AUGMENTED REALITY GAMES FOR CHILDREN: STIMULATING CHILDREN'S PHYSICAL PLAY

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This report is submitted in partial fulfilment of the requirements for the Bachelor of Information Technology (Game Technology) with Honours

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2017

DECLARATION

I hereby declare that this project report entitled

AUGMENTED REALITY GAMES FOR CHILDREN: STIMULATING CHILDREN'S PHYSICAL PLAY

is written by me and is my own effort and that no part has been plagiarised without citations.

STUDENT:  Date:29/8/2017

(NOR FARAH NAQUIAH BINTI MOHAMAD DAUD)

I hereby declare that I have read this project report and found this report is sufficient in term of the scope and quality for the award of Bachelor of Information Technology (Game Technology) With Honours

Date:29/8/2017

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DEDICATION

To all those who have supported, encouraged, challenged and inspire me and specially to my beloved parents, honourable lecturers and friends for all their guidance, love and attention which has make it possible for me to make it up this point.

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ABSTRACT

Augmented reality is the new technology that allow user to integrate the digital information with the environment in real time. This project was developed to provide a simple AR mobile game to stimulate physical play of children. This simple game aimed to capture the attention and interest of children in order to stimulate their physical play. Due to the fact there are static that stated, nowadays children enjoyed doing indoor activities rather than outdoor activities and this might harm their physical play as they become more passive and introvert. In fact, this project is design and develop using augmented reality technology that could give immersion feeling to the children as they play the game. Thus, the outcome for this project is to enrich the children in overlaying digital graphics to stimulate the children's physical play.

ABSTRAK

Augmented Reality (AR) adalah satu teknologi baru yang membolehkan pengguna mengintegrasikan segala paparan digital dengan persekitaran disekeliling kita. Projek ini telah direka dan dibangunkan untuk menyediakan satu permainan mudah alih yang mengunakan teknologi *Augmented Reality* untuk merangsang pergerakan fizikal kanak-kanak ketika mereka bermain. Hal ini demikian kerana, statistik menunjukkan bahawa kanak-kanak pada hari ini lebih cenderung menikmati aktiviti di dalam berbanding aktiviti di luar rumah. Justeru, hal ini boleh menyebabkan kanak-kanak membesar menjadi seorang yang pasif. Tambahan pula, permainan mudah alih yang telah direka membolehkan kanak-kanak menghayati dan merasai keseronokan ketika berinteraksi dengan permainan ini. Oleh itu, projek ini adalah untuk adalah untuk menggalakkan kanak-kanak melakukan aktiviti di luar rumah dengan menggunakan teknologi AR.

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CHAPTER I

INTRODUCTION

1.1 Introduction

Augmented Reality (AR) is a technology enriching the real world with digital information and media where the new technology such as augmented reality would enlighten everyone. Due to the fact that, augmented reality game is well known over the world because of the interaction of superimposed graphics, audio and other sense enhancements over a real environment. As well knows, augmented reality is still a very new technology. The first person used augmented reality was Boeing on 1990 and next in 1999, the ARToolKit was released by Hirokazu Kato. As the matter of fact, this enhance the chances for the other people to discover augmented reality technology as ARToolKit is the open source development process of AR applications.

However, AR hasn't become popular with the general public until these last couple years, until recently most people did not know what AR was. Now, there are numerous libraries to allow the usage of AR in development of applications. In addition, AR technology essentially connects a user to a database or to a virtual or partially virtual environment using any combination of the user's visual or aural or kinaesthetic sense.

Hence, with AR technology may enable a user to participate in an activity in a virtual world such as in entertainment, education, business, medical simulation and others.

The goal of this project is to develop a simple game using augmented reality technology to stimulate children's physical through playing AR game and also to evaluate the usability of AR game. Due to the fact that, AR game can help to attract the interest of children as it is a live direct or indirect view of a physical, real-world environment whose elements are augmented by computer generated sensory input. Thus, a simple game inspired by arcade game called Whack-A-Mole has designed with enhancement of AR technology.

