AUGMENTED REALITY FOR EDUCATIONAL APPLICATION

PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report titled **"AUGMENTED REALITY FOR EDUCATIONAL APPLICATION"** is the bonafide work of **Mr. Alagappan.CT [Reg.No.:13BEC011],Mr. Arunkumar.S[Reg.No.:13BEC213],Mr.Ragul.P[Reg.No.:13BEC242],Mr.Sasikumar.P[Reg. No.:13BEC243],**who carried out the project work under my supervision. Certified further that, to the best of my knowledge the work reported herein does not form part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Recent advances in technologies are being effectively applied to educational contexts. Our project presents an educational application using augmented reality technology which aims to encourage the learning activities. The project promotes autonomous learning through exploration and inquiry. The application encourages interaction and allows content adaptability. It can be successfully adopted for learning and development in education. Nowadays the advances in augmented reality has a rapid growth in shopping environment and lesser exposure in educational environment. So our motive is to create an efficient learning methodology in the educational environment. Initial objective is to create a 3D model of an electronic component which is created on a CAD platform . The created model is assigned to a particular marker based AR image or to a marker less AR that is the virtual image which is viewed in the real world and this process is enhanced using an android application. Through this application an individual can view the model of the component in the screen and can view the image in 3 dimension which enhances the efficient learning

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CHAPTER-I
INTRODUCTION

The aim of this project is to create an efficient learning methodology in the educational environment. Initial objective is to create a 3D model of an electronic component which is created on a solid works platform. The created model is assigned to a particular marker based AR image or to a marker less AR that is the virtual image which is viewed in the real world and this process is enhanced using an android application. Through this application an individual can view the model of the component in the screen and can view the image in 3 dimensions which enhances the efficient learning. There are many previous attempts to use AR for educative purposes which have been verified the motivating effects of using AR and have confirmed improvements in the academic performance in various education levels when adequately applied. The application of AR in education is considered feasible, and the deliberated introduction of new technologies in the new curriculum of preschool education makes the use of AR at this level more than suitable [1].

Several studies have proved that the implementation of educational experiences using AR, some of them at school or college education level, has improved the students' performance at learning. There are also some experiences at classrooms in Teacher training universities which have introduced the concept to future teachers and additionally, they have made the students a proposal to design their own activities using an AR tools. These experiences show that students at the teacher training university have positive attitude and interest in these experiences [2].

The interactive and explorative character of the AR, makes it suitable for education because it suits the characteristics of this development stage, where

student are exploratory and physical and they need a high degree of freedom of activity and movement. Nevertheless, materials and time for exploration and opportunities to be physically active are not always the first option in traditional methods. AR includes exploratory activities which motivate continuous discovery and which makes the student wonder what is behind an image (or marker)[3]. These activities imply motor tasks such as moving towards the tablet, selecting and changing markers or pointing at the markers with the device to self-evaluate. In the case of special needs students or those with attention difficulties or disorders, AR can be an excellent resource to complement some other activities.

CHAPTER-II
AUGMENTED REALITY

Augmented reality is the integration of digital information with the user's environment in real time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it [20].

2.1 HOW IT IS USED:

Augmented reality is hidden content, most commonly hidden behind marker images, that can be included in printed and film media, as long as the marker is displayed for a suitable length of time, in a steady position for an application to identify and analyze it. Depending on the content, the marker may have to remain visible. It is used more recently by advertisers where it popular to create a 3D render of a product, such as a car, or football boot, and trigger this as an overlay to a marker. This allows the consumer to see a 360 degree image (more or less, sometimes the base of the item can be tricky to view) of the product. Depending on the quality of the augmentation, this can go as far as indicating the approximate size of the item, and allow the consumer to 'wear' the item, as viewed through their phone. Alternative setups include printing out a marker and holding it before a webcam attached to a computer. The image of the marker and the background as seen by the webcam is shown on screen, enabling the consumer to place the marker on places such as the forehead (to create a mask) or move the marker to control a character in a game[20].

2.2 WORKING PRINCIPLE:

Using a mobile application, a mobile phone's camera identifies and interprets a marker, often a black and white barcode image. The software analyses the marker and creates a virtual image overlay on the mobile phone's screen, tied to the position of the camera. This means the app works with the camera to interpret the angles and distance the mobile phone is away from the marker.

Due to the number of calculations a phone must do to render the image or model over the marker, often only smart phones are capable of supporting augmented reality with any success. Phones need a camera, and if the data for the AR is not stored within the app, a good 3G Internet connection. On the spectrum between virtual reality, which creates immersive, computer-generated environments, and the real world, augmented reality is closer to the real world. Augmented reality adds graphics, sounds, haptic feedback and smell to the natural world as it exists [19]. Both video games and cell phones are driving the development of augmented reality. Everyone from tourists, to soldiers, to someone looking for the closest subway stop can now benefit from the ability to place computer-generated graphics in their field of vision.

2.3 APPLICATIONS:

Main classes of applications:

1. Medical
2. Manufacturing and repair
3. Annotation and visualization
4. Robot path planning
5. Entertainment
6. Military aircraft

2.3.1 Military:

The Heads-Up Display (HUD) is the typical example of augmented reality when it comes to military applications of the technology. A transparent display is positioned directly in the fighter pilots view. Data typically displayed to the pilot includes altitude, airspeed and the horizon line in addition to other critical data. The term "heads-up" comes from the fact that the pilot doesn't have to look down at the aircraft's instrumentation to get the data they need [18].

2.3.2 Medical:

There have been really interesting advances in the medical application of augmented reality. Medical students use the technology to practice surgery in a controlled environment. Visualizations aid in explaining complex medical conditions to patients. Augmented reality can reduce the risk of an operation by giving the surgeon improved sensory perception. This technology can be combined with MRI or X-ray systems and bring everything into a single view for the surgeon[18].

2.3.3 Navigation:

Navigation applications are possibly the most natural fit of augmented reality with our everyday lives. Enhanced GPS systems are using augmented reality to make it easier to get from point A to point B. Wikitude Drive for the Android operating system which is currently in beta brings the GPS into the 21st century. Using the phone's camera in combination with the GPS, the users see the selected route over the live view of what is in front of the car [18].

