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Revolutionizing education system with interactive augmented reality for quality education

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ABSTRACT

Augmented reality would soon impact the modern learning cycle in education. AR has the ability to alter research location and timing, adding new and additional forms and methods. Augmented Reality technology's capabilities will make classes more interactive and knowledgeable. We all are 3D creatures. Our brain is the most powerful 3D computer technology in the world. All of us have evolved to think and store memory in 3-dimensions i.e when we look at the information in a flat piece of paper or computer screen, our brain takes its own time to translate it back to a 2D visual and store it. This is how our education system is, it started with textbook material and recently educators have started encouraging the use of smart classes which again shows videos. As a result, there is no practical exposure that lags us a step behind. This is where a promising technology of the future called Augmented Reality holds for us. Learners will have a 360-degree view of the real-world entities, interacting with those entities by touching them which will eventually make them have better insight about the concepts. Hence our learning curve decreases increasing the brain's productivity. With the development of smartphones, Augmented Reality is applied to a broader range. Augmented reality can turn an ordinary classroom into an engaging experience. The aim is to implement an interactive Augmented Reality Experience using Vuforia, Unity 3D and Blender. The purpose is to promote situational learning, experimental learning, transformative learning as the learning theory basis of mobile Augmented Reality.
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1. Introduction

In the year 1968, an AR sort of device was invented by Ivan Sutherland and in the year 1974, Myron Krueger developed a system of projectors and cameras to show the projection of computer graphics on the screen. And later in the 90s, the word Augmented Reality was the first commonly used term created by Thomas Caudell. Augmented Reality is a leading-edge technology that blends the virtual world with the real world and provides the capabilities of computer-generated visual objects, character texts, audio, and other effects to create a splendid user experience [1]. Recent research and development in this technology allow it to combine with other technical concepts like machine learning, artificial intelligence, deep learning, etc. Multiple applications of this technology include archaeology, architecture, Stem Education, Military, Flight Training and much more. Some real time applications include Snapchat, cardskool, Inkhunter and Mondly.

In recent years institutions face the challenge of motivating and encouraging students to engage in professional careers in AECO-Architecture, Engineering, Construction, and Operations sectors as they do not find jobs appropriate to their degree. This is because the students lack proper intuition and insights as a skilled professional. To overcome this problem computer-enabled learning came into practice. There are many methods of computer-enabled learning concerning the skill one needs. The choice of learning technology and innovation depends on his/her access to various facilities and the surrounding infrastructure. To get the better of this situation we use the technology of immersive experience that provides accessibility with the help of handheld devices like Mobile phones, tablets, iPads, etc. Mobile Augmented Reality can work without the internet providing a better experience for students in rural areas with limited facilities. Students commonly find Science subjects to be abstract, requiring a depth of understanding and visualization

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skills (Gilbert, 2004). When students have difficulties in understanding the concept well, it leads to misconceptions [2]. Augmented Reality supports interaction between the virtual and real environments and allows a tangible interface metaphor to be used for object manipulation. There are many ways of augmenting the entities, the two most widely used types of AR are marker-based AR and markerless AR. Location-based AR which is GPS based requires Map based API like MapBox, MapMyIndia and Google Map API accuracy is hardly achievable with phone GPS. Our paper focuses on using Marker-based Augmented Reality which uses an ImageTarget/Marker that acts as visual hints or triggers to spot the AR content. Using the R-Technologies such as AR, MR and VR gives tutors a chance to start thinking more intense about the factors of mobile learners and can take any circumstance, atmosphere or experience to the next level of understanding. Augmented reality is changing the way learners "learn on the move" [3]. Some hardware technologies like and share lots of factors like computer-generated virtual scenes, 3D objects and interactivity but to make it cost-effective our work allows students to get virtually enlightened by using their mobile devices/tablets/iPads itself. The objective of this paper is to impart practical learning to students pursuing a career in the AECO sectors which will help to make them better professionals and can also enlighten them with concepts like never before.

2. Augmented Reality in education

It helps the students easily acquire, process, and remember the information. Additionally, AR makes learning itself more engaging and fun. In Augmented Reality teachers now have a strong tool. AR will inspire and engage students to make the learning process of STEM and coding easier, more enjoyable and better than it has ever been. Educational institutions that use the latest technologies both in the classroom and in field trips can provide an entirely different learning environment for the Alpha children. Through this they will contribute to better training for potential leaders. Alpha kids are used to acquiring awareness by watching, screen-touching and witnessing. Schools need to have an effective environment for this form of learning. The best approach to teach young Alphas is, therefore, to improve their logical thinking and problem-solving skills. It is important to Alpha children to see issues from multiple viewpoints in order to make the best possible decisions. Teamwork would allow them to examine potential alternative approaches from various points of view and then make decisions based on their own rational thinking, both personal and individual. AR and VR content can make learning more effective, quicker and enjoyable. It can be applied to virtually any subject from mathematics to chemistry to biology with some imagination AR.

