AR BOOK - EDUCATION

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Abstract - *Augmented Reality (AR) is a combination of 3 basic features: - a union of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. In this growing tech world, Augmented reality (AR) is increasingly used across a range of subject areas in healthcare, business, the army, education, and automobile companies. It offers the user an enriched experience and enhances the natural environment.AR technologies add computer vision, incorporate AR cameras into Smartphone application, recognizes object, and many more. Augmented reality (AR) has a lot of capability in gathering and sharing trait knowledge mixed reality and computer-mediated reality are the two largely synonymous terms that are strongly related to augmented reality (AR). This paper discusses the accentuates of the Augmented Reality (AR) Book in Education as well as the visualization issues of a school learning system.*

Key Words: Augmented Reality, Tech world, User enriched experience, Mixed reality, Computer-mediated reality.

1. INTRODUCTION

Education quickly adopted AR technologies to benefit everyone. There are numerous systems and applications built which have made learning easy for students. But those applications also had a few limitations coming along. Education consists of a large amount of knowledge, fields, and research. AR technologies are yet to be introduced in many areas. Our application covers one part of this entire education system which is 10th standard Maharashtra State Board students.

AR book education is an application developed for 10th standard students. AR applications give learners the ability to visualize and interact with a 3D representation of the human body.AR book application shows the 3D models of the Biology, Physics, and Chemistry section of the 10th standard science textbook. There are two different applications built according to the students' textbook: one application for science 1 book and another for science 2 book. This application makes study really fun for the students and also helps them to visualize things better by showing 3D models of all Biology, Physics, and Chemistry diagrams.

1.1 Problem Statement

Augmented Reality (AR) is additive, overlaying, digital content onto the real world. The user is aware of and can still interact with this environment. Students really get bored of reading textbooks and hence it is very necessary to enhance the learning fun.

This application is developed to enhance the learning ability of the students so they can understand things better.

1.2 Motivation

This research accentuates AR Book-Education as well as the visualization issues of a school learning system. This application is well implemented and conveys innovation and responsiveness from forward-thinking bands.

2. LITERATURE SURVEY

As this application is made for education purposes, 10th standard Science Textbook is the first literature that we reviewed for our system. The SSC Science Textbook Part 1 consists of concepts of Chemistry and Physics. Dr. Prabhakar Nagnath Kshirsagar; Dr. Vishnu Vaze; Dr. Prachi Rahul Choudhary are the authors of this textbook.[1]

The second literature review is Science Textbook Part 2, Dr. Prabhakar Nagnath Kshirsagar, Dr. Vishnu Vaze, and Dr. Prachi Rahul Choudhary give detailed learning concepts of Biology, Environment, Microbiology, Biotechnology in this book. The three-dimensional models have been made referring to the diagrams given in the textbooks. [2]

In January 2009, Tobias Sielhorst, Marco Feuerstein, and Nassir Navab wrote an article in the Journal of Display Technology named Advanced Medical Displayed: A Literature Review of Augmented Reality. This paper not only reviews the related literature but also establishes the relationship between subsets of this body of work in Medical Augmented Reality.[3]

Misty Antonioli, Corinne Blake, and Kelly Sparks published a paper named Augmented Reality Applications in Education in 2014. This paper focuses on how AR technology can be applied in an educational application.[4]

Egui Zhu, Anneliese Lilienthal, Lauren Aquino Shulzas, Italo Masiello, and Nabil Zary, 2015 published a paper named Design Of Mobile Augmented Reality In Healthcare Education: A Theory-driven Framework. This paper discusses a learning theory to develop a mobile augmented reality education (MARE) design framework. The primary goal of the paper published was to guide the development of the AR education app. The framework is theory-driven with an understanding of the characteristics of AR in the Education field.[5]

In March 2015, Phil Hennel and Manuel Schmidt-Kraepelin in a conference published a paper name Benefits of Augmented Reality in Educational Environments – A Systematic Literature Review. This paper states the benefits of AR in education, introduces the AR concepts, and describes AR's Five Directions in an educational environment.[6]

Po- Hsuan Cameron Chen, Krishna Gadepalli, Robert MacDonald, Yun Liu, and Shiro Kodowaki in 2019 published a paper called An Augmented Reality Microscope with Real-time Artificial Intelligence Integration for Cancer Diagnosis. The goal of this challenge is to evaluate new and existing algorithms for automated detection of metastases in hematoxylin and eosin.[7]

