Proceedings of the Fifth International Conference on Intelligent Computing and Control Systems (ICICCS 2021)
IEEE Xplore Part Number: CFP21K74-ART; ISBN: 978-0-7381-1327-2

Knowledge Transfer to Pre-schoolers based on Augmented Reality

Jayashree Katti
Pimpri Chinchwad College of Engineering, Pune, India
jayashree.katti@gmail.com

Prasad Bhavsar
Pimpri Chinchwad College of Engineering, Pune, India
prasadbhavsar7777@gmail.com

Mohit Gidh
Pimpri Chinchwad College of Engineering, Pune, India
mohitgidh@gmail.com

Riya Desale
Pimpri Chinchwad College of Engineering, Pune, India
riyadesale9@gmail.com

Pooja Chaudhari
Pimpri Chinchwad College of Engineering, Pune, India
poojachaudhari18399@gmail.com

Sonali Patil
Pimpri Chinchwad College of Engineering, Pune, India
sonalimpatil@gmail.com

2021 5th International Conference on Intelligent Computing and Control Systems (ICICCS) | 978-1-6654-1272-8/21/$31.00 ©2021 IEEE | DOI: 10.1109/ICICCS51141.2021.9432313

***Abstract*—Augmented Reality has overwhelmed the world for the last decade but still it has failed to reach the general public. This paper tries to present a system which uses Augmented Reality to enhance knowledge transfer and make the learning experience more immersive and interactive for pre-schoolers. The system recognizes each image to be assembled through object recognition techniques. A 3D object which is modeled with the help of modeling techniques is placed in the real world. In this current COVID -19 pandemic this Augmented Reality application will help students to learn in an effective and beneficial way.**

Keywords—Augmented reality; Object recognition; Object modeling; Education; Virtual classroom;

I. INTRODUCTION

Most important factor in any classroom is engaging children in learning. If children are not interested and engaged in the learning process, then they aren't really learning, or they're at least not learning to their full potential.

Nowadays, Visualization is essential in the education field. Visualization allows creating and recreating scenes for better interaction [1]. The human brain is forced to believe that the things created by humans are real. Visualization can be powerful; it can make things easy to learn and remember. Visualization provides detailed information.

In this study, an Augmented Reality based Android application was developed. Unity 3D and Vuforia SDK were used for the development. This application uses the advantages provided by augmented reality to modernize the learning process and make it more interactive for the kids. When users will move the camera over the specified image, they will be able to see the 3D models and hear the details of the concerned object and it will allow them to move or rotate the object as per their choice. So instead of reading books, kids can see it.

II. OVERVIEW OF AUGMENTED REALITY

Augmented Reality is overlaying virtual objects on real world images and thus augmenting the experience. Augmented reality is an interactive technology where the objects in the real-world environment are represented using computer technologies [2],[3]. Instead of replacing the real-world experiences, Augmented Reality enhances the real world with virtual information. Augmented Reality is a technology that delivers three basic qualities: real-time interaction, a mixed version of virtual and real objects and 3D modeling of real and virtual objects. It creates a composition for the user which consists of both real-world scenes and computer-generated visuals. Augmented Reality allows the real-world users to interact seamlessly with digital world components [1]. Transformation of human processes is occurring as augmented reality is accelerating the development of skills.

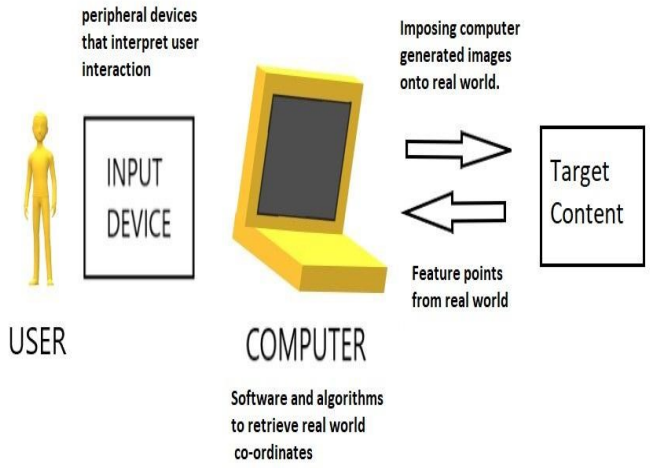

Figure 1: Augmented Reality Flow

III. Literature Survey

A. Psychological characteristics of children

Development of young children's thinking consists of three phases, first is intuitive action, then the specific image thinking and finally the abstract logical reasoning thinking [4]. When children think, specific images are used by them to solve problems they face. So, images play a very crucial part in the development of their thinking and hence their learning process.