Whack it! is inspired by a game called Whack-A_mole which is an arcade game in which p players use a mallet to hit toy moles which appear at random. In Whack it!, the objective of the game is similar to the arcade game but the difference of it is where Whack it! will be develop by using the technologies of augmented reality. The goal of this project is to develop a framework based on augmented reality game for children to help them to stimulate their physical via playing AR games using and Android-based tablet or smartphone platform. The AR activities will be designed to improve hand-eye-coordination of the children. As we all know, AR allow users to use real world objects to interact with computer generated environments.

As mentioned above, Whack it! is simple game that has designed to stimulate the children's physically play through interactive games because of nowadays a lot of games that allow player to interact with the game using their body and most famous game that allow player to physically interaction is game that develop with Kinect technology. However, AR technology also can allow that element in gaming sector.

1.2 Problem Statement

Nowadays, children are really intrigued by television and computers. According to the Cabinet Office, the Government of Japan (2001) reported that school-aged children in Japan spend a large fraction of time in front of television or video games during weekdays and weekends rather than doing some activities that would stimulate their

development of physical such as exercise. Besides that, there are numerous articles raising alarm over childhood exposure to television or video games such as “Watching TV: even Worse for Kids than You Think” on TIME headlined. This scenario would create unhealthy environment as it would affect the children’s behaviour, health and cognitive development in negative ways. Hence, there is question that have been motivated this work which is how far is AR games can stimulate and develop the children’s physically play.

1.3 Objectives

The project objectives are:

i. To investigate how Augmented Reality (AR) games can help the children to stimulate physical through playing AR games.
ii. To develop a simple game with AR technology in order to stimulate children’s physical play through interactive games.
iii. To evaluate the usability of Augmented Reality games with children.

1.4 Scope

This project is targeting on children between 8 and 10 years old where mostly children around this age can understand rules of the game and can interact according the simple rules were given. Furthermore, this project also focused on children because the aim of this project is to know whether the target audience are suitable a simple AR game or not.

The limitation of considering the scope of project is this project is suitable for a children age around 8 to 10 years old because of the augmented reality technology that

allows relationship between concrete objects and virtual to be constructed and displayed in the real-world context may be confusing for the children.

1.5 Project Significance

The aim of this project is to stimulate the children's physical through playing a simple AR games. Hence, this work may enable to help increase the development of physical, cognitive, behaviour and memory skills for children as this game has designed to help children to improve their hand-eye-coordination while moving around through playing a game. As we all know that youth are very close to the advanced technology so with that kind of interest, this project is an effort to denial the fact that games couldn't bring a benefit to children. Hence, by playing this game, children are enables to play the game at anywhere and anytime as the game are not restricted to certain places. In fact, this project might also help children with special needs as this game could help children that suffers attention deficit hyperactivity disorder (ADHD) to pay attention and help to control their impulsive behaviours.

As matter of fact, with the help of advanced AR technology, the information about the surrounding real world of the user becomes more interactive and digitally manipulated and this would help to increase the interest of children to play the game. By any chance, this project also could bring a new idea for a game developer to develop a game with used of AR technology in education, medical simulation and others.

Therefore, the expected results of this project are to achieve all the objectives of the game development which is to investigate how AR game can help the children to stimulate their physical through playing AR game. In fact, this project also expected to help most of children to spontaneously engage in more physical interaction while playing the game such as moving around and increased their ability of hand-eye coordination.

Besides that, through this project, a simple game with AR technology were expected to be developed to stimulate the children's physical play through an interactive game as nowadays a lot of games promote a whole-body level of

interaction, even those requiring a simple handheld controller can lead to physical activity. In addition, this project also expected to evaluate the usability of AR game when children interact with the game that they were playing.

Overall, this project expects to be one of the contribution knowledge of AR technology in gaming so that it could bring a bright side of game development industry.