Improved collaboration capabilities. Augmented reality apps offer vast opportunities to diversify and shake up boring classes. Interactive lessons, where all students are involved in the learning process at the same time, help improve teamwork skills. A faster and more effective learning process. AR in education helps students achieve better results through visualization and full immersion in the subject matter [7]. A picture is worth a thousand words, right? So, instead of reading theory about something, students can see it with their own eyes, in action. Practical learning. Apart from schooling, professional training can also benefit greatly from the use of AR. For example, accurate reproduction of in-field conditions can help master the practical skills required for a certain job. Safe and efficient workplace training. Imagine being able to practice in heart surgery or operating a space shuttle without putting other people in danger or risking millions of dollars in damage if something goes wrong. It is possible with AR. Universally applicable to any level of education and training. Be it learning games for kindergarten or on-the-job training, AR isn't limited to only one use case or field of application.

2.1. The opportunities and challenges

Augmented Reality technologies in education include innovative ways to teach and learn, bridging the gap between the physical and the virtual worlds. Researchers on the subject are increasingly considering AR's benefits in education. Augmented reality can serve many purposes in education. It helps the students learn, process, and remember the information easily.

In fact, AR makes learning itself more enjoyable and entertaining. It is also not limited to a particular age group or educational level, and can be used equally well across all educational levels; from pre-school education to college, or even at work.

Augmented reality animated content in classroom lessons could attract the attention and inspire students. Including additional data, e.g. a person's brief profile, interesting facts, historical location or event data, visual 3D models, will give students a better understanding of the topics.

A lack of necessary training: Some teachers may struggle to put these new technologies into action, as their background training does not include the skills required. In education, even the most open-minded teachers and creative educational organizations are able to implement augmented reality software.

Dependence on hardware: Using augmented reality in the classroom requires a certain resource base. For example, not all students have smartphones capable of supporting AR applications.

Content portability issues: The AR app you build needs to work equally well on all platforms and devices. However, it is practically impossible to provide the same quality of AR content on any device.

3. Related works

Traditional educational approaches as we know it are becoming a thing of the past. These are gradually digitized, and powered by advances in technology. Augmented reality rightly takes a leading role among the most important developments in. The paperwork on Engineering Graphics Education using Augmented Reality proposed in an International Symposium which uses an algorithm that recognizes gestures along with some operation tips [4]. In 2014 a paper was published in the XVI Symposium on Virtual and Augmented Reality for creating awareness on sound loudness among children that focuses on enlightening children about certain parameters like pitch, rhythm, melody, etc [5].

AR and VR application that shows simulations of pet animals using a 3D camera on HMD's was developed to attract kids and increase stakes of the companies selling pet animals like dogs, cats, fishes, and birds [6]. Smart Wearable Glass Technology in Museums to engage visitors by displaying the details of the objects when recognizing the QRcode associated with it. These applications aim at enlightening visitors with historical facts and making the travel experience more interesting.

4. Implementation

Providing an enjoyable learning environment is vital for any educational institution's success, and in particular, the educator's success. Augmented Reality technology is widening the physical world; adding layers of digital knowledge to what we can see with the naked eye; It will be difficult for colleges, educators, and educational organizations to cope with Generation Alpha children's demands if they fail to change themselves, their curriculum, and curricula to follow a modern approach to education.

The most popular application for augmented reality in education is possibly the direct use of AR apps in the classroom. They will help the instructor illustrate a subject in this case, provide a visual representation of the content and help students test their knowledge in practice.

With the major consideration of the learning issues, augmented reality application is created to show the working of AC generator [8].

