

Interactive Learning Application for Kindergarten Education Using Mobile Based Augmented Reality

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Abstract - This paper presented about the augmented reality learning application for kindergarten education. This paper explains how the learning application is developed and used to increase the motivation and engagement of the children. Education is transferred from traditional way of learning to the use of immersive, interactive technologies. Game based learning environment is very useful for children to learn very efficiently. Marker based Augmented Learning application is developed using Unity 3D game engine and hardware used for viewing is mobile phone. Augmented learning application consists of two main courses - English, Mathematics. In every course, application is developed in two modes - learn and play. After learning each module, children are tested using the play mode. Children are able to interact with the 3D objects and animations, audio visuals are used for enhancement.

Keywords: Augmented Reality, Educational Games, Interactive Learning Environment

I. INTRODUCTION

Education plays an important role in the world. It is used to enhance various skills such as observing skills, learning skills, problem solving skills. Early childhood education is one of the main factors in increasing their knowledge and also for their future success in life. Educating a person is very complex task subjected to both internal and external factor influences the educational method. Since the technology is developing at a higher speed, traditional way of teaching learning process is changed greatly. Computer technologies had a great wonderful impact on the education. (Juan Mateu, 2015) It changes a passive learner to the active learner. Alternative way of teaching process should provide learning environment that attracts the students. This Technology Enhanced Learning will motivate and engage the young children in the learning programme.

Augmented Reality is one of the emerging technologies may bring the pedagogical innovations in various areas. Augmented reality is used to superimpose virtual elements on the physical world. Definition of Augmented reality differs among various research. According to Azuma, Augmented reality system has three major features.

1. It merges real objects and virtual objects.
2. It provides opportunities for real-time interaction; and
3. It provides accurate registration of three-dimensional virtual objects and real objects (Azuma, 1997).

According to Milgram, Augmented reality is in between the real environment and virtual world.

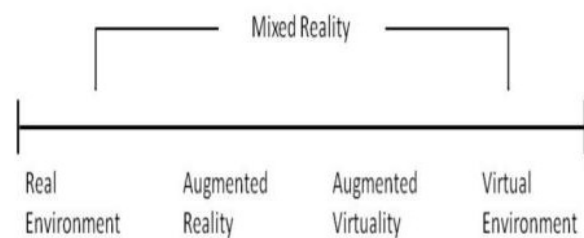


Fig. 1 Milgram's Reality-Virtuality continuum

In olden days, Research in augmented reality is limited due to the availability of devices. Increasing in usage of smart phones, tablets, advanced projector system, various research in the AR field are done. Types of display used for AR application are classified into: head mounted display, spatial display, handheld display. In terms of cost efficient, handheld display is mostly used. There are three types of augmented reality-marker based augmented reality, marker less augmented reality, projection based augmented reality.

AR is used for several applications which includes surgical training, tourism, advertisement, education, shopping.

II. RELATED WORK

A. Advantages of Game Based Learning

Many research has been conducted to find out the effectiveness of integrating the software game with the learning. It provided positive impact on the students to engage in a particular activity. Children who were less interested in studies may benefit from extra motivating environments such as of virtual reality educational games (Maria Virvou, George Katsionis & Konstantinos Manos, 2005). Competition based learning increased the motivation of the users and their learning performances. Competition brought the additional challenge which attract the attention of the player. This increases collaboration of the work and students feeling of enjoyment. (Burguillo, 2010). Chun Hung Lin compared the various effectiveness of video-based instruction and game-based instruction. This work also explained the effectiveness of using multimedia devices for

learning mathematics. Learning and thinking skills were enhanced using game environment than video-based learning. (Chun-Hung Lin, Eric Zhi Feng Liu & Yu-Liang Chen, 2013). Miller presented guiding principles that are very useful for the development of environment and educational games design for children. (Jennifer L. Miller & Carly A. Kocurek, 2017). Many studies have indicated that game-based learning environment is efficient, which increases the motivation of students. Based on the review, researchers and game developers are trying to integrate educational content with game-based content with a goal to transform educational process into fun-based learning.

B. Uses of Augmented Reality

Boletsis developed a table mystery collaborative augmented reality game which is useful for teaching chemistry. This work indicated that students are more excited and engaged while learning in AR environment. It showed that AR games can be used for educational purpose (Boletsis & McCallum, 2013). Construct 3D is a tool developed for teaching geometry and mathematical concepts using augmented reality technique at high schools. It proved that AR has provided more positive experience in learning and also improved the spatial skills (Hannes Kaufmann & Dieter Schmalstieg, 2003). AR Garden increases the interactive experience of the user. Marker based augmented reality technique is used for learning. It has some simulations such as fertilizer, water, light to the animated flower in the augmented environment (Sejin Oh & Woontack Woo, 2008). Di Serio, Ibanez, and Kloos (2013) compared the effects of the effects of augmented reality technology in visual art course with the traditional art course. Results found that student that uses augmented reality method achieved a greater level of concentration while doing various tasks. Augmented reality method helped in memorizing the content very easier.