2.3.4 Gaming:

With recent advances in computing power and technology, gaming applications in augmented reality are on the upswing. Head-worn systems are inexpensive and computing power is more portable than ever. Ogmento, an augmented reality game developer recently received $3.5 million of institutional funding to develop gaming applications for the iPhone and Android devices. Ogmento is betting on continued adoption of this niche technology and acceptance by the gaming community. Augmented Reality (AR) can be fun technology to play with. The basic premise of AR is to overlay digital content on top of real things using something like a map, a camera, or sometimes the sky. Aside from being awesome, AR is also one of the more polarizing categories of apps and games in Google Play[18].

CHAPTER-III
BLOCK DIAGRAM

3.1 HARDWARE:

Mobile phone-The electronic gadget has inbuilt android software which functions the developed augmented reality application and displays the output on the digital screen.

A new wave of innovation in the mobile market will bring augmented reality to smartphones, allowing users to interact virtually with their surroundings. Augmented reality, or AR, is a term that refers to technology that superimposes computer-generated content over live images viewed through cameras. The technology, which has been used in gaming and in military applications on computers, has been around for years. But thanks to more sophisticated devices, faster wireless broadband networks, and new developments at the chip level by companies like Qualcomm, it has become inexpensive enough to put into smartphones and tablets[10]. Even though these are still the early days for the technology-chip vendors like Qualcomm are just now giving demonstrations-- augmented reality could have a major impact on smartphones in the coming years.

"The idea that a mobile device knows where I am and can access, manipulate, and overlay that information on real images that are right in front of me really gets my science fiction juices flowing," said Mark Donovan, senior analyst at ComScore. "It's just beginning now, and it will likely be one of the most interesting trends in mobile in the next few years." Just as location-based services have begun to change how wireless subscribers use their cell phones and marketers reach an increasingly mobile audience, augmented reality will go a step further, bringing a wealth of collected data to users' fingertips. Today, GPS and other

location-based technologies allow people to track and find friends on the go. It allows them to "check in" at particular locations. In other words, wireless subscribers provide information about their surroundings, such as where they are, and that information is stored and shared with others via the Internet cloud. That information can be used so friends can locate you, or it can be used by marketers to send you coupons and other promotions.

ANDROID:

Operating Systems have developed a lot in last 15 years. Starting from black and white phones to recent smart phones or mini computers, mobile OS has come far away. Especially for smart phones, Mobile OS has greatly evolved from Palm OS in 1996 to Windows pocket PC in 2000 then to Blackberry OS and Android. One of the most widely used mobile OS these days is ANDROID. Android does a software bunch comprise not only operating system but also middleware and key applications. Android Inc was founded in Palo Alto of California, U.S. by Andy Rubin, Rich miner, Nick sears and Chris White in 2003. Later Android Inc. was acquired by Google in 2005[13]. After original release there have been number of updates in the original version of Android.

Features of android:

Android comes with an Android market which is an online software store. It was developed by Google. It allows Android users to select, and download applications developed by third party developers and use them. There are around 2.0 lack+ games, application and widgets available on the market for users. Android applications are written in java programming language. Android is

available as open source for developers to develop applications which can be further used for selling in android market[8]. There are around 200000 applications developed for android with over 3 billion+ downloads. Android relies on Linux version 2.6 for core system services such as security, memory management, process management, network stack, and driver model. For software development, Android provides Android SDK (Software development kit).

APPLICATIONS:

These are the basics of Android applications:

1. Android applications are composed of one or more application components (activities, services, content providers, and broadcast receivers)

2. Each component performs a different role in the overall application behavior, and each one can be activated individually (even by other applications)

3. The manifest file must declare all components in the application and should also declare all application requirements, such as the minimum version of Android required and any hardware configurations required

4. Non-code application resources (images, strings, layout files, etc.) should include alternatives for different device configurations (such as different strings for different languages).

3.2 SOFTWARE:

1. Unity- This is an augmented reality software by which apllications related to AR can be created and tested

2. Vuforia-It is an Augmented Reality Software Development Kit (SDK) for mobile devices that enables the creation of Augmented Reality applications

UNITY:

Unity is a cross-platform game engine developed by Unity Technologies and used to develop video games for PC, consoles, mobile devices and websites. First announced only for OS X, at Apple's Worldwide Developers Conference in 2005, it has since been extended to target 27 platforms. Nintendo provides free licenses of Unity 5 to all licensed Nintendo Developers along with their software development kits (SDKs) for the Wii U and Nintendo 3DS Family. Five major versions of Unity have been released. At the 2006 WWDC show, Apple named Unity as the runner up for its Best Use of Mac OS X Graphics category.

OVERVIEW:

With an emphasis on portability, the engine targets the following APIs: Direct3D and Vulkan on Windows and Xbox 360; OpenGL on Mac, Linux, and Windows; OpenGL ES on Android and iOS; and proprietary APIs on video game consoles. Unity allows specification of texture compression and resolution settings for each platform that the game engine supports, and provides support for bump mapping, reflection mapping, parallax mapping, screen space ambient occlusion (SSAO), dynamic shadows using shadow maps, render-to-texture and full-screen post-processing effects. Unity's graphics engine's platform diversity can provide a shader with multiple variants and a declarative fallback specification, allowing Unity to detect the best variant for the current video hardware and, if none are

compatible, to fall back to an alternative shader that may sacrifice features for performance.

Unity is notable for its ability to target games to multiple platforms. Within a project, developers have control over delivery to mobile devices, web browsers, desktops, and consoles. Supported platforms include Android, Apple TV, BlackBerry 10, iOS, Linux, Nintendo 3DS line, macOS, PlayStation 4, PlayStation Vita, Unity Web Player (including Facebook), Wii, Wii U, Nintendo Switch, Windows Phone 8, Windows, Xbox 360, and Xbox One. It includes an asset server and Nvidia's PhysX physics engine. Unity Web Player is a browser plugin that is supported in Windows and OS X only,[19] which has been deprecated in favor of WebGL. Unity is the default software development kit (SDK) for Nintendo's Wii U video game console platform, with a free copy included by Nintendo with each Wii U developer license. Unity Technologies calls this bundling of a third-party SDK an "industry first".

