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AUGMENTED REALITY BASED AR ALPHABETS TOWARDS IMPROVED LEARNING PROCESS IN PRIMARY EDUCATION SYSTEM

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ABSTRACT: Education gives the insight to take us to the future which has not been possible to grasp due to lack of research methodologies towards learning process. Traditional formal education methodologies feel like living in the old age as existing learning processes are not advanced like technology which starts from primary education. As a result, children are losing interest in education due to the way of learning. In this context, learning is a continuous process where the quality cannot be justified by just including reading and writing, the overall process should be creative and interactive as well. However, existing primary education system seems to abandon the main idea about education and learning process to lean towards memorization and rote learning. The way of acquisition of education should be through discussion, research, storytelling, training which should be fun and interesting but our traditional primary education is based on two-dimensional materials and does not provide any of these opportunities. In this context, augmented reality or AR can be considered as advanced technology which can revolt the learning through visualization and interaction by engaging various characteristics. Recently, scientists are researching about how to incorporate AR with education where they gained positive results and by taking the positive result from the previous researches, this research proposed an Augmented Reality application: AR Alphabets. This research integrated proposed AR Alphabets with traditional primary education for better and improved learning experience. Experimental evaluation demonstrates effective efficiency to improve the learning process using proposed augmented reality based AR alphabet.

KEYWORDS: Augmented Reality, Primary Education, Learning Experience

I. INTRODUCTION

Education is the way of gaining knowledge, skills, values, beliefs, and habits. Formal education starts from primary level. Traditional education system is based on two-dimensional material which can only be used for reading and writing, but education should be more than that. Students should enjoy when they learn, this way they feel motivated and interested in learning. But traditional primary education has not been capable of doing so and children are losing their interest from learning. Children aged from five to eleven are the ones who go to primary school and they opt to learn from seeing rather reading and memorizing. For this reason, traditional primary education is highly criticized and yet it has not changed. To keep the children focused, motivated, creative and to keep their enthusiasm alive, education system must be changed in the way to deliver education to the children. However, current educational materials cannot provide visualization capability which initiates the need of adopting technology with improved education methodology. So, when adaptation for technology, consideration on visualization and boosting engagement of students are needed in a great extent. Technology with such visualization power as well as interactivity is Augmented Reality, which bring virtual and real world together by putting digital information on the world we see it.

Augmented Reality is an advanced technology which connects virtual and physical world around us by superimposing digital information like sound, images and objects on the world we see by the help of devices like smartphones, tablets, computers etc. AR puts an extra layer of digital information on the devices by which we see and lets us interact with the virtual objects which were represented by the system. AR gives sub immersive feelings by interacting with the digitally overlaid information over real world. To users, computer-generated objects and reality exists in the same space. Augmented reality can be achieved by regular handheld devices like mobile phones, tablets, laptops. This capability also makes augmented reality portable and affordable for all. All these characteristics of augmented reality make it dynamic and perfect combination for technology-based education system.

Taking the gist of the novel work done by researchers, proposed research designed an Augmented Reality application called: AR Alphabets to teach students English Alphabets. Previously designed most of the systems were used to teach science related subjects and only a few systems were designed to teach general subjects. Proposed research designed the methodology keeping in mind that it will help to make learning

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

experience fun and interesting like science subjects and with the visualization power of augmented reality entrap student's attention and boosting their interaction in class room. Proposed research also analysed student's behaviour changed with the proposed methodology.

II. BACKGROUND STUDY

Traditional education system is not developed since it has been structured and due to that existing education methodologies cannot keep its pace up with the technological world we live in and hampering us in a lot of ways, students are not feeling motivated and curious about learning, they become tired of memorizing and reading books when they cannot grasp and there is no alternative to it. Education sharpens the way to our future which is important to work for the betterment of education. However, the overall process is not easy to improve education system in a short time, improved idea needs to be proposed which will address all the problems and provide solutions to most of the problems as well as will not become outdated within a short period of time. Making education better with technology, researchers are continuously conducting researches and they have come up with the technology called "Augmented Reality" or AR. For the last few decades research has been going on the possibilities of augmented reality in education system and most of the researches have been conducted on higher level of education to teach different subjects and measuring its success based on some key factors like, i.e. students' motivation towards learning, engagement with materials, concept understanding, visualization for enhancing spatial abilities, grasping deeper understanding of abstract and difficult topics etc (Lee 2012). The result of the research is positive and successful in terms of achieving the satisfactory level of students and teachers expectation. Augmented Reality has provided students with new techniques of visualizing course materials, new way of interaction with course materials within the class, changing their perspective of learning and increasing their interest to the courses.

