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Scope of Augmented Reality in Education

Mohammad Areeb Momin
IMCOST, Thane

Abstract: ***Augmented Reality (AR) can be defined as a technology in which virtual objects are mixed with the real-world. Users of AR can interact with virtual 3D models just as they do in real life. Augmented Reality (AR) applications nowadays used in many sectors such as Architecture, Science, Military etc. But our focus for this study is Education sector. As in AR technology virtual objects is combined with real objects this can be used by teachers and educational institutions to explain different topics to students easily. This also increase interest of students as AR provides very immersive and enjoyable experience for the students. There are many applications out there that can help students in learning many complex topics easily as AR can be used to display many 3D models that helps students in learning. When students interact with virtual objects they can learn more easily and in a fun way. Also, for teachers AR will help them in explaining concepts to students as they have good reference to explain. In the light of all these, this study focuses on the positive impact that AR can make in education system. In this study we will dive deep in how actually AR must be implemented in education so that students and teachers can get benefited from this revolutionary technology. After that we will be discussing about different SDKs that can be used for developing AR based applications and finally, we will be focusing on which apps are available nowadays that uses AR to promote learning.***
Keywords: Augmented Reality (AR), Software Development Kit (SDK), Virtual Reality (VR).

I. INTRODUCTION

Augmented Reality (AR) consists of three major components, first is that AR is an integration of digital assets in real world, second is that the digital asset can be interacted in real-time, and third one is that the digital asset is a 3D copy of real-world objects. A general perspective of AR is that it is only in visual form, but it can also give effect in audio, sensory modalities, and haptic forms etc. As compared to Virtual Reality (VR) AR gives more real touch to its users, as VR is completely based on virtual environment. To experience AR, we need many hardware components such as processor, display, input devices, and different sensors such as GPS, accelerometer, Solid State Compass etc.

By taking required hardware's in considerations smartphones and tablets becomes the most suitable device for AR implementation. Beside smartphones and tablets there are many devices that uses AR features to its users such as Smart Eyeglasses, Head-Up Display (HUD), Virtual Retinal Display etc. From AR application development perspective there are many SDK's that support the development are ARCore by Google, ARKit by Apple, Lens Studio by Snapchat, SparkAR by Facebook etc.

AR is very feasible technology that is why it can used in almost any aspects of life, such as architecture, urban designing and planning, military, video games, education etc. In this article we will discuss about implementation of AR in education in details. Till now AR is rarely used in education system when compared to its advantages although it has increased at good rate in last few years. But there is lots of space for AR to revolutionize the education system.

Currently in education students only have access to 2D pictures when they study any topic. For 3D experience they can watch videos, but videos do not give a real touch to the viewers. Also, videos are not very satisfying for curious learners who wants to dive deep in the concepts. AR is the only feasible way to give a real touch to its viewers as well as provides satisfying experience to all users as they can experience the objects as many times as they want just as they have that object or visual in real life.

AR will help each and every person in education sector as it simplifies works for teachers as well as students. As we know after AR is implemented in education system students does not have to depend on 2D pictures to learn different concepts as they have a 3D access to that structure. From teachers' perspective AR will make teaching easier as AR will give almost a real life feel of a particular structure just as they have that in real world. Because of this, teacher will have a strong reference to explain the concepts to the students.

We can classify AR based apps in two parts marker-based applications and location-based applications. In marker based, app tries to identify the predefined marker to put the digital content there. In location based, app makes use of location and sensors such as GPS, accelerometer, and digital compass to overlay the digital information. Publishers must include the embedded markers in textbooks for every topic that require 3D understanding of the object or visual. By this, students can easily access the 3D model of the topic with the help of their smartphone or tablet while studying. By doing this they don't have to store every model by their own embedded markers will help.

