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In Art Design & Cultural Heritage

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Interaction Design in Collaborative Augmented Reality (AR) Storybook for Children

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Abstract— The study is to review some aspects within the field of human computer interaction (HCI) to be incorporated in the development of collaborative augmented reality applications with children's storybook. The content analysis method was used to explore various theories and principles related to HCI. Thus, the review analysis and findings able to provide clear direction for future research and to contribute to the body of knowledge in this area.

Author Keywords: *augmented reality; malaysian children learning; human computer interaction*

1. INTRODUCTION

The vast development of technology today encourages children to spend more time on digital gadget at early childhood stage. More than half of population in Malaysia owns a smart phone which shows the high accessibility to download applications and games easily. Due to that, digital gadget is often used by the children to play games. Thus, reading session time has lessened.

"It is dry, it is boring, and what will we need it for?" are what the children nowadays think about reading book, especially on history and literature. They do not find enough fun and motivation to continue reading. Both adults and children, the digital gadget has overtaken their interest in reading book as everything can be accessed through the mobile devices or computers.

However, parents should also consider book reading activities among their children and instill the reading habit at the early stage. A study indicates that early stage of reading procurement have shown that the home environment and support from adults is essential to develop literacy improvement (Neuman, 1996). Thus, by bringing interactive elements into published materials such as storybooks or creating new digital materials that fused with publications are innovative ways to engage the readers. (Uzzan, 2010)

The positive part about development of the digital technology is the presentation of information covers the combination of various media such text, graphics, sound, animation and video. It is cost effective as the applications is easy to be developed and accessed. Educators, parents, and students are convinced that multimedia is useful in the teaching and learning process. (Lawrence, 1998) In addition, the high level of interactivity made children learns better through the interactions with the application.

Augmented reality (AR) is one of the emerging digital technologies that is getting attention by the Malaysian users. It is applied to help experience our surroundings in new means and also enhanced our perception through the multi senses. In mobile augmented reality (AR), users observed real image from the camera on their mobile phone and the view that they see is enhanced by the embedded three-dimensional virtual objects. The real object captured through camera is actual environment and the three dimensional images on the camera is called augmented reality. (Fatin Norsyafawati et al., 2016)

The objective of this study is to review some aspects within the field of human computer interaction (HCI) to be incorporated in the development of collaborative augmented reality applications with children's storybook.

2. METHODS

For the purpose of this preliminary study, the classical content analysis method was used to explore and analyze several related literature in order to achieve the objectives of the study. The exploratory started by analyzing the contents of documentary material such as books and research articles. The research includes content from other verbal material like videos, interviews, and forum. The research focuses on finding design preferences suitable for AR storybook for children.

3. CONTENT ANALYSIS RESULTS AND DISCUSSION

The content analysis based on diverse related theories and literatures show several significant findings that potentially meets the objectives of this study.

3.1 Children Development and Visual Design

Lawrence (1998) stated that the study of the user interface design relates to the intention of how does the application able to maximize the learning success of the user when using the applications. Furthermore, the combination of visuals such as type and images, animation and sounds in games or applications provide the high level of user interactivity which enhance children's learning in an enjoyable environment.

Amanda Nicole (2006) stated that the cartoon style is significantly effective in motivating and helping children to understand instructions. Illustrations are able to visualize complex idea into a simplified form. They play important roles in stimulating children's imagination and able to promote conceptual change of certain information.

Jean Piaget was one of the most influential researcher on child development during the 20th century. Piaget's theory is based on the idea that the developing child builds cognitive structures through a process called adaptation from the physical and mental stimuli. Assimilation and accommodation are two parts of the adaptation process. It is a process where children construct their own knowledge through experiences with the surroundings or with the given stimuli. His views have influenced both psychological and educational research, as well as research within the field of interaction design and children. (Eiksund, 2012)

3.2 Human Computer Interaction (HCI)

HCI (human-computer interaction) is the study of how people interact with computers or digital presentation. Ubiquitous research discussed on criteria for successful interaction between human and computer. Children learn better from digital representation when they are designed in ways that are consistent with their cognitive functions that are fused with research based principles.

