

EDU-AR: Integrating and Optimizing Education with Augmented Reality

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Abstract - Augmented reality has made a remarkable advancement in the field of technology. AR is one of the trending technologies among the industry 4.0. this technology if approached from a futuristic way it can be enhanced and advanced to be implemented in various fields such as Military , Hospitals ,Medical studies , Technical education, Astronomy , Game development and many more .this paper is about our implementation of augmented reality using a smartphone based android application developed by us ,into technical education such as engineering educational training like this requires a perfect balance of practical and theoretical knowledge . in order to develop industry relevant skills, one needs to learn the concept in a more visualized way and this is where augmented reality can be used as a perfect tool. as this technology comprises of visualized and 3D based learning it eases the way of understanding complicated and complex concepts in more simple and generalized manner.

A - Keywords

Augmented Reality, Marker based AR, Marker less, AR book, Vuforia, AR core, Unity 3D, Target image/Trigger image..

B – Abbreviations

Augmented Reality (AR), Virtual Reality (VR), Software Development Kit (SDK), Head, Mounted Display (HMD), Visual, Auditory and Kinesthetic (VAK), High Definition (HD), 3 Dimensional (3D), User Interface (UI), Application programming interface (API), In-Plane Switching panel Liquid Crystal Display (IPS LCD) , Global Positioning System (GPS), Streaming SIMD Extensions 2 (SSE2) , Single Instruction, Multiple Data (Intel SIMD) , iphone Operating System (iOS) ,

I. INTRODUCTION

Over a past decade education sector has observed a huge implementation of technology taking academics and curriculum towards more enhanced learning. In the field of engineering every graduating student has a smartphone which runs on either android OS or iOS, both of these platforms support augmented reality and have specialized and enhanced support plugins i.e. AR core and AR kit respectively deployed for it. even though AR core is an exceptional case as it is compatible with only latest android devices but an AR android application can be developed in such a way by using respective API's for respective version of android so that the android device with minimum hardware and software can run an AR application smoothly and responsively. AR technology works in a way where real world is superimposed with a virtual or computer-generated graphics in real time it provides seamless experience [1] AR is such a technology if implemented into practical and real life it will improve the quality of education when compared

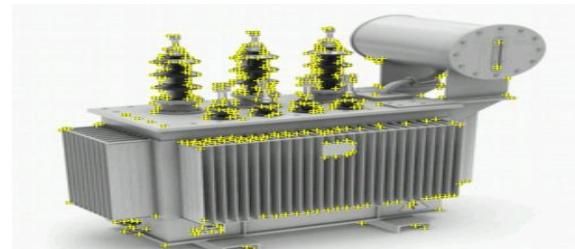
to normal classroom-based learning. this has more advantages like visualized learning here students will not only learn the concepts but they will be experiencing it. animated version of any concept helps in easy understanding and makes learning more enthusiastic and interesting.one can as why only AR is the best technology which can be implemented in education out of twins AR and VR. VR is such a technology where the whole environment is virtual and requires extra hands on devices like VR box, which is cheap and affordable but gives a limited experience due to which the VR technology is not fully explored ,in order to experience an ultimate VR dynamic experience special devices like HMD's (Head mounted displays) for example oculus Go, HTC vive etc. these devices are not cost efficient and scalable . unlike AR technology hardware requirements are Gyroscope, GPS, accelerometer digital cameras, solid state compasses, optical sensors and IPS LCD display. these components are easily found in any of the smartphones. which make AR more scalable than any other technology without compromising with user's wallet.

II. WORKING PRINCIPLE

1.1 Augmented reality

Basically, Augmented reality is divided into two parts one is marker based augmented reality and marker less Augmented reality which is sub classified into projection AR and location-based AR [2].