In a recent article which was published in February 2020 named Augmented Reality Practices in Health Services: Literature review, Merve Bosat, Emrah Onder, and Ugur Arcagok discussed the purpose of the present study to determine AR practices usage area in the domain of Health. This article was published in the journal of Science and Technology.[8]

Martin Eckert, Julia S Volmerg, and Christoph M Friedrich published a paper named Augmented Reality in Medicine: Systematic and Bibliographic Review. This paper discusses the applicability and future development of augmented and mixed reality technologies such as wearable computers and AR devices.[9]

Jaris Gerup, Camilla B. Soerensen, and Peter Dieckmann reviewed the progress of learning approaches in their paper named Augmented Reality and Mixed Reality for Healthcare Education Beyond Surgery: An Integrative Review. This review suggests various approaches based on AR and MR for various medical subjects while moving the research base away from feasibility studies on prototypes.[10]

3. ALGORITHMS USED

1. VUMark Tracking - Focused on product lines and machinery.[11]

2. Image Tracking - Tracking is on the flat image, i.e., Plane Surface.[11]

3. Multitarget Tracking - Tracking is done on flat surfaces and multiple images e.g., cubes.[11]

4. Cylindrical Tracking - Tracking on the cylindrical-shaped images e.g., Bottle.[11]

5. Object Tracking - Used for objects such as toys that have consistent shapes[11]

6. Model Target Tracking - Reads the model and tracks it accordingly.[11]

4. BLOCK DIAGRAM

Figure 4.1 depicts the block diagram of the system that represents the overall working of the system. The block diagram consists of major 3 parts. The first part consists of the creation of 3D models. The scanned images from the textbook are saved in the Vuforia database and the models are created above the image target.

The second part consists of app assets, logic, and a rendering engine linked with the Vuforia engine. The 3D models' content is retrieved in the engine. The user interface is created through the target position given by the Vuforia engine. Then the 3D models created above the image target are saved and recognized by the device target database. The last part is where UI is created on the basis of the target management system, thus the system is converted into an application and the desired application would be really used.

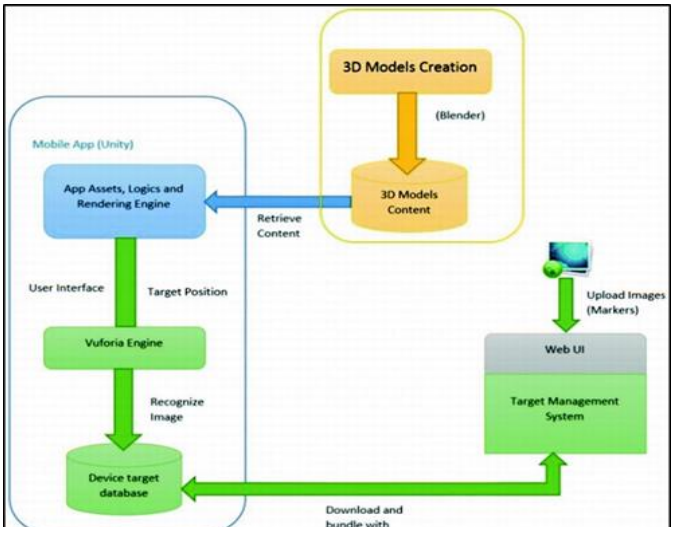

Figure 4.1: Vuforia and Unity Sync

5. IMPLEMENTATION

The process starts by creating a unique ID in Vuforia. The Vuforia generates a separate key which will always be used while login into the database. The scanned images should be added to the database. The scanned images should be added to the provided Vuforia database. On the other hand, the entire creation of models would take place in unity by importing the unique key id generated in Vuforia to unity will link the database to unity. Importing the key makes Vuforia drag all the databases saved to unity. Next in line creation of models takes place above the image target. One by one image is imported into the game scene and models are created by the developer. After using different assets and adding desired animations the models are ready to be implemented. In the end, the window application is converted into an android application and the AR BOOK app is ready to be used by the students.