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If we discuss about students in particular fields, we can understand the real power of AR in education. For mechanical students AR will help them in understanding different mechanical parts just as they would have experienced in real world. For chemistry student they can interact with different chemical and can visualize the reaction of different chemical combinations just as they have experienced in real world. For civil students they can experience how a structure will look like before building that structure with the help of AR. Thus, as we have already understood that AR will help every student in their learning journey by making learning more interesting and immersive as it gives a real-world touch to its users. As we know AR is being used in many sectors but its usage in education system in very less. The biggest advantage of AR is that we don't have to buy a dedicated device to use AR based applications we can make use of exiting devices such as smartphones or tablets. This advantage also gives AR more accessible and cheaper technology than VR, as VR requires a dedicated device for VR based applications. There are many AR applications developed for education purposes, but they are not widely used because many students and institutes doesn't have access to devices that support AR applications. Also, many students and educational institutions don't know the power of AR in education. As the focus of this study is education sector, it is considered that the devices that will be used for running AR based apps are smartphones and tablets. For this reason, we will be studying deep about Android and iOS operating system and how AR is implemented in these OS. When talking about AR implementation in smartphones and tablets there are many successful apps that are making use of AR for enhancing the user experience. The apps are Snapchat, Pokémon Go, Google Translate etc.

II. MOBILE SDKS FOR AR

As we are focusing on AR implementation on smartphones and tablets lets first discuss about SDK's we can use to build AR based applications on smartphone and tablets. SDKs are as follows:

A. Vuforia

Vuforia is the most widely used for AR development. Vuforia supports both Android and iOS. Vuforia supports tracking of objects and spaces such as images, objects, and environments.

B. ARToolKit

ARToolKit is an open-source SDK for building AR based apps, it is available for both Android and iOS. It has all the major features required for building AR apps.

C. Google ARCore

Google ARCore as the name suggests is built by Google, which is available for Android and iOS operation system. Major features of ARCore are Motion Tracking, Environmental Understanding and Light Estimation.

D. Apple ARKit

Apple ARKit as the name says it is built by Apple, which is only available for iOS operating system. Some features that ARKit provides are Visual Inertial Odometry (VIO), face tracking, detecting surfaces etc.

E. Maxst

Maxst have 2 different SDKs for different dimensions one is for 2D recognition and second one is for 3D recognition. It supports for Android and iOS. Some important features are tracking and mapping environments, images, and plane tracking etc.

F. Wikitude

Important features offered by Wikitude are 3D and image recognition and tracking, location-based tracking and can be integrated with smart glasses. Wikitude can be used to build Android and iOS apps.

III. AR BASED EDUCATIONAL APPS

Let's discuss about apps that can be used for education purposes. They are as follows:

A. Augmented 3D

Augmented 3D is a mobile application build using ARCore, it helps visualize 3D models in real time. The biggest advantage of Augmented 3D is that we can add our own 3D models to the app. This feature will help educational institutions in providing a more immersive learning experience to students by building their own 3D models. Also, students will get more interested in learning with the help of this method. Beside this Augments 3D also has features such as comparing multiple 3D models, can view models in different colors and textures, etc.

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B. Google Translate

Google Translate is a widely used mobile app for translations. As Google Translate translates language in real-time when we enter text manually. But this app also has a feature to translate text captured by camera in real-time. Google Translate first captures text from camera in real-time and makes use of AR to display translated text in real-time. This feature set user free from manually entering text to app for translation. User can just show the text they want to translate and that's it, this app will display translated text quickly in real-time with the help of AR. This app will help both teachers and students when they are learning new language as they don't have to manually enter words, they can just get the translation by showing the text in camera.

C. SketchAR

SketchAR is an app that makes use of AR for helping artists. This app shows the virtual lines with the help of AR on the paper and user can just follow those lines to draw the sketch. This app is very helpful for new artists who wants to learn drawing. Also, users can upload their own drawing and can create NFT's from that sketch. This app is very helpful for students who loves drawing sketches or who wants to learn drawing sketch as well as students will get exposure of creating NFT's.

D. Wikitude

Wikitude is a mobile app as well as an SDK for developing AR based apps. Wikitude mobile app allows users to enjoy the AR based digital contents such as campaigns, projects, promotions, and many more by just scanning the things. Wikitude also provides Wikitude Studio Editor for creating AR based digital content and users can publish their 3D contents on Wikitude app easily. Wikitude can be helpful for institutions for creating digital AR based content easily and can be published on app easily. With the help of Wikitude, institutions can give life to banners, brochures, magazines, books, labels by mapping it to videos, animations, and 3D models.