VUFORIA:

Vuforia is an Augmented Reality Software Development Kit (SDK) for mobile devices that enables the creation of Augmented Reality applications. It uses Computer Vision technology to recognize and track planar images (Image Targets) and simple 3D objects, such as boxes, in real-time. Load Data Set automatically loads the associated dataset from Streaming Assets / QCAR when the app initializes. Activate automatically activates the dataset after it is loaded. If you don't load and activate datasets through the Editor, you'll need to do so using the Vuforia API, See: How To Load and Activate Multiple Device Databases at Runtime

Vuforia Configuration

Camera Device Mode Setting enabled us to prioritize render quality vs frame rate for your app. Selecting MODE_DEFAULT will typically prioritize rendering except on devices with lower performance characteristics. Max Simultaneous Tracked Objects defines how many targets can be tracked within the camera view at the same time. Object Recognition supports a maximum MSTO value of 2. Delayed Loading Object Data Sets enables object datasets to be partially loaded to conserve memory when several object targets are in the dataset. This option should will delay detection but reduce memory requirements. World Center Mode defines which object in the scene will serve as the origin (0,0,0) of the scene's world space. When SPECIFIC_TARGET is chosen the World Center field is presented, enabling you to select which target is used as the scene origin.

Dataset Load and Activate

Load Data Set automatically loads the associated dataset from Streaming Assets / QCAR when the app initializes.Activate automatically activates the dataset after it is loaded. If you don't load and activate datasets through the Editor, you'll need to do so using the Vuforia API, See: How To Load and Activate Multiple Device Databases at Runtime

ObjectTarget

The ObjectTarget prefab encapsulates the Object Target Behaviour and Default TrackableEventHandler.

Object Target Behaviour

1.Data Set defines the dataset to use for this target instance.

2.Object Target defines which target from the dataset to use

3.Length dimension value for the Bounding Box

4.Width dimension value for the Bounding Box

5.Height dimension value for the Bounding Box

Object Recognition supports a maximum MSTO value of   Delayed Loading Object Data Sets enables object datasets to be partially loaded to conserve memory when several object targets are in the dataset. This option should will delay detection but reduce memory requirements. World Center Mode defines which object in the scene will serve as the origin of the scene's world space. When is chosen the World Center field is presented, enabling you to select which target is used as the scene origin.

CHAPTER-IV

EXISTING SYSTEM

We provide an overview of the common definitions of AR, and show how AR fits into taxonomies of other related technologies. A history of important milestones in Augmented Reality is followed by sections on the key enabling technologies of tracking, display and input devices. We also review design guidelines and provide some examples of successful AR applications. Finally, we conclude with a summary of directions for future work and a review of some of the areas that are currently being researched. A Survey of Augmented Reality is an invaluable resource for researchers and practitioners. It provides an ideal starting point for those who want an overview of the technology and to undertake research and development in the field.

The elementary-school mathematics classroom is an ideal place for augmented reality, as children are moving from playing with physical toys, to understanding abstract numerical concepts. The capabilities of AR technology of overlaying digital information on physical objects, allows for the creation of games that bridge physical and abstract content, potentially allowing students to learn difficult math topics more easily and in a more engaging manner than using traditional approaches. Existing research projects have investigated educational AR applications for mathematics. However, more research is needed to understand which specific curriculum topics are 'valuable' to address using augmented reality applications.The proposed system provides observation of a magnetic field distribution and its stereoscopic vision in 3D space using head mounted display.

4.1 Leihoa: A window to augmented reality in early childhood education International:

Hyperlink to the physical world: it links the physical and the real world. Barcodes or QR that link an object with virtual information. Marker based AR: Involves image recognition with a custom marker. The 2D markers are provided beforehand and they are recognized in real time. Marker-less AR application: At this level no marker is required compass, sensors and GPS provide the data required to present the enriched information.

To introduce the tablet and augmented reality in the classroom To promote AR activities in the classrooms to introduce the visualization of virtual images in the real world by means of motivating activities. To integrate the tablet in the classroom with activities that contextualize the use of the electronic 3D model [1].

Image recognition is an imperative component of augmented reality systems. By use of identifying visual markers already embedded within the system, physical world objects are detected for superimposition of virtual elements. In order for an AR application to estimate the orientation and position of a camera with respect to the real world frame, most applications employ a tracking technique known as marker based augmented reality. This form of tracking was introduced in AR approximately a decade or so ago. The marker tracking allows the use of a digital image to identify optical squares or markers and gauge their relative orientation to the camera itself. The optical square marker usually consists of a black square within a white box of a predefined size. It is the black square which is encoded with the ID of the marker. A variety of techniques is used which decode the marker by cross-matching with it.

4.2 Enhanced interactive learning using augmented reality:

Augmented reality can be used to teach students, the concepts which are imaginary and are difficult to understand. This study shows that using AR for educational purposes can affect students at a deeper level by promoting both engagement and motivation. Due to innovations in the mobile technology, it is now possible to Integrate AR technology in mobiles. The augmented learning books with 3D models, pictures and voiceovers provide a compelling learning experience. These augmented books are highly interactive, such books can provide a more visually understandable view of complex concepts as students can simply rotate the marker to see different views.[2]

There are mainly two types of AR: Marker-less and Marker- based. Marker less AR is further divided into Markerless vision based and Marker-less GPS based. Marker-less vision based augmentation is used in real time applications. The augmented content is placed after image based recognition and analysis. The offside marking technology in football is one of the prominent implementations of this technique [2]. Markerless GPS based AR uses the Global Positioning System (GPS) or digital compass feature of mobile devices to locate and interact with surroundings. The information gathered is then superimposed on the camera view of the mobile device providing enhanced view of the environment to the user. Marker-based AR relies on a marker which is usually a Quick Response (QR) code. Recently, technology to deal with pictures has also been developed [2]. The device camera I used to gather information about the QR code or the picture which is then analyzed and the model or information related to it is displayed.

4.3 Discovering Educational Augmented Reality Math Applications by Prototyping with Elementary-School Teachers:

The elementary-school mathematics classroom is an ideal place for augmented reality, as children are moving from playing with physical toys, to understanding abstract numerical concepts. The capabilities of AR technology of overlaying digital information on physical objects, allows for the creation of games that bridge physical and abstract content, potentially allowing students to learn difficult math topics more easily and in a more engaging manner than using traditional approaches. Existing research projects have investigated educational AR applications for mathematics. However, more research is needed to understand which specific curriculum topics are 'valuable' to address using augmented reality applications[3].

Specifically, in the present work we aim to identify which mathematics curriculum topics are causing difficulties for elementary-school teachers, and to identify which of these topics should be addressed through future augmented reality applications. Through the prototyping activity we have explored only a few possibilities for addressing the curriculum topics identified as difficult to teach in the elementary-school math classroom[3]. It may be possible to create other applications that target the same topics, and it may be possible to create applications that are effective at targeting the topics we have marked as unsuitable for AR. We hope that future research continues to investigate the suitability of AR games for addressing elementary-school classroom topics.