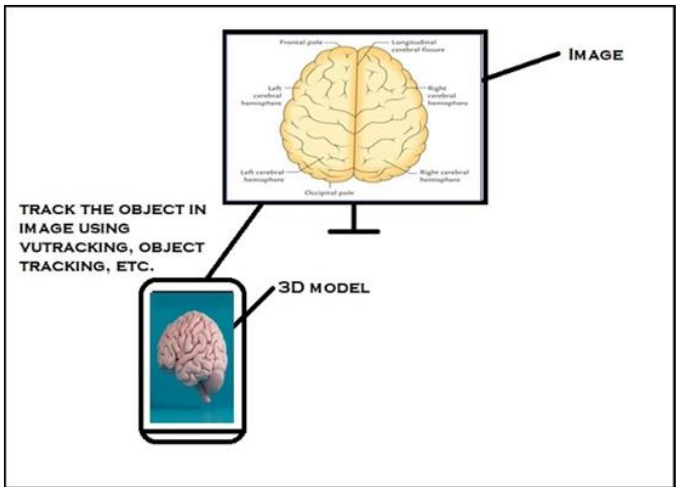

Figure 5.1: Vuforia Tracking

6. SYSTEM DESIGN

The system is designed based on Use Case Diagram and Sequence Diagram. These diagrams helped us build our system in an efficient way.

6.1 SEQUENCE DIAGRAM

A sequence diagram (**Figure 6.1.1**) shows object interactions arranged in a time sequence. It shows the system interaction in an arranged order according to the time sequence. The below sequence diagram provides step-by-step interaction of the entire system in particular time order.

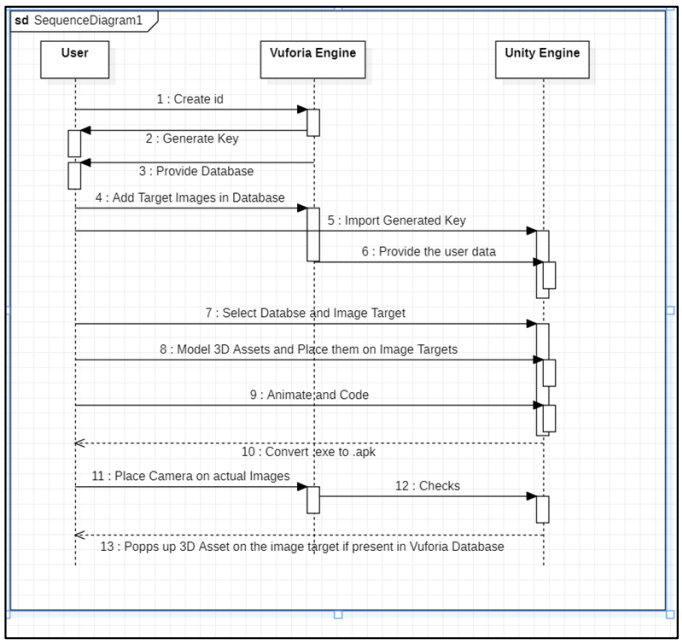

Figure 6.1.1: Sequence Diagram

6.2 USE CASE DIAGRAM

Use case diagram (**Figure 6.2.1**) basically help users to understand and interact with the system. It is a graphical depiction of the system and makes it easy for the user to refer to the process of the system. The given use case diagram consists of special characters and connectors which will help students to adapt the working of the application.

