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RealityScope : AR Textbook Visualizer

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Abstract— **Augmented Reality (AR) has become a crucial research area for mobile apps and social interactions. Mobile augmented reality technologies include the blending of the virtual and physical worlds, cognitive representations, and interactions between people via portable devices. By allowing the three-dimensional object to completely join with the client's actual surrounding, it enhances the apparent range. The purpose of this study is to develop three-dimensional models of complex engineering concepts and diagrams having intricate designs, and layered functionalities of the scene using Unity 3D modelling to teach students how to learn about fascinating subjects in a more modern manner than traditional textbook teaching and learning methods. Users may interact and manipulate virtual objects in an augmented environment. This application assists students to learn in a way that results in enhanced knowledge, enhances their skills, and develops their remembering capacities by challenging them to be original and creative in order to absorb things that may otherwise be lost when taught in a conventional manner. The development of a mobile application is demonstrated in this study using Unity 3D environment, Vuforia, and Android SDK.**

Keywords - *Augmented Reality , unity3d , vuforia , android , 3dmodels , education*

1. INTRODUCTION

The younger generations of students are highly computer aware, with a focus on social media, mobile devices, and strategic games. Virtual Reality (VR) learning applications are one type of digital technology that can lead to effective and efficient learning. In order to provide an effective learning environment, many schools and educational institutions have recently expressed interest in adopting such technology.

Virtual reality gave rise to a new technology called augmented reality. Rather than producing a totally fake environment, augmented reality (AR) creates an interactive experience and seeks to complement the real world. For computer-generated graphics, the backdrop and target images are the actual objects in the person's environment. The user is

more cognizant of the surroundings in real life when using augmented reality. The way we educate and learn is being revolutionized by augmented reality (AR).

Based on the data provided by the computer system, this technique primarily improves the user's view of the real world. Reality can be "augmented" by superimposing computer-generated virtual items, scenarios, and system alerts over the actual scene. It basically helps people show the inaccessible scenes in the actual world.

Future advancements and technologies will follow the path of augmented reality, a relatively new technology. It has a wide range of uses in the industries of medicine, marketing, advertising, entertainment, education, manufacturing, and maintenance, as well as in the domains of architecture, navigation, emergency systems, search and rescue, interactive gaming, and tourism.

In order to improve students' learning experiences, this study offers an architectural concept of a mobile application that leverages augmented reality technology. The device uses an Android handset. In order to produce a more efficient teaching strategy that improves student learning, this effort creates a system that makes use of augmented reality technology. It describes a method for scanning 2D images of computer/mechanical complex concepts and diagrams using an Android-based smart phone's camera which further overlays the augmented model in real time.

2. LITERATURE REVIEW

[1] **Development of Augmented Reality (AR) for Innovative Teaching and Learning in Engineering Education**, by Nur Idawati Md Enzai1, Norhayati Ahmad, Mohd Amir Hamzah Ab. Ghani, Siti Sara Rais , Syazilawati Mohamed. In order to get over physical space constraints, safety worries, and low student participation in the learning and teaching process, augmented reality (AR) was developed, as described in this study. Engineering education must take into account factors like limited space, safety procedures, and lack of facilities. AR can be a good answer to problems in engineering education since it can be used anywhere and

offers virtual experiences rather than direct physical touch with lab equipment. As a result, an AR for microprocessor courses has been created with computer hardware components as the contents. For the initial testing of the produced AR, a number of instructors in engineering classes were chosen to experience AR demonstrations. The replies gathered show that the created augmented reality is highly appreciated and has the potential to increase student involvement in the teaching and learning process.

[2] **Augmented Reality in Education**, by Raqshanda Siddiqua ,Pallikonda Subhashini , Pamu Pavani , Aitha Keerthana . The study allows users to hold a camera over a page to obtain augmented data, such as a 3D model, video, or explanation of the page. It is a place where accessing information does not require typing or searching. The programme helps the kids by motivating them to learn new concepts with the use of graphics. A student can use the programme in accordance with his or her preferences because it can be delivered on any smart phone. The interactive elements of this programme, such as the 3D model demonstration, help the user understand the concept from every angle. The programme may be improved and used by many age groups to assist people not only adapt but also visualise and understand concepts more quickly. It offers a remarkable and captivating way to study and understand complex concepts.

[3] **Application Development with Augmented Reality Technique using Unity 3D and Vuforia**, by Xinqi Liul, Dong-Won Park, Young-Ho Sohn. Before highlighting Unity 3D technology and Qualcomm QCAR development framework, Vuforia, this article discusses the underlying concepts and structure. On the basis of this, Unity 3D creates a representation of the scene in three dimensions. In accordance with the comparative location and information of various identifiers on the optical plane, the Vuforia engine may recognise and monitor distinguishing traits and build the suitable 3D model. With a digital surrounding, it can play videos, control animation, and engage with both the virtual and physical worlds. Also, the entire gaming environment's process may be seen. The experimental effect is made more vivid and nearly genuine by images that have been merged after multiple angle observations.

[4] **Augmented Reality- an Application for Kid's Education**, by Shailendra Kumar Jha, Surabhi Nanda. The study examines the area of augmented reality with a primary emphasis on children's education. Augmented reality bridges the knowledge gap between the classroom and the actual world.. In general, an AR system creates a composite view, which combines the user's vision of the actual world with a computer-generated virtual scene that adds more details, in real time. In an enhanced environment, it enables users to manage and interact with virtual things. The essential building blocks of each language are its alphabets. By using such an application, students may engage in pre-school learning, get a greater understanding of the letters and the sounds that go with them, improve their pronouncing skills, and strengthen their recall of the English alphabet. It enhances the educational experience of students. The programme has various fresh and intriguing features, such as home screen and previous/next alphabet navigation buttons. In each scenario, more words that begin with the exact same alphabet have been added. Any smart device that has the installed AR application can serve as the hardware.