Attention span is a child's ability to give undivided to a specific task at hand. For a pre-schooler, average attention time is less than 15 minutes and for younger ones, it is 5 minutes. But when they are performing the activity of their choice, they tend to focus for more time. Attractive things, images, models and sounds have the ability to increase the concentration, thus they should be included in their learning.

Children record life experiences and imagery memory occupies a large part of their minds. It is easier for them to recall experiences, if they are a participant instead of being an observer [5]. They tend to use routines and images to recall sequences. Hence, knowledge given to them in the form of games has more capacity of being recalled easily.

B. Impact of Augmented Reality in education

1) Positive Impact

Increased Understanding:

A study conducted in 2015 at the Ludwig-Maximilians University in Munich which paired AR learning activities with a traditional anatomy lab showed that out of the 850 first-year medical students that took part in the study, a little over 80% reported that the AR (augmented reality) tools increased learning motivation and 93% said it increased their understanding of anatomy.

Improved Collaboration:

One of the important aspects of education is to promote interaction among students and encourage healthy sharing of knowledge. Augmented reality can help users to collaborate in a virtual space while being present in the real world [6],[7]. The Most common examples of collaborative AR are AR navigation exercises.

Interactive Experiences:

Interaction with the world is very crucial in the learning process. Augmented Reality has the ability to provide a high level of realism in learning and hence makes it interactive [8]. Learners get immersed in the concepts and understand better.

2) Challenges

Difficulty in Use:

AR technology though providing means for easier understanding, many users participating in research studies have reported that use of AR tools is complicated compared to the traditional and already existing digital tools of learning [9].

Differed preferences:

Although various studies have reported that students have found AR tools helpful [2]. Many subjects have said to have preferred the traditional way of learning over AR, as the traditional way has proved effective for them in the past.

Inflexible Content:

The educational content which is available through AR is not flexible. Educators may find it difficult to control the content. Altering or updating the content as per the requirement is not easy.

C. Existing Teaching Practices

1. Traditional Approach:

The most widely and traditionally used method for teaching children is through chalk and board. A teacher with the help of a chalk or marker tries to illustrate the given topic on the board and then manages to convey the knowledge to the students. The students also learn about various real-world objects through the diagrams or pictures that the teacher shows them.

2. E-learning Systems:

The letters and their respective real-world representations are displayed to the students through a 2D screen. The teacher can create videos and visuals for the students to watch using various modeling or video editing tools [10]. The teacher can also add sounds to make the objects seem alive. Animating the objects can also be used to engage the students in the learning process. In most cases an entire course or subject is made available through the e-learning platform for the students' convenience. To involve students in a virtual classroom, Kahoot app is used.

3. QR code based augmented reality learning platform:

QR code based augmented reality apps are a trend in the market today [11]. AR apps developed in the mentioned way come with images which can be downloaded from the app storage onto your device, or you can visit that company's website to download the trigger images. The app uses computer vision techniques (Computer vision is a scientific field that studies and develops techniques to make computers able to understand and learn from images and videos.) to detect markers (QR-code) on the image targets and then use the AR toolkit to augment the 3d images onto the image. The apps are often supplemented with head mounted displays which lay the computer-generated output onto the real world by extracting the real-world coordinates depending on the user's head position.

Limitations in the existing system

- In the traditional approach the teacher generally relies on drawing the objects on the board. The engagement of the students therefore depends on the drawing skill of the teacher which is usually very limited. Moreover, the traditional approach only allows one way transfer of knowledge and does not let the students experiment or interact with the objects and prevents them from

getting any practical experience. This limits the extent of learning to 2 dimensions.