The needs assessment study generated a list of math topics that serve as valuable starting points for future educational tools. It shows the list of mathematics topics rated as difficult to teach in Grades 1 to 3 classrooms, and the degree to which teachers and researchers determined AR to be a possible solution.

4.4 computer aided education system based on augmented reality by immersion to 3-D magnetic field:

An immersive real-time visualization system of 3D magnetic field for educational purposes is presented. This immersive visualization system is based on augmented reality technology. To improve the visualization capabilities, a new real-time method for drawing magnetic flux lines in 3D space is developed and presented in this paper.

The proposed system provides observation of a magnetic field distribution and its stereoscopic vision in 3D space using head mounted display. It enables a user to easily observe and grasp a magnetic field generated by multiple sources in an augmented 3D space[4].

In this paper an immersive real-time visualization system of 3D magnetic fields utilizing augmented reality technology suitable for educational purposes is presented. By utilizing the proposed visualization method, one can easily observe and perceive in real-time the magnetic field distribution generated by multiple sources or by single source and other magnetic or nonmagnetic object in an augmented 3D space. Additionally, the user can move sources or objects interactively and observe the magnetic field distribution changes in real-time, providing intuitively observation, analysis and understandings of the physical phenomena of the magnetic field in 3D space. Through the prototyping activity we have explored only a few possibilities for addressing the curriculum topics identified as difficult to teach in the elementary-school math classroom. It may be possible to create other applications that target the same topics, and it may be possible to create applications that are effective at targeting the topics we have marked as unsuitable for AR. We hope that future research continues to investigate the suitability of AR games for addressing elementary-school classroom topics[4].

4.5 Application of Low-Cost 3D Scanning Technologies to the Development of Educational Augmented Reality Content:

In educational environments, AR has been used successfully in many disciplines such as engineering design graphics, architecture, medicine , and repair and manufacturing training [5]. In addition, AR technology has been consistently listed by the Horizon Report as a tool that will be widespread in both K-12 and higher education in the near future. The potential of AR for learning and assessment allows students to build new knowledge based on interactions with virtual models that bring the underlying data to life. In terms of practical implementations, however, many problems exist beyond merely cost and technical considerations that prevent AR technology from fully and effectively entering educational arenas. For example, many existing educational AR applications provide predefined content with limited or no customization options. Therefore, it is difficult for instructors to create their own materials. Authors Kerawalla et al[5] reported that teachers value the potential of AR technology as an educational resource, but demand more control of the assets, so they can adapt them to the specific needs of their students.

The development of high quality 3D content is a fundamental component of the augmented reality experience. 3D computer modeling refers to the process of developing a three dimensional representation of an object in the computer. Requirements and strategies for 3D modeling depend on many factors such as the level of detail, reliability, accuracy, costs, and operational aspects, among others [5]. While 3D modeling software packages allow full control of the geometry during the modeling process and provide powerful tools to build highly realistic, accurate, and sophisticated shapes, they typically require a high level of proficiency, training, and skill, which beginners typically do not possess [5].

4.6 **Augmented Reality and Holograms for the Visualization of Mechanical Engineering parts**

This section presents an example of using augmented reality to create an overlay with a 3D model that is used by the teacher to help students improve learning of orthographic views. Students of Mechanical Engineering learn the basic concepts and techniques of technical drawing as a language definition and transmission characteristics of systems and industrial products, with gradual introduction of the use of computer aided design (CAD) systems. However, when students start learning technical drawing, in the first year of their studies, they commonly have many difficulties in understanding and drawing the shape of objects from two dimensional representations[6]. The same is also true when they have a representation of the 3D model of a mechanical part and they need to draw the front, left and top views. Wu and Chiang [9] show that applying animations provided more enthusiasm for the learning activity, better performance in understanding the appearances and features of objects and improve the spatial visualisation capabilities. We decided to use augmented reality tools to help students visualize the 3D models for better understanding of their shapes. For this purpose, the first thing the teacher needs is a 3D modelling tool. At our faculty, most teachers use AutoCAD which is free for education. With AutoCAD, teachers can create 3D models that are stored as dwg files. If the teacher wants, it is also possible to add textures to the model and make it look like a real object made of wood, for example. In this way, it was easy to create the 3D model that is represented in an isometric view (see Figures 2 and 3) and the corresponding front and top orthographic views (Figures 4 and 5, respectively) that are given as an exercise to students. To help students visualize and understand this 3D model, we used augment reality to render the 3D model in a mobile device triggered by a QR code, an image trigger or a url link[6].

4.7 Data Compression for Photo-Based Augmented Reality on a Tablet

Marker-type augmented reality (AR) is a technique that superimposes computer graphics (CG) of a virtual object on an image shot with a camera as if the virtual object were present in reality. AR has been applied in a number of fields, including entertainment, medicine, manufacturing, repair, and training. Recently, AR applications are used on tablets or smartphones which spread rapidly. A typical AR system requires prior preparation of a three-dimensional (3D) model by modeling software. This preparation needs enormous amount of time or modeling techniques. In our previous work, we proposed a photo-based augmented reality (Photo AR) system that renders multi-viewpoint photo images onto a camera view without a 3D model, thus providing realistic images [7]. Although this system eliminates the preparation of 3D models, it consumes a large volume of disk space because a large number of PNG images with transparent data (alpha channel information) are required. To resolve this problem, we have proposed data compression methods by using JPEG and video format [7]. Especially, it was verified that the method using video format has achieved high compression rate, because multi-viewpoint photo images of an object from adjacent angles are similar. However, this method is impractical due to security restriction on a tablet device as mentioned later in Sect. II Therefore, to implement a Photo AR system on a tablet, we consider a image compression method that decimates pixels in multi-viewpoint photo images and interpolates them. We also evaluate quality of the images and rendering time for the proposed method because image compression degrades them. We consider a data compression method not to use video files. In general, a method based on the "Ray-space" theory.

CHAPTER-V
PROPOSED SYSTEM

This project involves three modules based on the types of augmented reality dimensions in which we created our idea towards educational application. The three modules are as follows:

1. Marker based Augmented reality

2. Markerless Augmented reality

3.Marker based Augmented reality for electromagnetic field lines of force.