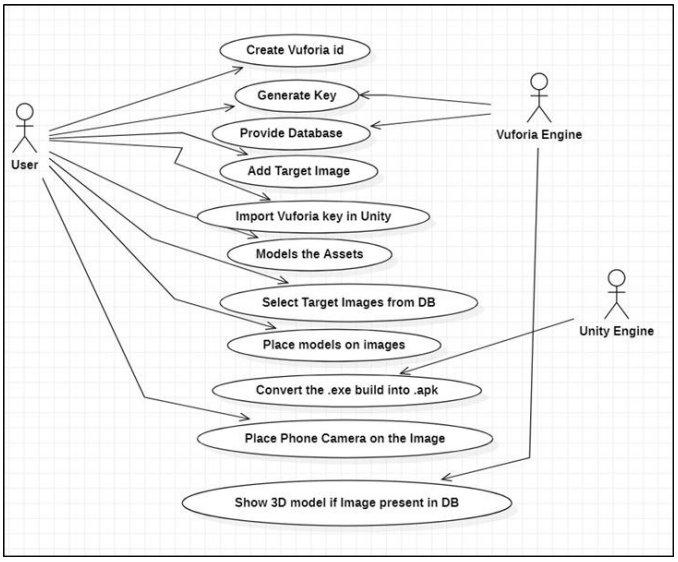

Figure 6.2.1: Use Case Diagram

7. ADVANTAGE

AR books make lessons fun learning. Today's generation is not a chalk and board generation. Studies reveal that students are easily bored with standardized methods of teaching. The reality is that students tend to remember what they see more than what they learn from a book. AR books take them to the next level by helping them not just to see but also to experience and participate. As a result, this system delivers a positive impact on the students by giving them edutainment.

8. FUTURE SCOPE

1. Making this application available for all school grade students with different boards.
2. 3D assets instead of videos will be attached.
3. The system needs up-gradation so that it also can be used for MBBS students who must virtualize complex diagrams.

9. RESULT

Figure 9.1, Figure 9.2 and **Figure 9.3** depict the final result and look of the application providing the models of Chemistry, Physics, and Biology each that is implemented using AR in which the camera tracked the target image present in the Vuforia database accordingly and displayed the 3D model on that image.

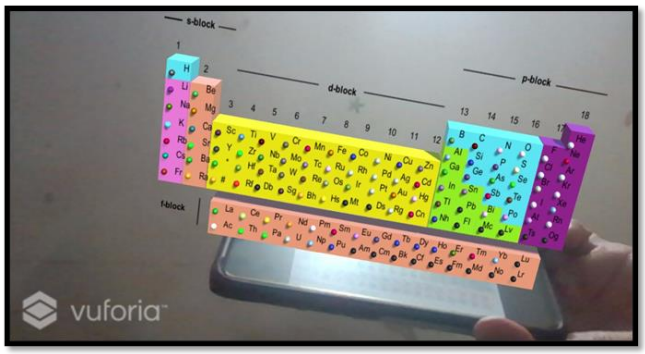

Figure 9.1: Periodic Table (Chemistry)

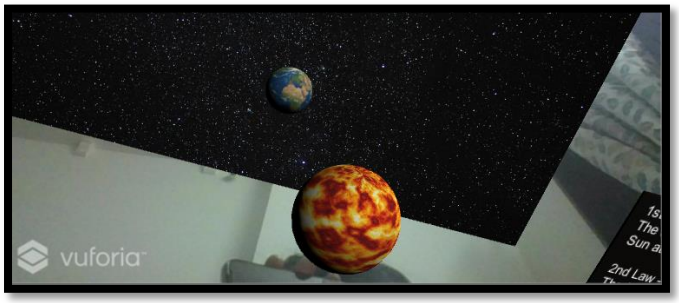

Figure 9.2: Kepler's Law (Physics)

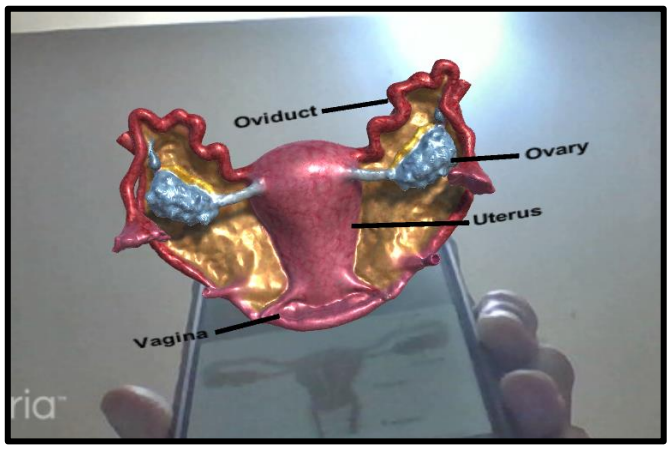

Figure 9.3: Female Reproductive System (Biology)

10. CONCLUSION

AR Book is an augmented reality (AR) real-world application that shows digital content and interaction. The user is aware of and can still interact with this environment as this application uses the camera to sense the real objects and places the live 3D models on top of them according to the path and algorithm.

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[11] https://developer.vuforia.com/