1.6 Conclusion

In the conclusion, in this chapter, it describes the overall idea of this project. It stated that this project will developing a simple game by using AR technology as AR technology has become one of attraction for people nowadays not even in gaming but as well as in education, medical simulation, rehabilitation and others. Besides that, statistic shows 77% of respondents in the Information Systems Audit and Control Association (ISACA) said that they believe that AR enhancements could make Internet of Things (IoT) devices more susceptible to data breaches because the attraction of AR technology that enable the user to view the real world with digital overlays.

Therefore, in next chapter, elaboration about the methodology of the project would be explain as well as the process of project development.

CHAPTER II

LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

Augmented Reality (AR) is often mentioned in the same breath as Virtual Reality (VR) but however there are slightly different between both. Since AR technology is a live direct or indirect view of a physical, real-world environment whose elements are augmented by computer generated sensory input meanwhile virtual reality replaces the real world with a simulated one. Thus, this project would be focus on developing a simple game with AR enhancement.

Besides that, through the process of developing the game, the domain of this project and overall methodology and technique used would be determined as the aim of this project is to create a simple AR game that could help to stimulate children's physical play while playing an interactive game.

2.2 Domain

The domain for this project is Augmented Reality Games for Children: Stimulating Children's Physical Play, this game would be designed and develop with AR

technology. Hence, the project would be focus on the enhancement of AR technology in developing a simple game. Due to the fact that, AR technology integrates digital information with the physical environment, live and in real time and it means that AR are able to combine real life with a super-imposed image or animation using the camera on a mobile device with the addition of graphics, sounds, haptic feedback and others.

AR technology had reached worldwide recognition after the launch of popular mobile game such as Pokemon Go. Thus, this technology could also bring a bright side in game industry to develop a game for children with a special need with the used of AR technology. As mentioned before in article written by Silva et. al (2003), AR technology has many possible applications in a wide range of fields including medicine, engineering and manufacturing and it is expected that other potential areas of applications will appear with the dissemination of this technology.

In the literature review, this project found four (4) findings which are:

(i) Augmented Reality (AR) games can stimulate physical interaction for children.

Augmented Reality (AR) games are able to develop physical engagement and developing experience for children (Fails et. al, 2012; Price and Rogers, 2004; Bekker et. al., 2007; Radu and Maclntyre, 2012). Due to the fact that children nowadays rarely spend their time playing outside. They spend their time more playing inside. Tan et al. (2008) stated that learning can be achieved through an active participation and interaction among children because of physical engagement can attract children focus. Moreover, it is being stated that the more senses involved such as hearing, sight, touch, emotions and others, the more impactful the learning experience.

As matter of facts, children are exposed to exploration, trial and error, collaboration and others. Thus, AR games are able to develop children's physical. For example, in the studies (Bekker et. al., 2007), Flash-Poles is a design of a stimulating and safe outdoor environment that motivates children to play and perform physical activities such running and jumping while being socially active meanwhile Battle-bots is developed for a physical game in which children's body movements are used to remotely control battle-tank toys. Besides, activities such as hunting, hiding, running, jumping and others would attract the interest of children. Hence, these two designs can stimulate physical play of children throughout play session.

Moreover, Augmented Reality games can bring many benefits to children's lives such as skill development through physical manipulation (Radu and Maclntyre, 2012). In fact, augmented reality games that allowed children to experience augment 3D space had major influenced on them especially related to motor manipulation and spatial cognition which means it will develop children abilities on performing precise movements (fine motor skills), enable the children to move both hands at the same time (multi-hand coordination) and enable the children to perform large-scale movements and ability to sustain prolonged postures or repeated movements.

As well as mentioned by Bogost (2005), nowadays many video games that use physical input devices have been called as "exergames" which mean games that combine play and exercise. As we all know, from early arcades to the 8th generation of consoles, games have been influenced players toward physically-active gameplay such as Dance Revolution, Foot Craz, Games for Health and others. This mean, augmented reality also can be one of the factor that could help to activate children's physical play by playing a game rather than being passive.

Besides that, as mentioned in Berkovsky (2010) in order to motivate players to stimulate physical play while playing games, the design of the game must be modified so that player can gain virtual game rewards in return for the real life physical activity they perform. However, back in a few decades, physical activity is captured by wearable sensors attached to the player such as Wii Controller but nowadays, augmented reality mobile game can allow player to move around and to do physical play as they play the game.