5.1 MARKER BASED AUGMENTED REALITY:

Image recognition is an imperative component of augmented reality systems. By use of identifying visual markers already embedded within the system, physical world objects are detected for superimposition of virtual elements. In order for an AR application to estimate the orientation and position of a camera with respect to the real world frame, most applications employ a tracking technique known as marker based augmented reality. This form of tracking was introduced in AR approximately a decade or so ago. The marker tracking allows the use of a digital image to identify optical squares or markers and gauge their relative orientation to the camera itself. The optical square marker usually consists of a black square within a white box of a predefined size. It is the black square which is encoded with the ID of the marker. A variety of techniques is used which decode the marker by cross-matching with it. Once you begin using the marker-based augmented reality system with a digital device, the image of the physical world captured by your camera is converted into a grayscale image to expedite the image processing

algorithm. The algorithm then uses the image of the camera as well as the decoded marker ID to augment the virtual object onto the physical world model. By focusing the camera of whichever digital device you are using to deploy the augmented reality app on the specified markers, the app is able to retrieve the information stored to display the three-dimensional virtual object accurately[1].

5.1.1 MARKER BASED AR PROJECT:

STEP 1:

The corresponding image represents the front end of our application that we developed for this project. It consists of some selection buttons and by section of those buttons appropriate action takes place.

fig.no 1.1 Application front end

STEP 2:

a machine-readable code consisting of an array of black and white squares, typically used for storing URLs or other information for reading by the camera on a smartphone. We need a marker of any form as image target. The image target can be either a QR code, object or any image. Every QR code is unique so for every project module respective QR code is generated and assigned to particular model[2].

fig.no 1.2 QR code

STEP 3:

For the image target shown above, the developed 3D model is assigned along with the detailed description of that particular model for educational purposes. The required output of the target image is shown with a 3D model and along with the model description.
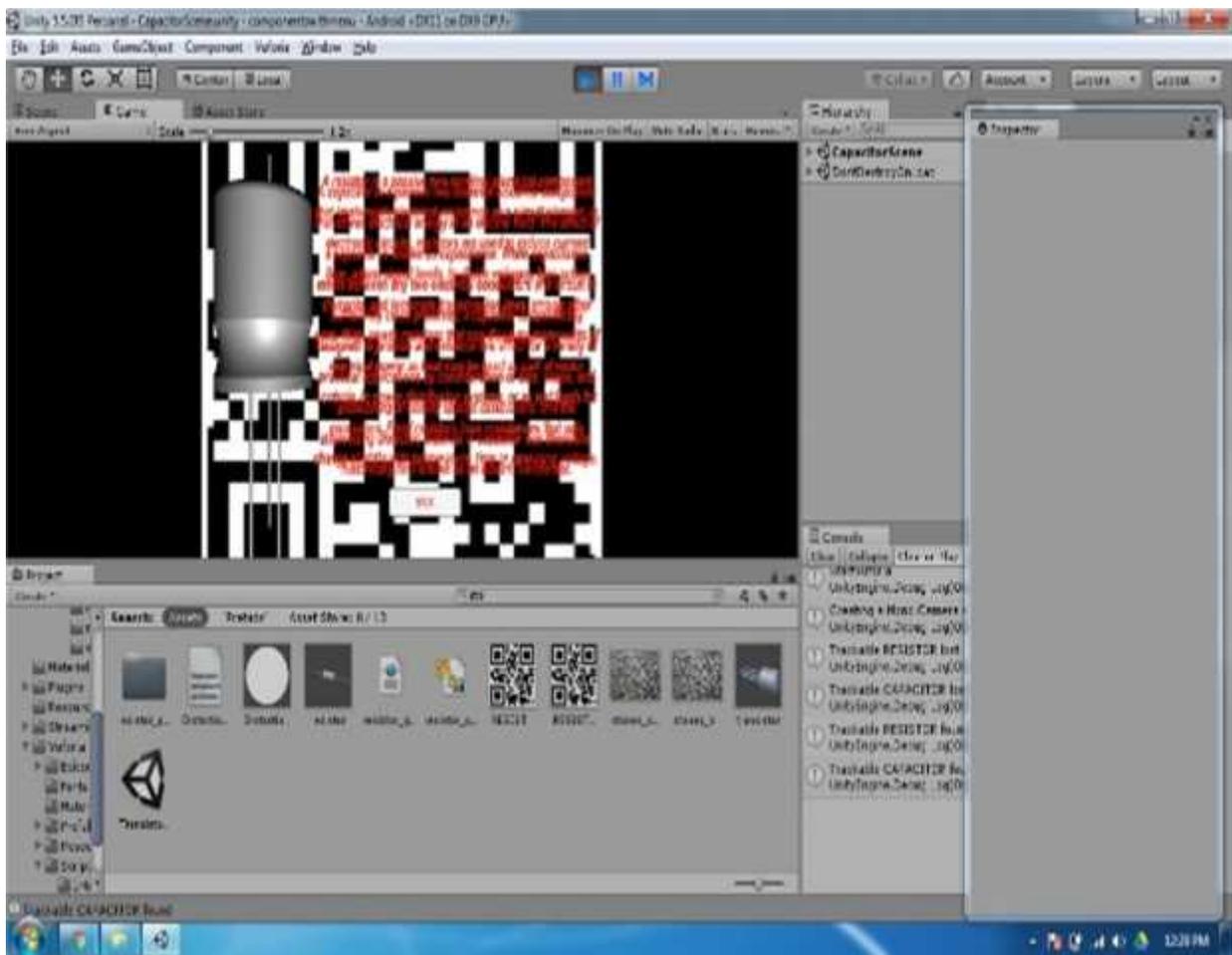
fig.no 1.3 Final output

5.2 MARKERLESS AUGMENTED REALITY:

New advances in the mobile hardware and software technologies led to the recent introduction of markerless augmented reality. This approach eliminated the need for 3D object tracking systems, overcoming the interactivity limitations marker-based augmented reality placed on the range of images encapsulated within the markers. Markerless augmented reality technique allows the use of any and all parts of the physical environment as the target or base for the placement of superimposed virtual objects. Markerless AR depends on the natural features of a surrounding rather than the fiducial identifying markers. What's more, some markerless systems have the ability to extract and store information and characteristics about the environments they are used on for later usage. When used in smartphones and other digital devices, the markerless AR system typically makes use of the GPS feature in-built in the device in order to locate and interact with the available augmented reality resources.