1.2 Marker based augmented reality



As the name says, it uses markers to produce augmented reality. these markers have a unique identity compared to rest of the environment so they are easily detected and computerized objects are projected on them. These markers are also called as Target or Trigger by developers because they specify the exact location of projection and project triggers additional contents like video,3D model, image or animation. There are many engines which make marker for

Augmented reality one of such platform is Vuforia. It provides both local marker recognition and cloud-based recognition, both of those features have their own pros and cons where local marker recognition has limited content but is fast as compared to cloud-based recognition. When it comes to cloud-based recognition, a device can access everything in cloud and have access to unlimited projection but the downloading of data from the server might make it a slow process. As a coin has two marker-based augmented reality has its own pros and cons. The major advantage of marker-based AR is that the accuracy of initial target detection is high, and it's easy to use, but as soon as the target image exceeds the range of camera view then the projection stops. Accuracy of detection depends on the quality of the target; a target image must have a well-defined feature which are to be detected and proper lighting conditions.

1.3 Marker less augmented Reality

This type of augmented reality unlike marker-based doesn't require target to overlap computer-generated graphics over it and this feature enables it to be independent of user's environment, the technology behind the marker-less AR is that instead of recognizing a target it tends to scan a ground plane where it can project, which makes it more preferable for gaming and education sector. ARkit, ARcore, and AR Foundation are some of the popular SDK's that are used for developing marker-less AR technology. One of the advantages that makes this technology more flexible and scalable is that once the content is overlaid then there are less chances of content getting disappeared even though the camera is at a farther distance.

2. TOOLS USED

2.1 UNITY 3D Engine requirements [3]

System	Minimum requirements
Operating system	Windows: 7 SP1+, 8, 10, 64-bit versions only macOS: 10.12+ Linux: Fixed at: Ubuntu 16.04, 18.04 and CentOS 7 Server versions of Windows and OS X are untested.
CPU	SSE2 instruction set support.
GPU	Graphics card with DX10 (shader model 4.0) capabilities.

2.2 Software and hardware requirement for user end [3].

iOS	iOS 9.0 or higher.
Android	OS 4.1 or later ARMv7 CPU with NEON support or Atom CPU OpenGL ES 2.0 or later.

3.FEATURES

To enhance the first-hand user experience features of a mobile application plays an important role

3.1 Interactive UI

User interface is the medium of interaction between the user and the application in order to experience the best of its UI must be responsive, attractive, intuitive and consistent. When the AR application is launched, first user needs to select the respective discipline through dedicated on-screen buttons.

3.2 360° and detailed view

Once the AR camera scans the target image, the 3D object is overlaid over the target image. User can take an overall 360-degree view, if the respective model is of HD then it may simulate the real-time scenario too.

3.3 Resizing and reshaping

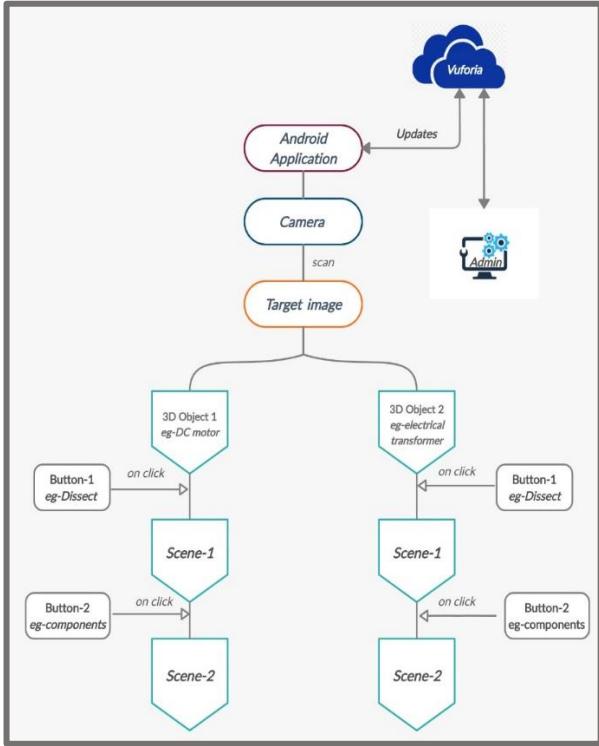
3D model which is projected can be reshaped and resized based on the user's real-time environment and dimensions, special buttons will be assigned to perform this particular task.