(ii) Augmented Reality (AR) games can increased the cognitive and memory skills development for children.

Video game has been used to stimulate cognitive functions such as attention, concentration and memory (Corea et. al., 2007). The main objective is to help people with skills such as creativity, attention, memory, planning, concentration, ready-response and others. In addition, video games and musical instruments are required technology in order to support people with cognitive or developmental disabilities.

Additionally, AR game also stated in studies (Radu and Maclntyre, 2012) that it enables the children to understand and mentally visualizing spaces, where it means that children are able to understand objects and relationship in visually-observed space (spatial perception), enable the children to remember objects and spatial relationships (spatial memory) and also enable the children to mentally imagine and transform space (spatial visualization).

Then, AR games also can develop children's cognitive (Bekker et. al., 2007). In the perspective of spatial knowledge acquisition and cognitive, AR games may utilize unique cognitive mechanisms for spatial acquisition (Shelton and Hedley, 2004). Moreover, this studies also mentioned that cognitive basis for AR is by involve the visuo-motor (related to the coordination of movement and visual perception by the brain) for the information process. It stated that, working memory is the mechanism for holding pieces of information in mind while performing a task and this is very important in children's lives due to this skill become employed when children must remember the rules of the game and a required mission that must be done.

In fact, memory reversal abilities may be challenged because children in age around 8 years old may have trouble in reversing items in memory. In addition, in some AR games children need to remember how to interact with the system. Besides that, AR games enable the abstract thinking in children, which mean children are enabled to involves processing some information about properties not concretely observed and generally, abstract thinking includes the ability to think about invisible aspects of a problem, reflect on one's previous actions and think strategically. Therefore, it is very crucial for children to have an abstract understanding of the game and to be aware that virtual objects are artificially constructed.

(iii) Children have better interaction with real world context and a simple interface of AR game.

AR games are allowed groups of players to sit around and play the game in a real-world context (Tan et. al, 2008). Moreover, AR games allows relationship between concrete objects and virtual objects that will be display in the real-world context where children can easily give their interest and attention towards the objects. In addition, activities such as handling, arranging, sharing or discussing the chosen physical

resources in a natural manner will become familiar to the children. The physical objects support collaboration both by their appearance, their immediate physical properties (weight, texture, etc), and their use as semantic representations, their spatial relationships and their ability to help focus attention on real problems.

Interactions between the user and the game is very important in game development as it will enrich the user experience throughout play session. Based on article written by Lv et. al (2016), there are three main contents in design the interaction design which is the construction of AR scenes that consist acquiring the real scenes and modelling the virtual scenes, touch screen interaction and also body motion interaction which consist smartphone sensors. Hence, these three elements are very important to make sure the development of augmented reality is friendly user to children.

Besides that, Billinghurst et.al (2000) mentioned that AR games can be enhanced by physical and spatial 3D user interfaces that be used to develop an effective face to face collaborative computing environments. Basically, shared space has explored the use of spatial and physical interaction in augmented environments so that user can directly manipulate virtual objects by manipulating marked physical objects with virtual objects on the game. Furthermore, based on Juan et. al (2010), the result of using tangible cubes as the user interface for AR games shows that children enjoyed playing the AR game more than playing the real game.

In fact, immersion is very important to ensure the player enjoy the game. Thus, in design and creating the interface, it is very important to look on the four aspect which is physical, emotional, social and mental of the target audience. As mentioned by Nilsen et. al (2004), player's experience is very important in creating a game world as it might could be from player's imagination in response to other stimuli such as the background music and the game level that can give an element surprise to the player.

(iv) Augmented Reality (AR) Games can Support Children Education.

Augmented Reality games have been developed for computer-aided instruction, manufacturing and medical visualization (Billinghurst, 2002). Thus, it means that augmented reality can enable a person to interact with the real world in any ways. It also been said that AR games has matured to the point where it can be applied to a much wider range of application domains and education is an area where this technology could be especially valuable.