Completely non-invasive, lighter and with a larger capacity for images, the markerless augmented reality system is now much preferred method of image recognition as compared to the marker-based counterpart. Layers are REST web services serving geo-located points of interest in the vicinity of the user. Layers are developed and maintained by third parties using a free API; Layar as a company is responsible for their validation in the publication process. An up and coming platform which uses the camera vision to detect and scan the surrounding environment in real-time and create a virtual one to superimpose it without the utilization of any external signals or GPS

Some of the most common examples of augmented reality programs which use markerless interaction includes:

Layar:

An application famous for being one of the most complex markerless augmented reality systems available in the market at the moment. This app, available for download for both iPhones and Android devices, allows the user to create augmented materials such as postcards, or flyers and can even include social media links and video messages. Data in the browser comes in the form of layers. Layers are REST web services serving geo-located points of interest in the vicinity of the user. Layers are developed and maintained by third parties using a free API; Layar as a company is responsible for their validation in the publication process. Third-party projects which utilize Layar can be programs which require QR tags, or locative games, such as fAR-Play.

Google's Tango:

An up and coming platform which uses the camera vision to detect and scan the surrounding environment in real-time and create a virtual one to superimpose it without the utilization of any external signals or GPS. Tango (formerly named Project Tango, while in-testing) is an augmented reality computing platform, developed and authored by Google. It uses computer vision to enable mobile devices, such as smartphones and tablets, to detect their position relative to the world around them without using GPS or other external signals[20].

5.2.1 MARKERLESS AR PROJECT:

STEP 1:

The corresponding image is the front end of the application that we created for this project. In which there are options to select and after selecting the suitable option, the assigned process takes place. Totally there are two options as marker based and markerless by selecting marker less option, automatically the 3 D model along with several alignment options is visible as output in this case.
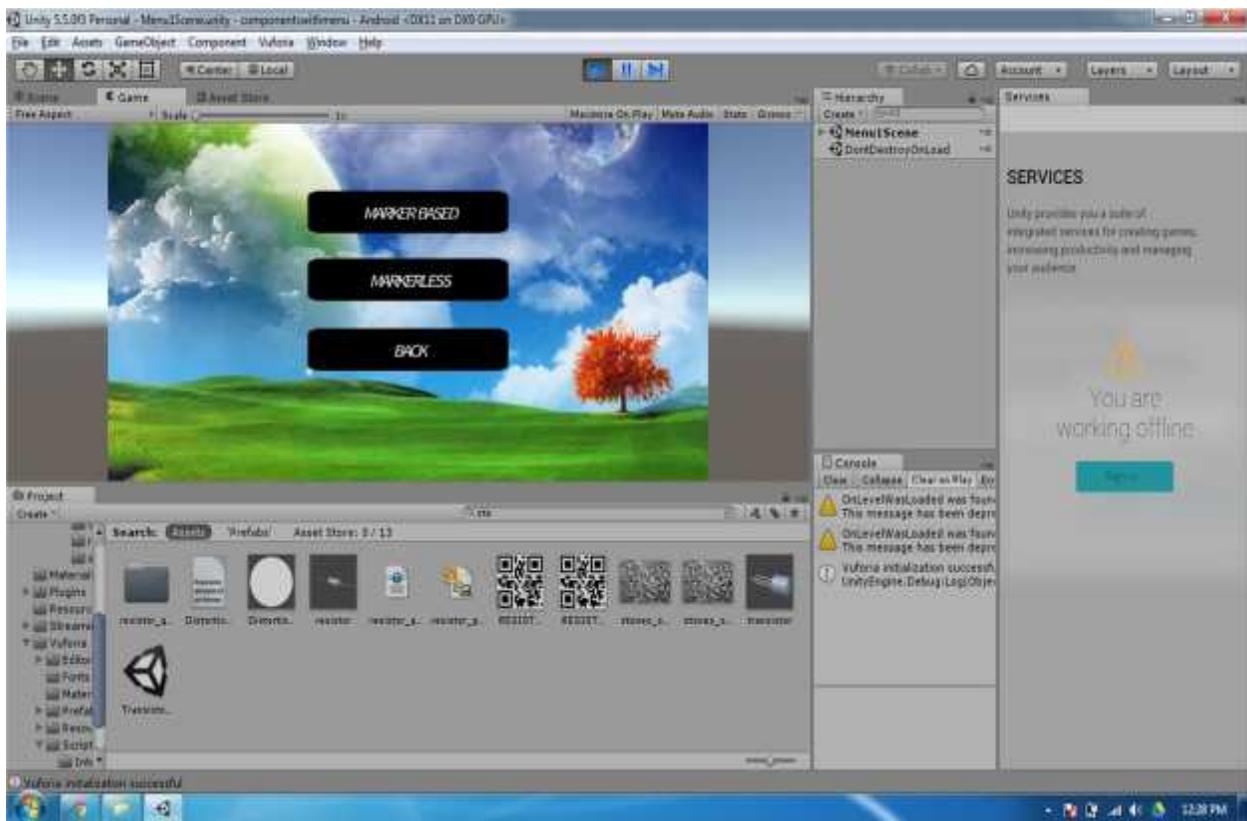

fig 1.4 App front end

STEP 2:

If the markerless category is selected. The user is taken to next page of options where the list of components are specified. By selecting any of the component from the list, the component can be viewed without showing any target image. Along with several options that involves the alignment functions for the visible 3D model.
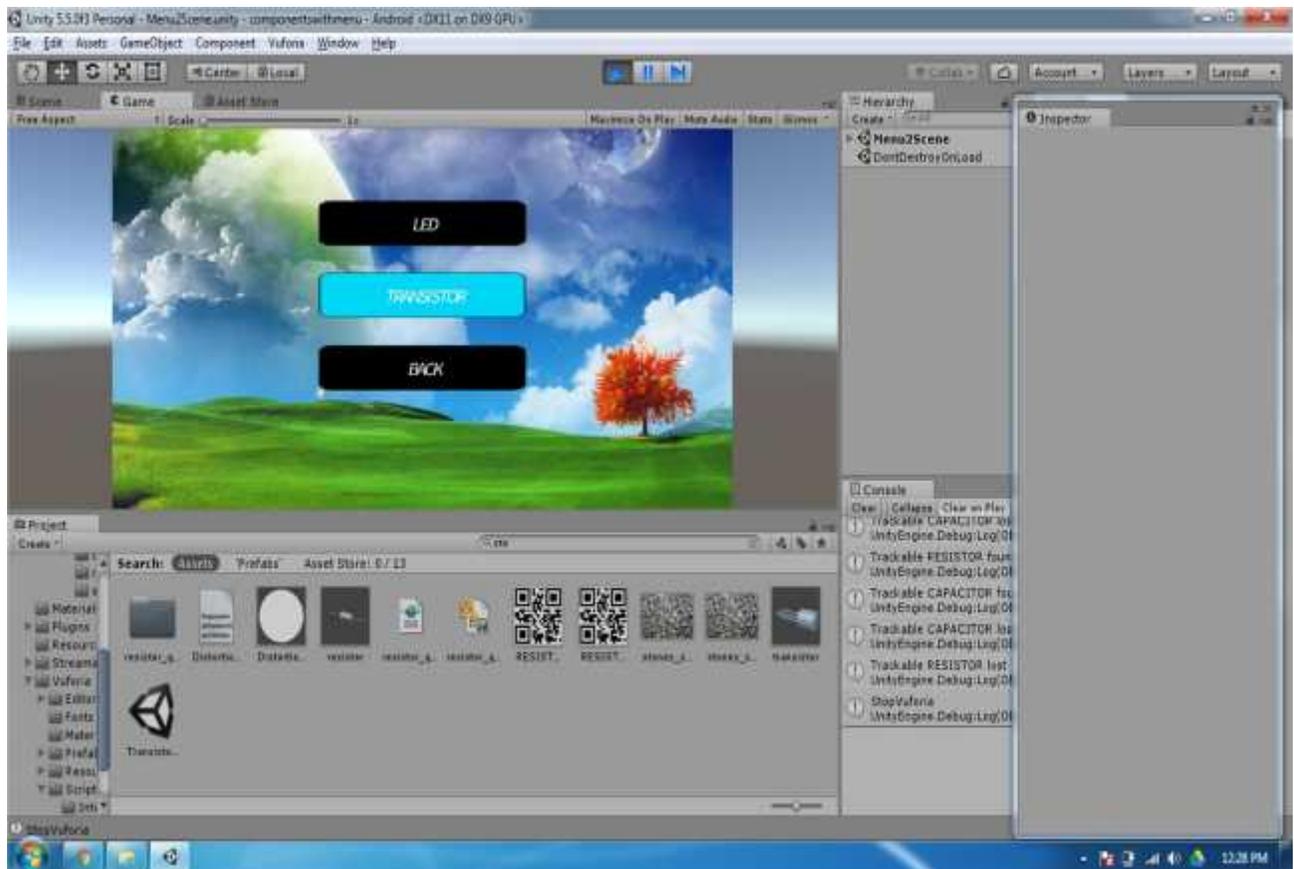

fig.no 1.5 Second page front end

STEP 3:

In the above shown page we have described two components namely LED and transistor. If the user selects the LED option then the corresponding model with various options following that 3D model is shown.
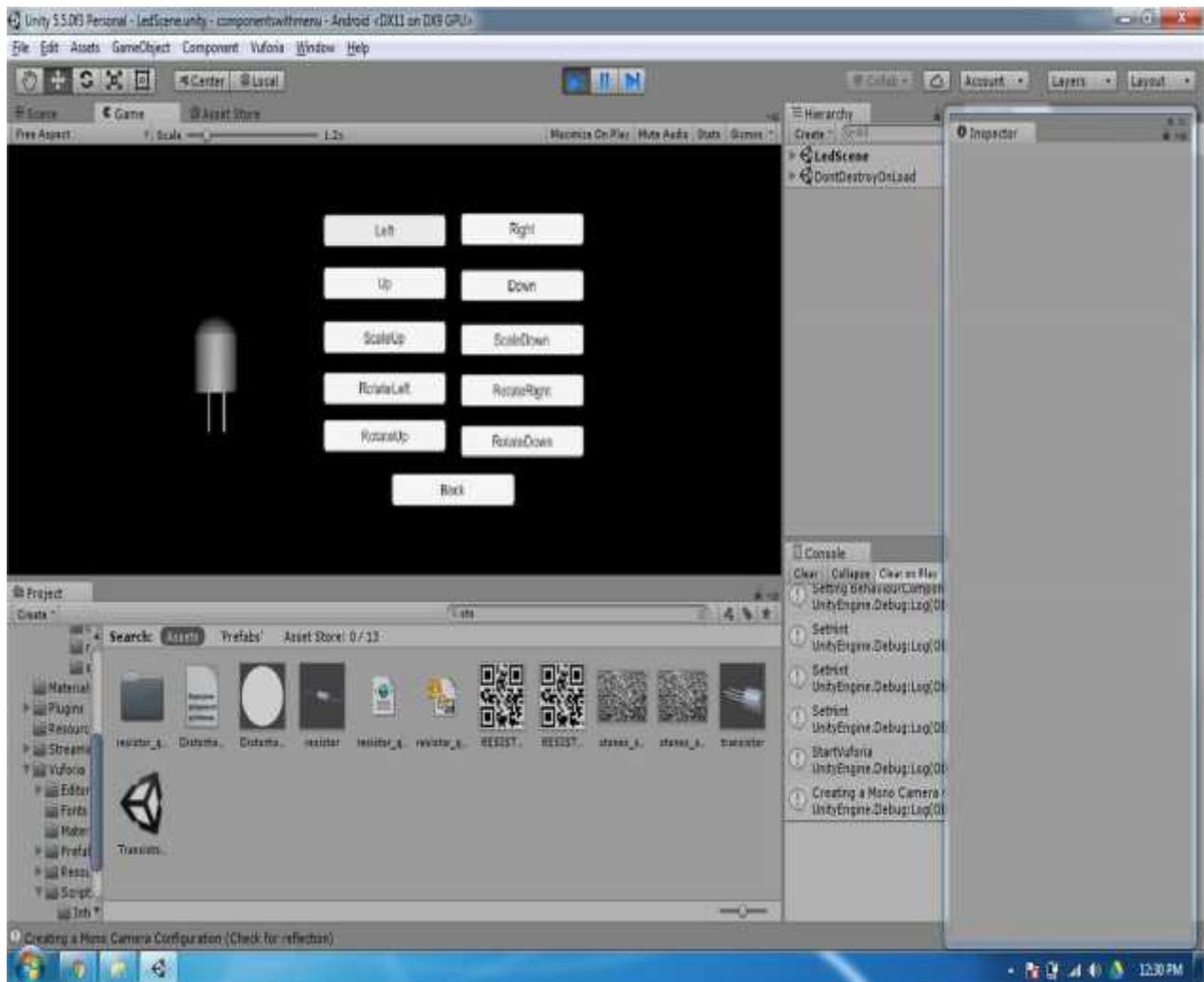
fig.no 1.6 Output for LED