[5] **Smart learning based on augmented reality with android platform and its applicability**, by Aashish Verma, Yogita Bahuguna, Kunal Raj. The goal of this study is to improve the present methods of learning and teaching by introducing the idea of augmented reality via mobile devices. Both children and instructors will profit from this technology. Also, educators may create improved 3D models of the topics they teach and creatively convey them to their students. Even pupils may learn the concepts more effectively with the aid of augmented reality 3D models. Another key benefit of android augmented reality apps is that they can be operated on even the most basic android-enabled devices with decent cameras. This programme also makes it easier to recognise many targets.

3. PROPOSED SYSTEM

Our Proposed System is a Mobile based AR Application. It is an application which helps to show 3D models of complex 2D computer and mechanical engineering diagrams and concepts having layered functionalities and multiple subparts; scanned from a text book for better understanding and making education more interactive and fun.

a. System Architecture

The major components of our application are shown below.

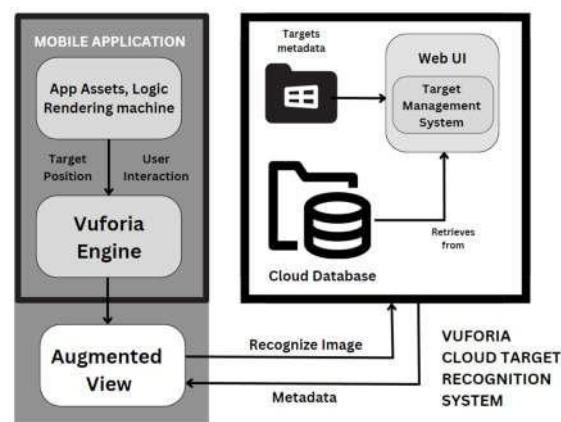


Fig. 1. System Architecture

The system has a client-server architecture, with communication taking place between the mobile application and the Vuforia Cloud System. Vuforia receives requests for scanned AR Markers and responds with the appropriate data.

The mobile app was created as an Android app. This component performs a variety of functions, including managing the camera, scanning targets which are the textbook images and Augmented Reality (AR) markers, identifying images, correctly interpreting them, sending requests to Vuforia for recognition. After Recognition metadata is sent back, based on which augmented view of the model is shown on the phone's display. Developers may host and manage online picture targets using Vuforia, an enterprise-class image recognition tool. It functions as a recognition system that looks for matches by comparing targets stored in the database with requests from the mobile application. When a match is found, the appropriate data related to the target is supplied to the client as a response in the form of a 3D model.

4. MATHEMATICAL MODEL

AR uses SLAM algorithm for the purpose of matching and identification and therefore to get good SLAM solutions, probability is crucial. SLAM algorithms use erroneous measurements of their surroundings to create an accurate map. The algorithm must rely on sensors to obtain data because it has no foreknowledge of its environment.

The direction and position of the mobile are described by the state vector \mathbf{s}_x at time step x .

The control vector, \mathbf{u}_x , specifies the odometer readings with alterations in position and orientation at time step x . The position of landmarks (clear identification locations on our two-dimensional pictures) are described by the time-independent vector \mathbf{v}_k . The range and bearing of the k th landmark from the sensor at time step x are described by the observation vector \mathbf{z}_{kx} . The algorithm's first calculations are incorrect. Two forms of input are used

1. The first is information provided by the mobile device's odometer, which projects the locations of the landmarks based on the device's past positions and most recent movements.
2. Readings from the vision sensor, which is the second form of input.

The location may be determined using these estimations. The position information from both sensors is combined as indicated in the general probability distribution of SLAM, which is used to characterize the location of the model.

$$P(\mathbf{s}_x, \mathbf{v} | \mathbf{z}_{0-x}, \mathbf{u}_{0-x}, \mathbf{s}_0)$$

- \mathbf{v} = Collection of all landmarks (irrespective of time).
- \mathbf{z}_{0-x} = The totality of all landmark-observations that reveal the direction and range of landmarks that may be seen in the related state.
- \mathbf{u}_{0-x} = Control input history representing changes in orientation or position as shown by odometry measurements.
- \mathbf{s}_0 = The mobile's initial location

This depicts how the likelihood of the mobile's position depends on the location of landmarks, the readings on its odometer, and the background of its former states.

5. CONCLUSION

Through this work, we have emphasized the project's architecture and introduced the notion of utilizing augmented reality's enormous potential in the field of education. The creation of augmented reality is discussed in this study in order to overcome various difficulties and to pique students' interest in the teaching and learning process. AR has emerged as a viable solution to issues in engineering education since it can be used anywhere and offers a virtual experience rather than direct physical touch. As a result, an AR for various complex diagrams has been created with computer hardware components and mechanical models as the contents. This project highlights Vuforia, and Unity 3D technologies before introducing several concepts and a framework. Based on this, Unity3D simulates a three-dimensional representation of the scene. The Vuforia engine is able to recognize and keep track

of distinguishing characteristics, as well as create the proper 3D model in line with relative position and location data of multiple distinguishing characteristics on the visual plane. Images that have been combined after multiple-angle observations enhance and almost perfectly replicate the experimental result. As befits today's technology age, we seek to apply ideas from textbooks to the actual world.

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