3.4 Superimposed information

In order to increase the better understanding, the information is provided in the form of 3D text and 3D labelling corresponding to the particular 3D object. This feature gives the instant information about the particular concept with details.



4. WORKFLOW / ARCHITECTURE



As per user end, user needs to download the android/iOS AR application in the respective devices once the application is installed user should launch the application in the backend application will be directly connected to the Vuforia cloud through a special license key which will be provided by the developer , the pre requisites of the user is that they must have AR book(fig-2 and fig-3) which has recognizable target images . once initiated with the application the user interaction with UI begins in a way that they need to register themselves first then they have to select their respective discipline and depending on the selected discipline by the user the content related to it will be accessed through the Vuforia cloud. Now, the user has to click on the camera button after that they should scan the target image within the AR book. once the camera recognizes the target image then the computer-generated 3D graphics are projected over it. user can have a 360-degree view with HD 3D models. user can also experience audio playback associated with the 3D projection. some most prominent features include interaction with models - where user can rotate, resize, extract and view individual parts, virtual buttons for switching into various animations. workflow can be understood by flowchart given in fig-2.

5. IMPLEMENTATION

The implementation of augmented reality can play a very crucial role in the field of education. most of the developing countries in the world follow classroom-based learning. even though from technical education point of view the similar type of learning is not enough. outcome of the content and concept should be more focused on skill based and industry-oriented understanding rather than just limited to theory-based learning. According to VAK model of learning through visualization means that one needs to see

the information to learn it, this kind of seeing and learning is done in many forms through photographic memory, brightness, color and visual information etc. [4]. . Practical and visual based learning is said to be very influential and impactful because whatever is learnt through a practical way remains in the brain memory for a longer period of time. if theory based and practical based learning are optimized simultaneously, then the understanding of the concept or the content becomes more effective. Introducing AR simultaneously into the class room-based learning would enhance and boost up the theoretical and practical learning with upscaling the interests in the particular content. Educational experience gives the opportunity to experience practical and hands-on training virtually[5]. In an engineering/medical/technical Training based class room where students attend to the lecture addressed by the lecturer, most of the learning process is done through interaction by projector or smart boards which limits the process. In the era of technology each and every student has a smart phone which can be utilized for educational experience through AR students just need to follow up the execution steps as mentioned in section -3 and fig-2 and then after things will be getting 3D-fied ,lecturer addressing the lecture will be able to teach the concept in most understandable way by the help of **features** mentioned in section.

6. WORKING

EDU – AR is an android application which is compatible with almost all android API versions from Kit Kat to the latest version.

6.1 Entry screen



This is the starting screen of the application, by clicking on the EDU-AR button they can proceed to the next screen and also they can exit by clicking on the exit button given on the bottom right corner.

6.2 Log in Screen

User needs to register with the application, once registered user can login with the credentials anytime.



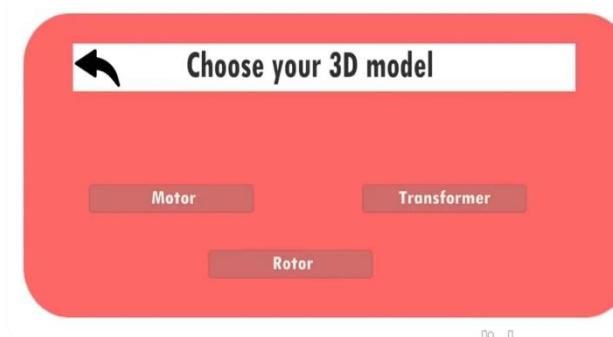
6.3 Menu screen

User can select any of the given discipline of their choice .