- The teachers also try making the sessions more engaging by presenting the students with real objects. But this kind of learning requires the teacher to carry a long list of items with him for every letter in the alphabet [12]. This is practically impossible and even if the teacher manages to do so, it is unlikely that every student will be able to get the object or prop to himself for experimentation.
- The E-learning systems even though providing a better means of learning than the traditional approach still lack in interactivity. Even if the platform is filled with videos and visuals the students still cannot get the real-world feel.
- The QR code-based systems are the best among those mentioned. But the over reliance of the systems on QR codes make them less effective [11]. The system fails to display the 3D model in case the marker is covered by an external object.
- The new proposed system tries to remove the reliance on QR-code by augmenting the 3D objects by scanning and extracting feature points from the target image itself. It also supplements the display of objects with audio and animation to overcome the shortcomings of traditional education.

IV. Proposed Method

Vuforia and unity are used for development of augmented reality project. Vuforia is an augmented reality SDK while unity is a cross-platform game development engine.

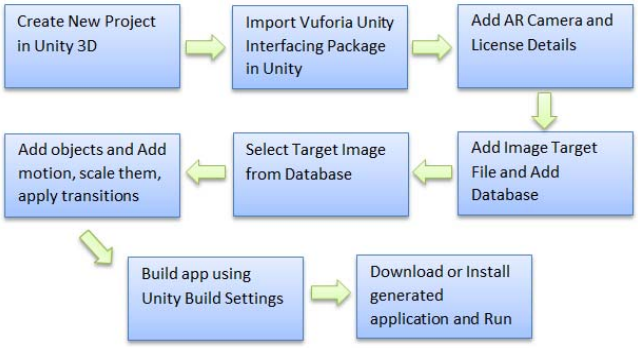

Figure 2: Pictorial overview of proposed system

A proposed augmented reality system works as shown in the above figure. Initially the application developed is used for capturing tracking the images that the camera recognizes as targets. Then the virtual objects are overlapped onto the target to produce an augmented output.

A new project is created in the Unity 3D framework and later required changes are applied to the framework according to the Vuforia version. The vuforia software development kit is imported into the unity game development engine. This leads to import of assets from vuforia to unity which contain the components for development of augmented reality.

The main camera that is present in unity scene by default is removed and the AR camera from the prefabs folder of vuforia folder is added to the scene. The Image target file is then added in the scene as a child to the AR camera. Custom vuforia packages need to be imported. The database containing the images uploaded is imported from vuforia. It consists of all the image targets. The license key is pasted onto the vuforia configuration's app license key field and then the database is loaded. In the game objects, 3D objects of various shapes are found. These objects are added in the scene and they are transformed as per need. Scripts are also added for elevated results and effects. The results are tested by pressing the play button.

After completing the project, it is built into an application with the help of Android studio.

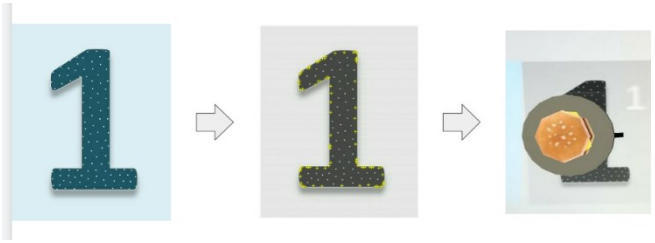

Figure 3: Shows camera tracking and projection of objects from database

The system allows the user to view 3D models on top of target images displaying numbers and letters of the alphabet. To augment 3D model of burger for instance, the system fetches the feature points from the target image which in this case is an image of the number '1'. The feature points extracted are stored onto the vuforia target manager. When the user tries to get the target image in his/her camera view, the feature points captured at run time are compared with the stored feature points. If the points match, the 3D model of a single burger created using blender is augmented onto the target image. The user can scale or rotate the burger model with the help of the buttons incorporated into the User Interface.