E. Smartify

Smartify is an AR based mobile app helps users in identifying arts all around the world. Basically, it is developed for users who enjoy visiting museums, events, and galleries of arts. This app is developed for information purposes to create awareness about great artworks around the world. It shows complete information and history about the artwork when user scans that artwork. Beside this there are other helpful features such as recommendations of events and museums, offline download support and planning and booking events, museums etc. This can be helpful for students and teachers when they are visiting any artwork and wants to get complete information about the artwork easily.

F. SpyGlass

SpyGlass is a mobile app that gives complete geography-based information about your surroundings. SpyGlass uses GPS for getting information, we can consider this as an advance compass in our mobile phone that displays details such as binoculars, maps, gyrocompass, waypoint tracker, speedometer, altimeter, Sun, Moon and Polaris star finder, gyro horizon, range finder, sextant, inclinometer, angular calculator, etc. SpyGlass makes use AR to get information of users surrounding and displays information on the screen. Students can use this app if they want to get some of the geographical details as mentioned above.

G. Blippar

Blippar is an AR based mobile app that help curious users knowing more about things that they see. It gives a simple interface to users who are always curious about learning things that they are surrounded with. Blippar makes use of AR to identify objects, places, logos etc. After identifying objects, it displays complete details about that object or place. For example, you can scan a logo that you don't know about, or a dog near you or it may be some artwork, you will get complete information about everyday things that you see by just scanning with Blippar. All the curious students who have some unanswered questions about things they are around them, will love this AR based app. Just download the app, scan almost anything you see, tap on it and that's all, complete details regarding that object will be displayed.

H. Civilizations AR

Civilizations AR is an AR based mobile app developed by BBC, Nexus Studio, and other museums. By using AR this apps brings all the major artifacts from history into your own home in just a click. User can move, scale, and rotate the artifacts just like the explorer. Users can also listen to audio guides about artifacts. Users can also take photo and share about the artifacts. This is one of the best apps for learners learning about different historical artifacts with the help of AR. Due to AR experience many students will learn about these historical structures in a very enjoyable way and this may lead to increase in their curiosity about history.

I. Star Chart

Star Chart is also an AR based mobile app which allows you to get details about the stars you are watching in the sky. With the help of AR technology, it gives magical star gazing experience. This app is just like a virtual planetarium in your hand, as you just point to the sky with your camera and this app will display complete details about everything you are seeing in the sky. This app uses GPS technology for getting your location and calculates the positions of each star visible from the earth in real-time and displays each start exactly where they are. This app also supports some voice commands to make users experience easy. All the students who want to know more about space and stars they are watching can consider this informative app.

J. Spacecraft AR

Spacecraft AR app is developed by NASA for educating people about different space models with the help of AR technology. This app is loved by students interested in space explorations. Using this app users can bring home models of Curiosity rover, Opportunity, InSight, SMAP, Voyager, Juno, Cassini, the 70 meter Deep Space Network Antenna etc. in just a click. Users can learn about mission Earth, Mars and beyond. Users must point it to the flat surface and then click on it, the models that they have chosen will be shown as a 3D model, which can adjust in size. These 3D models give complete information about each space models. Students who want to learn more about space can experience how the models looks like and about their different components.

K. Measure Kit

As the name says, Measure Kit is used to measure objects in real-time with the help of AR technology. Measure Kit can measure using 9 measuring tools such as Ruler, Magnetometer, Trajectory, Face Mesh, Marker Pin, Angles, Person Height, Cube, Level. Just point your camera on the object you want to measure, its measurement will be shown in screen using AR. This can be very helpful in day-to-day life as well as can be used just for fun.