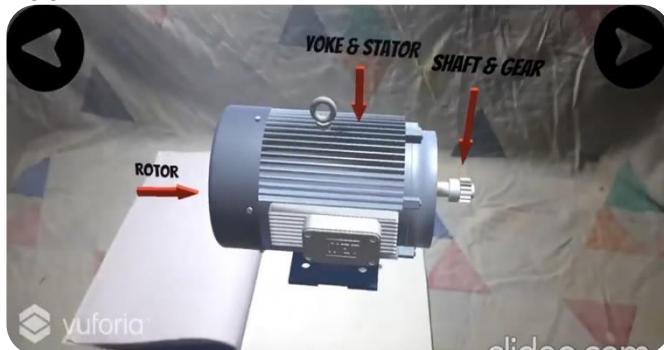
6.4 Engineering Menu

If the user selects the engineering from the menu screen (6.3), then the choice of 3D models should be made by clicking on the buttons on the Engineering menu screen



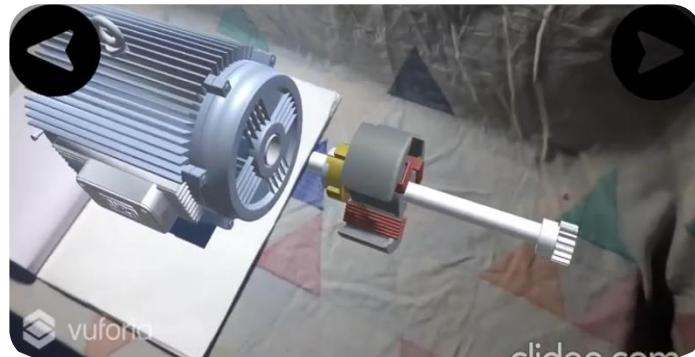
6.5 Motor 3D object

After clicking on the MOTOR button in the Engineering menu screen the camera of the device will be launched and user need to scan the respective target image from the AR BOOK



6.6 Motor 3D dissected view

After clicking on the top right button user can view the dissected view of the 3d motor



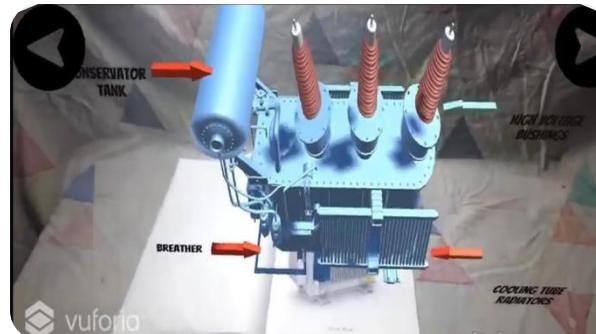
6.7

Clicking on the back button, user needs to select the rotor button and hence after scanning the respective target image of the rotor, a 3D model of the rotor can be viewed.



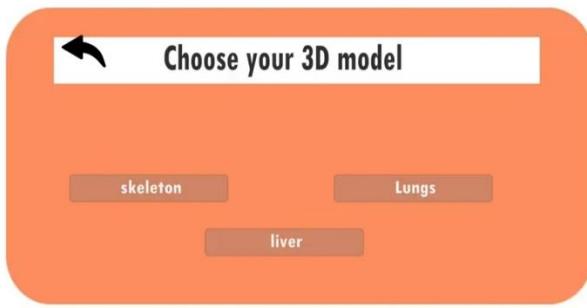
6.8

Clicking on Transformer button user need to point the camera to transformer image , as soon as image is recognize 3D model of transformer with detailed parts will be visible.