4.1. Augmented reality based system to describe the working of AC generator

Augmented Reality assisted system to show the working of an AC Generator is implemented using Unity 3D engine of version 2018.4.16f1, Vuforia Developer Portal v7.2, C# for coding the interactions and animations and Android SDK to build the complete apk file. The created application can be installed on all android devices of Version 4 and above. The 3d model used consists of individual objects of different components of the Electric generator such as the north and south Field Magnets, Brushes B1 & B2, Slip Rings, Rotating armature coil, Rotor, Galvanometer, its needle, etc. These objects are combined using the Blender Application to get the complete 3D Model of the AC Generator. All of these GameObjects contain a MeshCollider component i.e a collision primitive used in Unity. Vuforia, an AR SDK that uses CV Technology supports for 2D, 3D along with native support for IOS & Android Operating Systems. Vuforia Software Development Kit of version 7.2 is used for image recognition and tracking of the visual markers. Fig. 1 shows the marker image of the AC Generator. This image is developed using Photoshop. Three buttons are created in the canvas for creating an interactive experience in our scene.

On the click of Button1 in Fig. 1, each part of the Generator System will elevate popping up its name and description as in Fig. 2. By clicking the second button in Fig. 1 the user can witness the complete working of the system. Here 3D Animations of armature rotation, electron particle movements through the two carbon brushes and the galvanometer deflections are simulated. It will also display the directions of three different fields specified in Fleming's Right-Hand Rule using arrow objects.

To come up with a pragmatic approach a slider is used to give precise input for the rpm value of the rotating coil so that learners can observe how the system works for different inputs. Since the induced emf oscillates through the zero, negative and positive values that take the shape of a sine wave another interesting component is created in this phase. The Graph component that shows the appropriate sine wave for the relevant input provided by the user. This is created using the SineWave class and can be seen in Fig. 3.

5. Basis of practice

Now in the era of the Internet, Google's Androidand Apple's iOS systems for mobile Application design development here is good technical support. Vuforia with QualComm has released some latest features like External Camera, Support for ARCore 1.4, Enhanced tracking for Model Targets, Increased ability to detect small targets, Support for DragonBoard™ 410c. The greatest advantage is experienced in Mixed Reality, which serves with the most immersive form of interaction. The Mobile Computing OS supporting AR features is sufficiently good and can be improved by enabling more interactive experiences on handheld devices to enhance the visual experience of the real world.

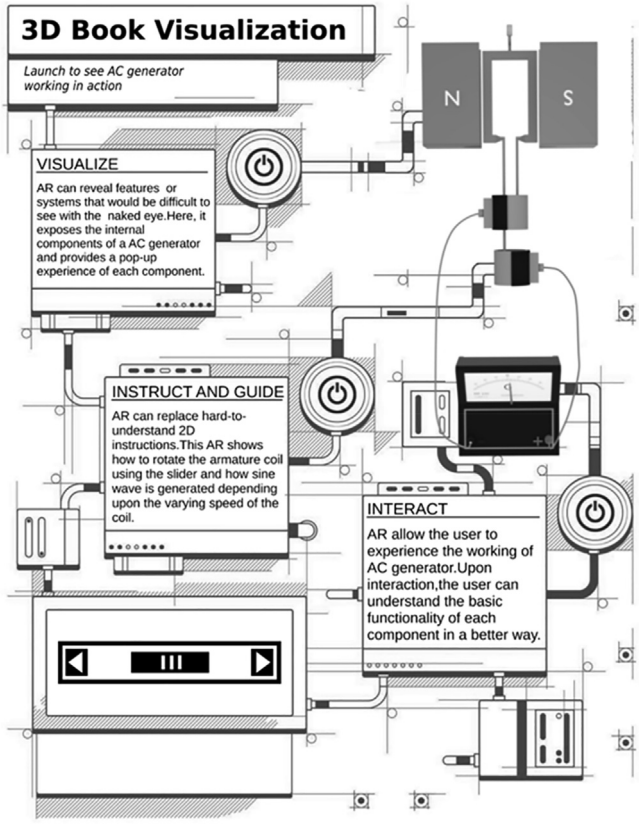

Fig. 1. Marker image of AC generator.