The focus of this study is in the area of interaction design, where the main concern is designing interactive systems that meet user experience and usability goals. Thus, several theories and principles related to HCI are explored.

According to Mayer (2009) in cognitive theory in multimedia instruction, learners tend to construct meaningful link between words and images and that they learn more genuinely than they could have with words or pictures alone. The learner's task is to make sense of the presented material as an active participant, ultimately constructing new knowledge. The theory s based on three main assumptions, they are two separate channels respectively auditory and visual for processing information, there is limited channel capacity for both channels and learning is an active process of filtering, selecting, organizing, and integrating information.

The understanding of usability in HCI is crucial as it refers to the ease-of-use of the application during the design process. Jakob Nielsen (2012) in his web article entitled “Usability 101: Introduction to Usability” explained five key components in assessing usability in an interactive application. There are, “Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design? Efficiency: Once users have learned the design, how quickly can they perform tasks? Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency? Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors? Satisfaction: How pleasant is it to use the design?”

Schaeer (2014) pointed out that there are four inspection methods of usability; which are *Heuristic Evaluation* which involved one or more evaluators who are novice to the prototype design. They will evaluate according to the given standard usability principles. Next is *Cognitive Walk Through* evaluation, this method is used to inspect the interaction between the user and the interface through some pre-defined tasks without having any prior training. *Laboratory evaluation* method is done in controlled environment which mimics real life scenario where the experimenter has full control of assignments of subjects, treatment and manipulation of variables. In *user-reporting* method, users are spontaneously involved. It is less time consuming than the other categories which allow interviews and questionnaires to take place.

3.3 Applying HCI in AR Storybook

There are abundance of research dealing with how children use AR storybooks, Olaug Eiksund (2012) suggested that studies on AR storybook varied in regard of technological implementation, choice of user interface, design of interactive parts and degree of integration of AR into the children’s activities.

Designing AR storybooks that are intuitive, with standard quality of usability and most importantly suitable for children, it is necessary to implement some of the preferences of theories and principles discussed earlier. Beside looking at children’s interaction with AR books, keeping the intrinsic value of the physical values of the book is also essential. (Dunser et al.,2007)

3.4 AR Storybook Prototype Requirements

The process to develop the AR storybook prototype is based on the existing application requirements. The prototype elements involved are the storybook, the markers, the three dimensional objects and set of activities to utilize the application.



Image 1.1



Image 1.2

The storybook is designed to fit the children's demographic in a way types of images or illustrations are carefully selected. As discussed earlier, cartoon or naive illustrations are potentially able to grab the children's interest in reading the book as they are more suitable with the simple language commonly used in children storybook. Detail study on the story plot, characters design and backgrounds are also considered for the reader's satisfaction. (See Image 1.1 and Image 1.2)



Image 2

The markers are functioned as the spot where the virtual content is overlaid with the real environment. The AR device will track and identify the markers to view the virtual content regardless of any movement of the device such as rotating, tilting or panning. In this case, the virtual content is the three dimensional objects. The objects can be animated and embedded with sound.

The sets of activities are the means for the children to use the AR device to interact with the storybook. They are presented in a form of stimuli to encourage learning process. The virtual content should be closely related with the story plot and the illustrations provided in the storybook in order to create understanding of the storyline.

4. CONCLUSION

The apparent potential of augmented reality application has been a driving force to encourage designers, educators, and students to innovate such application that is applicable in various fields. AR has brought a new dimension to learning experience as it allows the users to actively participate in the process by creating and interacting. The students are able to create their own application through open source tools anywhere at anytime using the mobile devices. Further studies within the field of human computer interaction on the features related to augmented reality applications such as usability, design principles , cognitive ability and user experience are equally important compared the studies on the AR technical specifications and functionality.

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