Augmented reality has all the characteristics needed to improve current education system and give education the pace it needs to catch up with the technology. The research conducted by scientist about how to implement AR with education system to improve education's current situations. In Turkey, the situation was very difficult to achieve good results in Ottoman Turkish reading but with AR technology they found that students had less difficulty and performed well in terms of performance (Özcan et al. 2017). Medical Subjects need much deeper understanding and they are facing problems especially in generating real life scenarios but using Miracle (Blum et al. 2012), an AR system it was possible to make real life scenarios and provide students with an interactive virtual human body where they can explore for their better understanding. Like this, there are a lot of augmented reality applications which are being used to teach different subjects to students in different countries. Augmented Reality applications are used in Medical Education (Kamphui et al. 2014), Science (Matcha and Rambli 2013), Engineering (Li et al. 2017), History (Kysela and Štorková 2015), Foreign Languages (Ji and Shin 2019), Computer vision applications, i.e. moving object detection(Mahayuddin and Saif 2019; Mahayuddin and Saif 2019; Mahayuddin et al. 2015), segmentation (Saif and Mahayuddin 2018; Saif et al. 2014; Saif et al. 2013), motion analysis (Saif et al. 2013; Saif et al. 2014), feature analysis(Saif et al. 2013;Saif et al. 2015). and a few mentionable Augmented reality applications are Elements 4D (Saif et al. 2013), Experience Chemistry teach chemistry (Saif et al. 2014), Anatomy 4D (Mahayuddin et al. 2015), Human Heart 3D (Mahayuddin and Saif 2020; Mahayuddin and Saif 2019), Corinth Micro Anatomy teach human anatomy (Mahayuddin and Saif 2019), CARE an Augmented Reality application build to teach Science (Saif et al. 2013), Technology, Engineering and Math parts ARVe- Augmented Reality applied to vegetal field (Richard et al. 2007), FreshAir TM teach discovery-based learning (Kamarainen et al. 2013), Construct 3D to teach math (geometry) to college students (Mahayuddin and Saif 2020; Kaufmann and Schmalstieg 2002), AR Physics to teach physics to college students (Lin et al. 2013). All these AR applications are really making some differences for engaging students and their motivation. But all of these are for college or higher-level study materials.

Augmented reality has also been used in primary level education but the usage is really few, yet the results are positive. Augmented Reality Popup Book application which is used to teach English Language in Malaysia and the course material were built according to English curriculum (Mahadzir and Phung 2013). In Spain, Realitat3 an augmented reality system which consists of six applications: skeletal apparatus, water cycle, plant development, frog metamorphosis, solar system and the senses. All these applications are being used to teach primary school students to improve their efficiency (academic achievement), usability and motivation. Again, in London, researchers (Mahadzir and Phung 2013) have explored the possibility of augmented reality application in teaching English to primary school children. In another research which was conducted in Chile and India to discover the geometrical disadvantages of technology for implementing augmented reality in education, the result illustrates positive feedback and promising output (Alcoholado et al. 2012). The application was one mouse per children and it teaches math to students. In addition, researchers used different methodologies to figure out better approach for integrating augmented reality with primary education system. Other business applications which are built for primary education are: Math alive teaches math's up to 3rd grade students, Animal Alphabet AR Flashcards are built to learn letters, Zookazam or Bug 3D to teach about animal

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

species. But there are few applications which can be incorporated with the curriculum provided for children. The results are remarkable to prove enough that AR can not only be incorporated with primary education system but also it is well acceptable by teachers, students, parents as well. It has showed better engagement with learning contents, more attentive, faster learning etc.