V. Implementation and Results

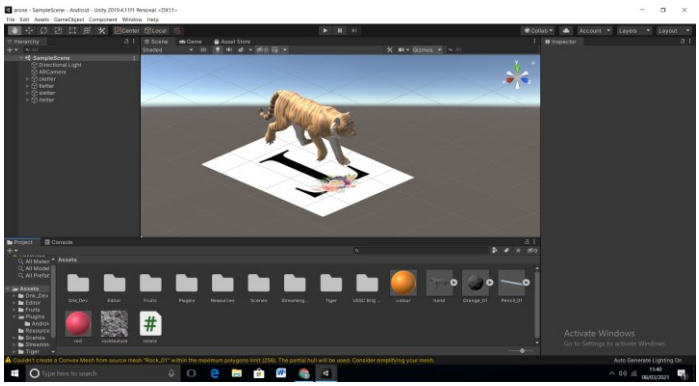

Figure 4: Shows overlaying of 3D model of tiger on letter 'T'

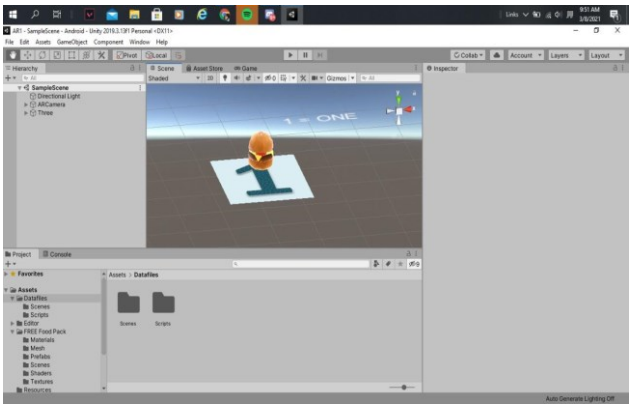

Figure 5: 3D model of burger augmented onto number '1'

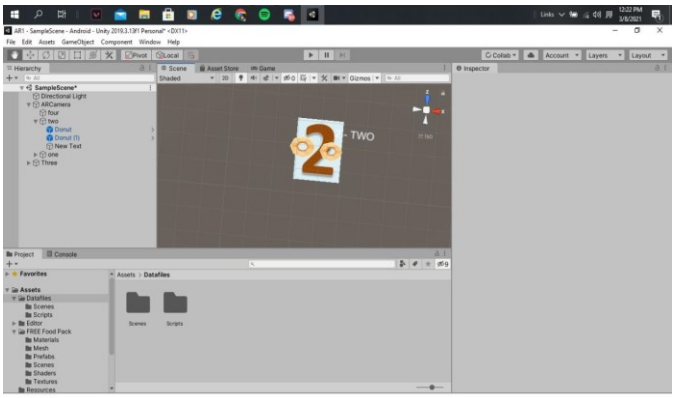

Figure 8: 3D models of 2 slices augmented onto number '2'

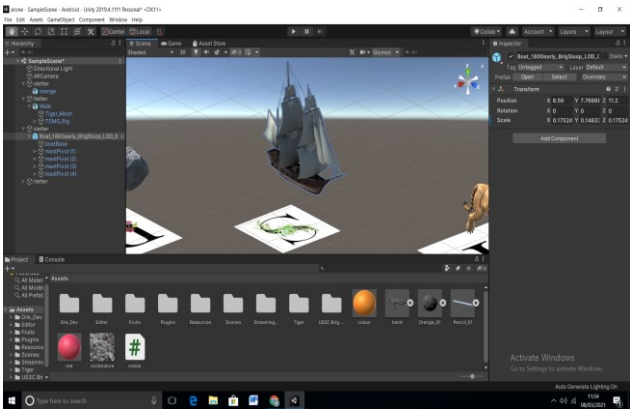

Figure 6: 3D model of ship augmented onto letter 'S'

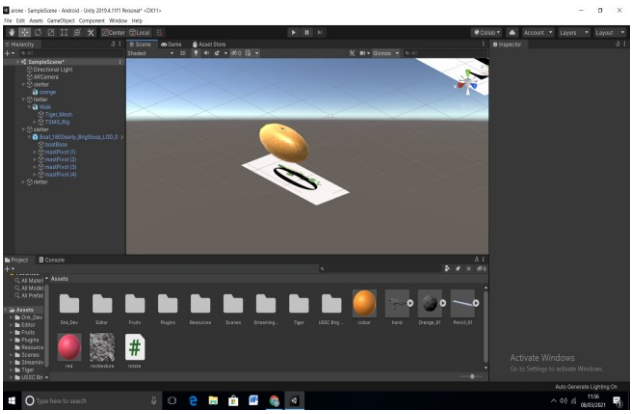

Figure 7: 3D model of orange augmented onto letter 'O'

VI. CONCLUSION

Augmented Reality is a booming technology in the field of education having its own pros and cons. The proposed project will help kindergarten and nursery students to get a better understanding of fundamentals and at the same time make learning a joyful and interactive process. It will help teachers to convince the concept with 3D modeling of objects, instead of relying on drawing skills. The easy-to-use User Interface with user friendly buttons and fields will ensure increased usability and ease for users.

