. Seale (Eds.), Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2007, pp. 4235-4239.
[15] Mohd. Zainuddin, N. M., Zaman, H. B., and Ahmad, A. A participatory design in developing prototype an augmented reality book for deaf students. In 2nd International Conference on Computer Research and Development 2010 IEEE
[16] Moore, A. H. Fowler, S. B. and Watson. C. E Active Learning and Technology: Designing Change for Faculty, Students, and Institutions. EDUCAUSE Review, vol. 42, no. 5 September/October 2007. pp.42–61
[17] Monahan, T., McArdle, G., and Bertolotto, M. Virtual reality for collaborative e-learning. Computers & Education. Volume 50, Issue 4, May 2008, Elsevier Science. Pages 1339–135.
[18] Zhou, Z. Y., Cheok, A. D., Tedjokusumo, J., and Omer. G. S. wIzQubesTM – A novel tangible interface for interactive storytelling in mixed reality. In The international journal of virtual reality, 2008, 7(4) pp.9-15.