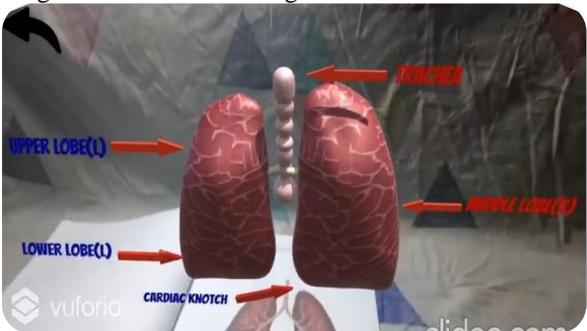
6.9

Selecting the Medical category from menu section user can select any of the 3D models they wish for.



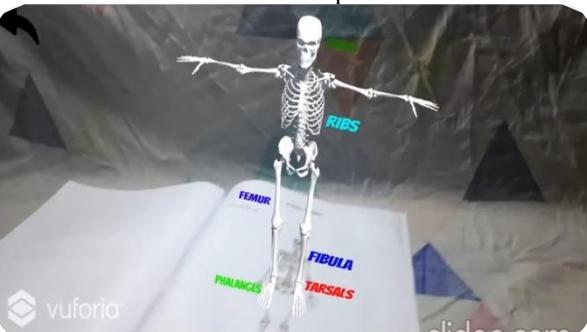
6.11

On selecting lungs from the medical menu user have a view of lungs with detailed labeling



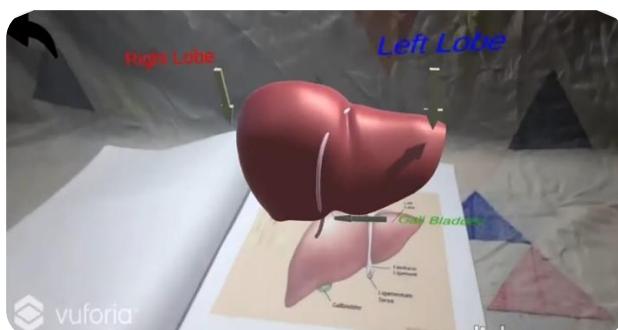
6.12

when the user chooses Skeleton in the menu .user can have 3d view of skeleton with detailed parts



6.13

On choosing liver from menu user can view it in 3d labelled part



6.14

On choosing School category, user can have a detail explanation of our solar system with Animation.



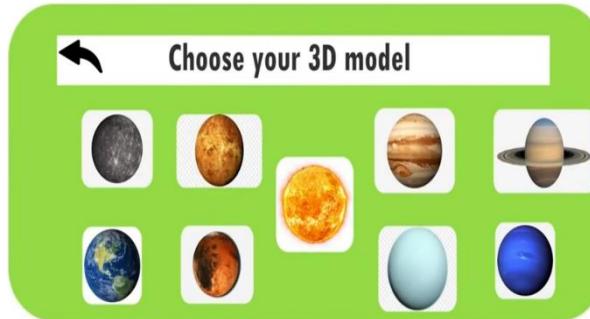
6.15

On selecting solar system button user can have an amazing view of our solar system with animation like planetary rotation and revolution of moons .



6.16

User can also have an individual view on plants by clicking the top right button on the previous scree and the individual planets and stars will be ready to be seen.



6.17

On selecting sun from the previous menu user can have a 3d experience of sun with informative data of it.



On selecting earth from the menu screen user can have detailed view of earth and moon with its data.



7. CONCLUSION

In this world, where all the technologies are advancing day by day and also integrating to improve and enhance sectors like education, military, game development. Our try was to make education more and more practical and interactive. with the beauty of Augmented reality and with current education we can make it more approachable and understandable. This is all done by our Android/iOS-based App “Edu-AR”, where user with no prior idea about the subject can also learn both practically and theoretically using 3D model and animation. After conducting 30+ tests with user we got a huge data about our idea and a major way to improve it. efficiency of image recognition is 88% which amazing to start with. UI have no glitch and is quite intractable with some buttons. total user experience rating is 84% which is quite good. and as the app is cloud based update of new content is easy compared to traditional way of manually updating it. This make this much different from other AR apps and shows sign of a good AR project.

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