IV. CONCLUSION

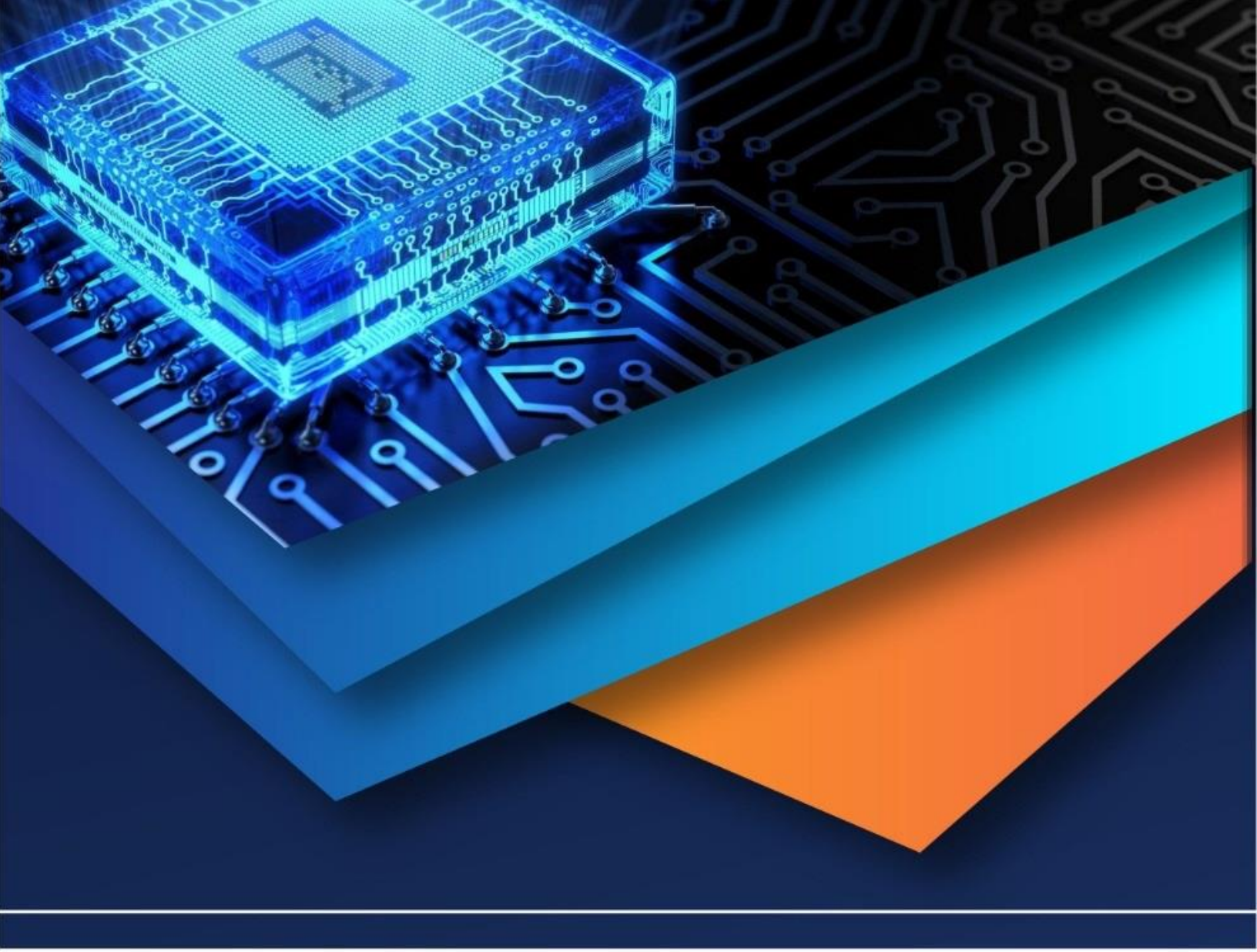
In this study we come to know about basics of AR, how it is used and all the basic theory regarding Augmented Reality (AR) technology. After that we have study about how AR will help students and teaching institutions in various ways. Then we have seen all the major SDKs of AR for mobile app development. Also, we have researched in detail about many AR based apps that helps students in learning and teachers in teaching.

Till now we have only discussed about possibilities of AR. Let's discuss a little bit on challenges of AR in a real scenario. The biggest challenge of AR to be implemented in education system is that AR is a relatively very new technology because of this it is expensive for majority of students and educational institutions, to use an AR based mobile app they must have expensive Android phone or an iPhone. Also, AR as a technology is still emerging as it does not work well in some scenarios. But we must consider AR as a very helpful technology in a near future.

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