Many research shows that use of augmented reality in education provides more fun experience for the students. Interaction between the teachers and students were greatly enhanced. It improved the learning effects and motivation in students. (Kuo En Chang, 2019)

C. Uses of Augmented Reality in Childhood Education

Yilmaz developed an educational magic toy which has puzzles, flash cards, match cards to learn animal, fruits, colors, numbers for average 5-6 years children. Teachers had an increased positive attitude towards EMT and believed them as useful. Results showed that children prefer mostly pointing, inspecting, turning and responding behaviors while playing educational magic toys. (Rabia Yilmaz, 2016) Sebastien designed the concepts for making augmented reality classroom environment. Classroom usability increases when the learning environment is designed considering constraints. This research showed the design principles to be used while developing augmented learning environment. (Sebastien Cuendet, Quentin Bonnard & Son Do Lenh,

2013). Some research explored whether games using augmented reality method on handheld devices shall be used to engage students with scientific thought. Results proved that it promotes the cooperation and understanding skills among users. (Squire, K. & Jan, M. 2007). Research showed that AR story books increased the learning and story reading experience. It also proved the interaction learning experience in the user. In one study, augmented reality ecological system was developed by integrating virtual breeding activities with campus host plants. Students used the tablet or any smart phones to breed virtual butterflies. It improved their learning effectively. It encouraged the children to acquire knowledge about butterfly ecology very realistic. This mobile based augmented learning helped as assistance for the students to learn the ecology. (Wernhuar Tarnq, Kuo-Liang Ou & Chuan-Sheng Yu, 2015).

From these reviews, it is found that AR is useful for educational application. Most of the papers are related to science education. Availability of AR based applications related to mathematics and English are limited. Learning objective could be achieved in short duration of time using AR based application.

III. METHODOLOGY

This work includes three modules. First module involves creation of 3D models and then it is imported in unity 3D with specific formats. Second module involves development of various learning modules. It includes animation, audio effects. Third module involves creation of user interface, providing user interaction using C# script and integration of appropriate learning modules. Software used for this work includes Unity 3D game engine. Hardware used for this work is mobile phone.

IV. DESIGN AND IMPLEMENTATION

A. Design of 3D Models

Interaction of the user with the book increases using the 3D models. 3D models are efficient to realize the real-life objects and learn the complex things in very easy manner. 3D models are developed, and textures are applied to increase the visualization and make realistic appearances. After the manual mesh reduction in the modelling software, it is converted in suitable format to be imported in unity.

B. Development of Augmented Environment

Augmented Environment is developed for various learning modules. Learning modules are generally divided into two courses: English, Mathematics. Models are imported in unity and arranged in specific order. Colliders are added to all the models. Every learning module has learn and play modes. In learning modes, children are allowed to learn the concepts in easy way. Children able to interact in the play mode and can learn things. Markers are selected according to the learning module.

C. Integration of Modules

User interface attracts the user to engage in the environment. It contains many elements such as button, text, images, panel. Separate Application for each module is not efficient for the children to learn. So, Integration of various modules in single application is developed. Audio and animation effects were used.

D. User Interaction

User can interact with the application by clicking the appropriate buttons in the learning environment. In mathematics course, three sections are developed. They are Numbers, Measurement, Shapes. In English course, four sections are developed. It contains alphabets, colors, preposition, actions.

E. Mathematics Module

In numbers, learning numbers from 1 to 10, addition, subtraction modes are developed. Children learn the number by counting the objects. Learning measurements includes various concepts such as taller, shorter, longer, heavier, lighter are developed. Shapes module contains learning 2D, 3D shapes. In playing mode, options are displayed as buttons, 3D models. When child clicks the wrong answer, it will stay in present question. When child answered correct, it will play next question. Voice commands are given to increase the active participation.

Following figure 2 shows the learning module for preposition.

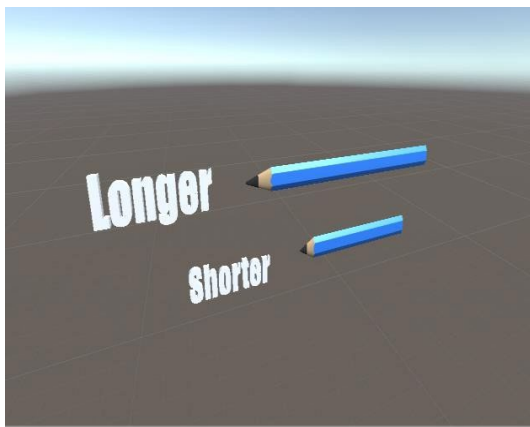


Fig. 2 Display screen for learning preposition

F. English Module

Alphabets is most basic for English to teach for young children. Alphabets module contains two sections: capital letters, small letters. Questions are randomly generated and displayed as image. User has to find out by choosing the correct alphabet. Question display screen for learning alphabets is shown in figure 3. In Colors module, user has to match the colors and remember their name. Voice command

is given for correct option. In preposition module, there are two modes-learn, play. Next button is provided for learning each preposition word. For playing preposition, User has to select the model and place it in a correct place based on the question. In actions module, better animations are used to learn in efficient manner.

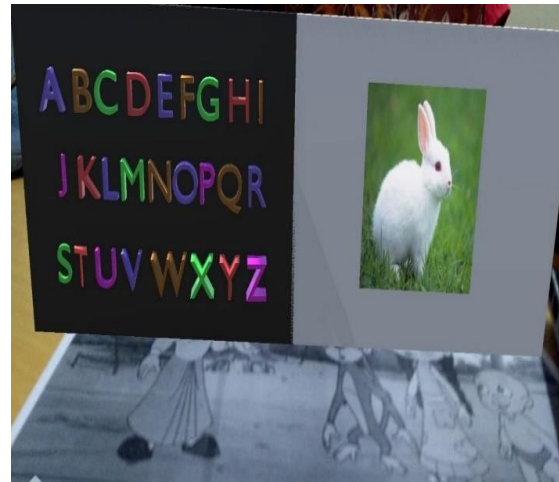


Fig. 3 Question Display screen for learning alphabets

V. CONCLUSION

Thus, Augmented reality learning application is developed, and interactions are done to improve the participation of the user. It increased the learning ability and knowledge of children. Virtual classroom includes 3D models, audio visual elements to increase the motivation of the user. It replaces the traditional way of learning method. This kind of learning environment makes the children to learn the education with more fun and immersion.

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