VII. FUTURE SCOPE

This project can be further extended and utilized to suit older students in various fields of education. Various Abstract concepts can be explained easily with the help of augmented reality. Students can be educated about the things that are extinct now. Expensive Instruments, which are not easily available to students, can be simulated using augmented reality. This will enable students to perform experiments any number of times and as per their choice of time. Detailed models of each concept can be made available. This will enhance their experience.

REFERENCES

[1] K. C. Raju, K. Yugandhar, D. V. N. Bharathi and N. Vegesna, "3D Based Modern Education System Using Augmented Reality," 2018 IEEE 6th International Conference on MOOCs, Innovation and Technology in Education (MITE), Hyderabad, India, 2018, pp. 37-42, doi: 10.1109/MITE.2018.8747078.

[2] Hadi Ardiny,Esmaeel Khanmirza. (2018). The Role of AR and VR Technologies in Education Developments:Opportunities and Challenges. Presented at IcRoM 2018.

[3] I. Radu, "Why should my students use AR? A comparative review of the educational impacts of augmented-reality," 2012 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), Atlanta, GA, USA, 2012, pp. 313-314, doi: 10.1109/ISMAR.2012.6402590.

[4] Y. Kuang and X. Bai, "The Feasibility Study of Augmented Reality Technology in Early Childhood Education," 2019 14th International Conference on Computer Science & Education (ICCSE), Toronto, ON, Canada, 2019, pp. 172-175, doi: 10.1109/ICCSE.2019.8845339.

[5] zhang heng, xiao haoran, li jiao, et al. Game development of preschool science education based on augmented reality technology [A]. Science and technology information 2016(04):92-93.

[6] Nasser Alalwan, Lim Cheng, Hosam Al-Samarraie, Reem Yousef, Ahmed Ibrahim Alzahrani, Samer Muthana Sarsam,Challenges and Prospects of Virtual Reality and Augmented Reality Utilization among Primary School Teachers: A Developing Country Perspective,
Studies in Educational Evaluation,Volume 66,2020,100876,ISSN 0191-491X,ScienceDirect

[7] Subhashini, P., Siddiqua, R., Keerthana, A. and Pavani, P., 2020. Augmented Reality in Education. Journal of Information Technology, 2(04), pp.221-227

[8] Jaziar Radianti, Tim A. Majchrzak, Jennifer Fromm, Isabell Wohlgenannt,A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda,Computers & Education,Volume 147,2020,103778,ISSN 0360-1315,ScienceDirect

[9] Yuan-Jen Chang, Chin-Hsing Chen, Wen-Tzeng Huang and Wei-Shiun Huang, "Investigating students' perceived satisfaction, behavioral intention, and effectiveness of English learning using augmented reality," 2011 IEEE International Conference on Multimedia and Expo, Barcelona, Spain, 2011, pp. 1-6, doi: 10.1109/ICME.2011.6012177.

[10] Tang, J.K., Duong, T.Y.A., Ng, Y.W. and Luk, H.K., 2015, December. Learning to create 3D models via an augmented reality smartphone interface. In 2015 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE) (pp. 236-241). IEEE.

[11] C. Teng and B. Wu, "Developing QR Code Based Augmented Reality Using SIFT Features," 2012 9th International Conference on Ubiquitous Intelligence and Computing and 9th International Conference on Autonomic and Trusted Computing, Fukuoka, Japan, 2012, pp. 985-990, doi: 10.1109/UIC-ATC.2012.56.

[12] Y. Bahuguna, A. Verma and K. Raj, "Smart learning based on augmented reality with android platform and its applicability," 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU), Bhimtal, India, 2018, pp. 1-5, doi: 10.1109/IoT-SIU.2018.8519853.