III. PROPOSED METHODOLOGY

The methodology proposed by this research work has mainly based upon making the learning experience more fun and enjoyable for the children, so that they do not feel demotivated from learning where proposed research intends to use general subjects for teaching using the proposed technology. Again, proposed research intends to harness the full potentiality of augmented reality to be the solution of the current problems causes due to the two-dimension materials used to deliver education. Proposed research takes visualization, usability, academic motivation and memorization as parameters to determine the success of the proposed methodology mentioned in figure 1.

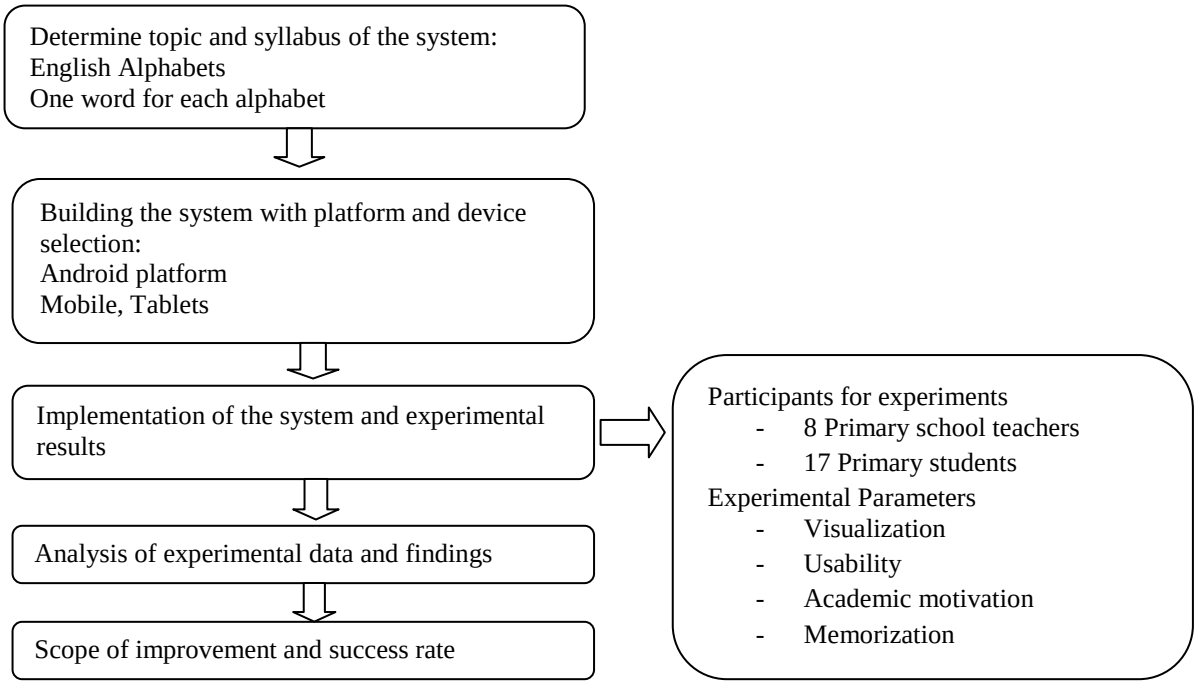

Figure 1. Proposed Methodology

Main purpose of integrating augmented reality in education is to make learning interesting and improve learning experience without rote learning. But choosing a system to improve learning experience is not an easy task and for choosing augmented reality proposed research considered some parameters. To build the proposed system, at first proposed research determined the scope of the system, i.e. what will be the core functionalities that should provide to make learning interesting. Proposed research decided to put audio with augmented objects to make them more appealing to students. As proposed research is experimenting augmented reality with teaching general subjects, proposed research recommends choosing the topic and syllabus carefully. Proposed methodology target primary education because children are more creative and curious about learning new things and they prefer learn by seeing. So, English alphabets are chosen for teaching as it is the very first thing children learn in primary school. Proposed research also decided to teach a word corresponding with the alphabet. After deciding the scope of system proposed by the proposed methodology and the topic, proposed research picked a platform on which system will run. This research build the system for Android Platform as it is the most popular and most usable platform now-a-days and the devices run on this platform is cheap and affordable, so most of the primary schools in any country is expected to afford to use the system proposed by this research. For experimentation, small group of students and teachers are selected to test the proposed methodology shown in table 1.