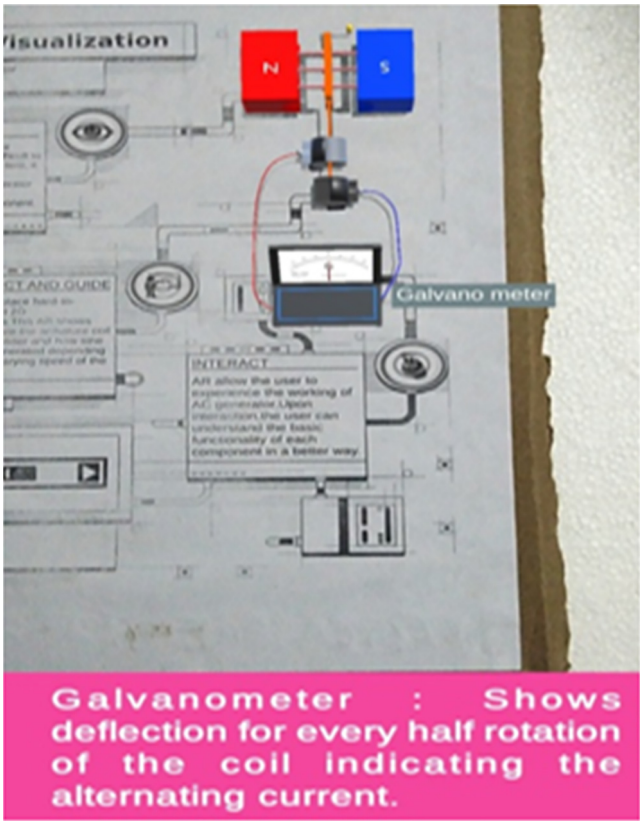

Fig. 2. Elevation of galvanometer part with description.

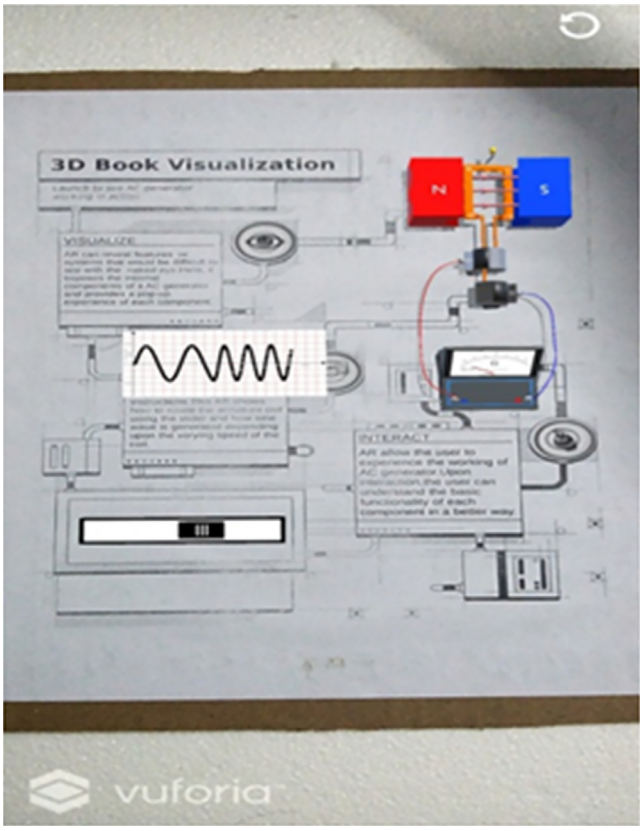

Fig. 3. Sign wave graph based on RPM input.

6. Future work

Making virtual patients for student doctors to learn human anatomy in depth by providing interactive simulations which allows them to perform surgical activities. It helps people working in different fields to prepare for risky circumstances without imperilling themselves or anyone else by simulating these situations. We take advantage of this and train the technicians by launching virtual demonstrations straight from the devices on how to install and work with different machine parts as an AR Overlay along with Image Processing and Machine Learning for Armed Forces, Fire Fighters, Bomb disposal squad, PowerPlant operators

7. Conclusion

Given the growing use of Augmented Reality in many aspects of the modern world, the augmented reality is still fresh and unsettled in education. While AR's teaching / study possibilities are fantastic, offering new ways of learning. Teachers are better able to draw students' attention and inspire them, while students are given new opportunities to imagine their subjects and abstract concepts, and to receive practical skills. Moreover, even parents can benefit – by engaging their children to study with playful apps. Augmented Reality (AR) is expected to become the cutting edge technology in education in the next couple of years. The most suited activity for using AR in education is during lab work. AR book as a learning material and AR Game as an evaluation tool for students will make students have better insight into the concepts. This will benefit students in rural areas where there are no lab facilities, thus enlightening all kinds of students with quality education. The technology-enabled learning process will be more active, effective, attractive, motivating and meaningful for a student. One's learning style may affect how well a person understands the learning concepts. Hence AR content integration may increase the learner's productivity to the next level.

CRediT authorship contribution statement

D. Roopa: Visualization, Investigation, Supervision, Software, Validation. **R. Prabha:** Conceptualization, Methodology, Software, Writing - review & editing. **G.A. Senthil:** Data curation, Writing - original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Further Reading

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