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

3.1 Participants and Teaching Sessions

Eight Primary School Teachers and seventeen Primary School Students aged between five to six years were selected to participate in the sessions. After selecting students, proposed research made small groups and hand out the materials to the teachers. First, alphabets and one word corresponding to the alphabet are taught to them in traditional way. While teaching in the traditional way, proposed research analyzed their attention and interaction in the classroom and after finishing them teaching in traditional way, delivering education with our AR Alphabets was done and recorded their attention level and interaction. Each session was for 45 minutes. Before starting the session, training was provided to class teacher on how to use AR Alphabets so that they can use the proposed system efficiently proposed by this research. After successfully completing each session, proposed research handed out a survey questionnaire to both class teacher and students to see how effective proposed AR Alphabets were delivering education.

Table 1 The distribution of groups of students and teachers

Students Group	**No. of Students**	**Session Time**	**Assigned Teachers No.**
Group 1	6	45 minutes	2
Group 2	6	45 minutes	2
Group 3	5	45 minutes	2

3.2 Class Teacher Interview

After conducting the session, interview of all the teachers were taken who taught in the session and interview of 2 more teachers were also taken who taught science in the primary school as opinion how they felt about the system and how effective it was. The interview was in a semi-structured and oral conversation was taken right after completing the session and survey.

3.3 System Architecture

Proposed methodology is built with Unity and for Android Platform. Android platform was selected because of the devices running on android, devices capability and pricing of the android devices. Proposed application by this research will support any android devices running on API level 19 (Kitkat) and upwards.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Data Analysis

Analysis was focused on the data gathered from survey and semi-structured oral interview from teachers. Survey questions were prepared on the basis of four parameters mentioned below.

a. Visualization capability of the system
b. Usability of the system
c. Academic Motivation
d. Memorization

In the Visualization parameter section, proposed research gathered results about the effect of visualization of AR Alphabets in terms of entrapping students' attention, finding students attention level, their problems with the visualization, improvement scope for the visualization of AR Alphabets mentioned in table 2 and table 3.

Table 2 Question and answer percentage for Visualization Capability

Questions	**Percentage of Strongly Agree/Yes**	**Percentage of No Comment/Neutral/Somewhere in between/ Cannot Understand**	**Percentage of Disagree/No**
Were students able to match the objects with real life objects?	92%	8%	0%
The visualization was capable of holding their attention?	100%	0%	0%

ISSN- 2394-5125 VOL 7, ISSUE 19, 2020

The visualization of AR Alphabets can make learning enjoyable?	100%	0%	0%
Is Visualization power of AR Alphabets able to grow interest in students to interact more with system?	100%	0%	0%
The interaction of visual objects is easy and intuitive?	92%	4%	4%
Is The quality of the visual 3D models adequate?	84%	12%	4%
The system has offered to learning in terms of visualization?	72%	4%	24%

Table 3 Question and answer percentage for improvement for Visualization Capability

Questions	**Percentage of 3D models with color**	**Percentage of Stable 3D models**	**Percentage of Others**
What is the improvement scope for visual objects?	84%	16%	0%

Questions	Percentage of Shaky Objects	Percentage of 3D models did not match with real life	Percentage of 3D models are hard to understand	Percentage of Nothing Above
What is the improvement scope for visual objects?	64%	4%	4%	28%

In the Usability parameter section, proposed research performed investigation about the usability of AR Alphabets. The questionnaires were designed to find out the affordance of the system, what difficulties can be arise during usage of the system, is the system collaborative or not mentioned in table 4.

Table 4 Question and answer percentage for Usability of the System

Questions	**Percentage of Strongly Agree/Yes**	**Percentage of No Comment/Neutral/Somewhere in between/ Cannot Understand**	**Percentage of Disagree/No**
tThere any difficulties or barriers that compromises the usability of AR Alphabets?	44%	4%	52%
Is the system collaborative?	100%	0%	0%
Did students prefer AR Alphabets over classical Book?	100%	0%	0%
Is the system stable enough to replace classical book?	92%	0%	8%
Do you think is there any difference in children's mood and level of enjoyment compared to traditional teaching of the topic?	84%	12%	4%

Questions	Percentage of Students were more attentive	Percentage of Easy to teach	Percentage of more collaboration	Percentage of all of them
Advantage of AR Alphabets over books	32%	56%	4%	8%

In the Academic Motivation section, proposed research investigated how proposed system was impacting for motivating students towards learning and was the system made students more responsive and collaborative in class mentioned in table 5.

Table 5 Question and answer percentage for Academic Motivation

Questions	**Percentage of Strongly Agree/Yes**	**Percentage of No Comment/Neutral/Somewhere in between/ Cannot Understand**	**Percentage of Disagree/No**
Is there any difference in the student's motivation depending the teaching scenarios proposed by AR Alphabets?	100%	0%	0%
Students were motivated using AR Alphabets?	96%	0%	4%
AR Alphabet capable to grow confident in students?	92%	4%	4%
Interaction makes students motivated to explore the system more?	76%	0%	24%
AR Alphabets making students ask questions about the system/ syllabus?	88%	12%	0%

In the Memorization Section, proposed research aims to find out how the system was helping students to memorize the lectures delivered by the teachers in class.

Table 6 Question and answer percentage for Memorization

Questions	**Percentage of Strongly Agree/Yes/Very Good**	**Percentage of Good/ Agree**	**Percentage of No Comment/Neutral/Somewhere in between/ Cannot Understand**	**Percentage of Disagree/No/Bad**	**Percentage of Strongly Disagree/ Very Bad**
How was the performance of AR Alphabets in terms of Memorization?	68%	32%	0%	0%	0%
Was Audio clip with visual objects help students to learn faster?	60%	40%	0%	0%	0%

AR Alphabets relate with the learning goals?	80%	0%	20%	0%	0%

4.2 Observation and Discussion

Human kind have evolved by adapting new methods or new ways of living, still human are doing same in every aspect of life except for education system. To keep our pace with this modern advanced era we need to identify the problems that we are having with our education and how to integrate them with the help of technology. Overall the study was successful in supporting and providing evidence for the potentiality of integrating augmented reality in the primary education system to make it more interesting and better. Proposed study of augmented reality was experimented based on four parameters, i.e. visualization capability, usability of the system, academic motivation and memorization shows that augmented reality have the potentiality to overcome the problems which we are facing with the traditional teaching method. Proposed methodology has been able to explore the problems and from the analysis, this research states that proposed system is capable of solving the problems.

4.3 Future Work

Even though proposed system was able to live up to the expectation but there still some issues need to be addressed for future improvement. Experimental data shows that there are some issues with visualizing 3D objects and their stability. Again, it has been concern of teachers that students will be more interested in using smart devices rather than using AR for learning, which will jeopardize the whole purpose of integrating AR with education. So, in future this research will be involved in improving the proposed system visually with more dynamic feature to make it more interactive where students do not lose their attraction for using augmented reality in the first place.

V. CONCLUSION

Proposed research has focused on integrating augmented reality into primary education to overcome the current challenges we are facing due to traditional educational method. With the help of augmented reality, proposed research aims to make education fun, collaborative and adaptive to deliver quality education. Proposed research integrated augmented reality with primary education method and analyzed the experimental results with respect of some key points, i.e. visualization capability, usability of the system, academic motivation and memorization. In each of the investigation, proposed research receives positive evaluation to claim for the integration of augmented reality with tradition education system in larger extent. Based on the illustrated investigation, it is certain that integration of augmented reality with primary education system will contribute in the future research of augmented reality, computer vision, image processing and pattern recognition research field.

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