STEP 4:

Image shown in step 2, has the descrptionof two components namely LED and transistor. If the user selects transistor option then the corresponding model with various options following that 3D model is shown.
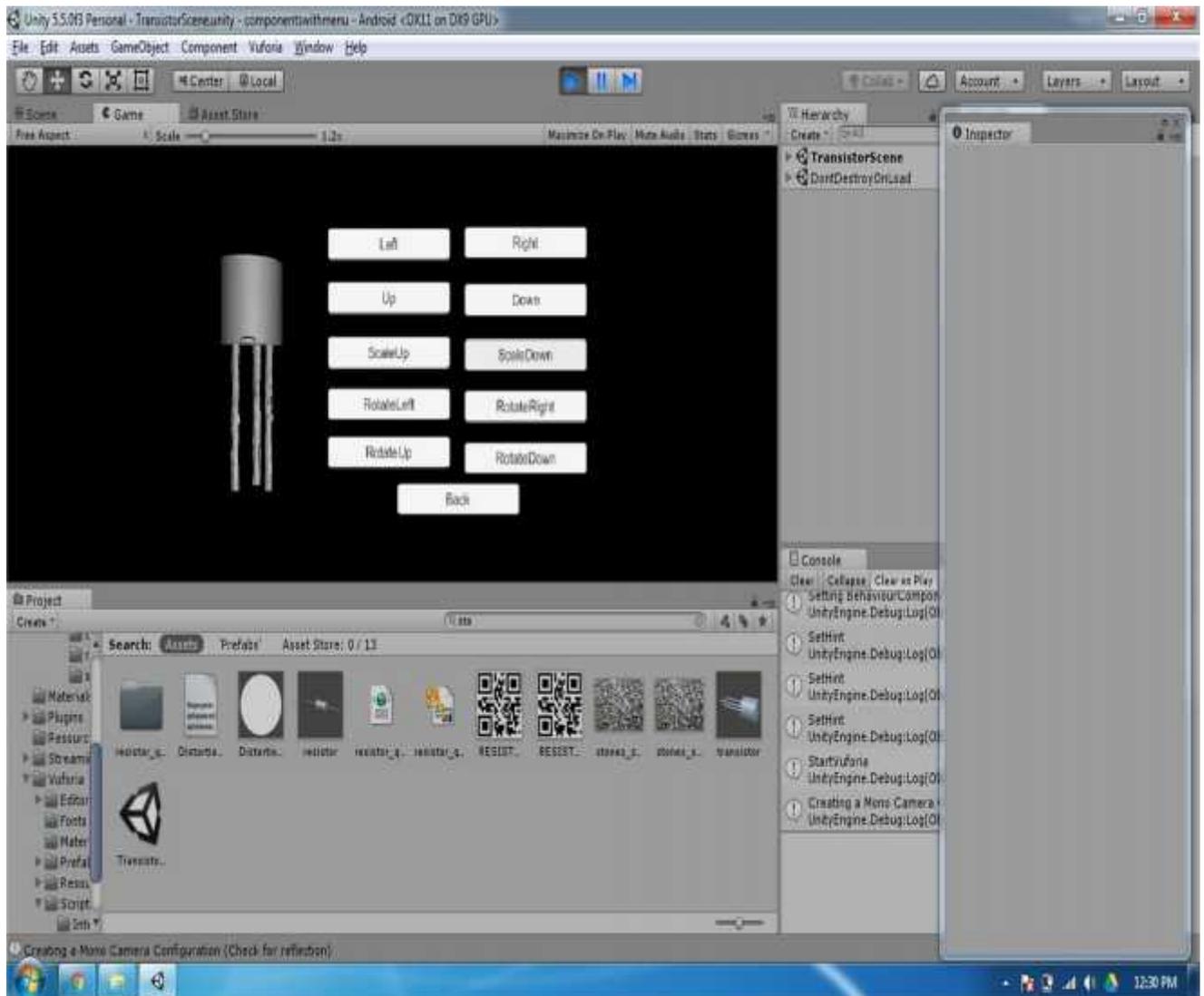

fig.no 1.7 Output for transistor

5.3 Marker based Augmented reality for electromagnetic field lines of force:

An immersive real-time visualization system of 3D magnetic field for educational purposes is presented. This immersive visualization system is based on augmented reality technology. To improve the visualization capabilities, a new real-time method for drawing magnetic flux lines in 3D space is developed and presented in this paper.

The proposed system provides observation of a magnetic field distribution and its stereoscopic vision in 3D space using head mounted display. It enables a user to easily observe and grasp a magnetic field generated by multiple sources in an augmented 3D space.

In educational environments, AR has been used successfully in many disciplines such as engineering design graphics [4-7], architecture [4], medicine [6,7], and repair and manufacturing training [5]. In addition, AR technology has been consistently listed by the Horizon Report [7] as a tool that will be widespread in both K-12 and higher education in the near future. The potential of AR for learning and assessment allows students to build new knowledge based on interactions with virtual models that bring the underlying data to life [7]. In terms of practical implementations, however, many problems exist beyond merely cost and technical considerations that prevent AR technology from fully and effectively entering educational arenas. . To improve the visualization capabilities, a new real-time method for drawing magnetic flux lines in 3D space is developed and presented in this paper. The proposed system provides observation of a magnetic field distribution and its stereoscopic vision in 3D space using head mounted display.

5.3.1 MARKER BASED AR FOR EMF LINES OF FORCE:

FRONT END OF THE APPLICATION:

In this method we show the detail visualization of electromagnetic field lines of force. We have created a separate application for this module. The front end of this application is shown below. In which the project execution is based on marker target image and individual marker is assigned for every model. And multi target execution is also processed in this module[3].

fig.no 1.8 Application front end

EMF OF SINGLE MAGNET:

Initially we are going to visualize a single magnet 3D model which appears by showing the correspond QR code(target image) and along with its lines of force direction(these magnetic lines are created using animation option in the unity software). The animation magnetic lines of force is executed using the unity animation options which is inbuilt in the unity software[3].
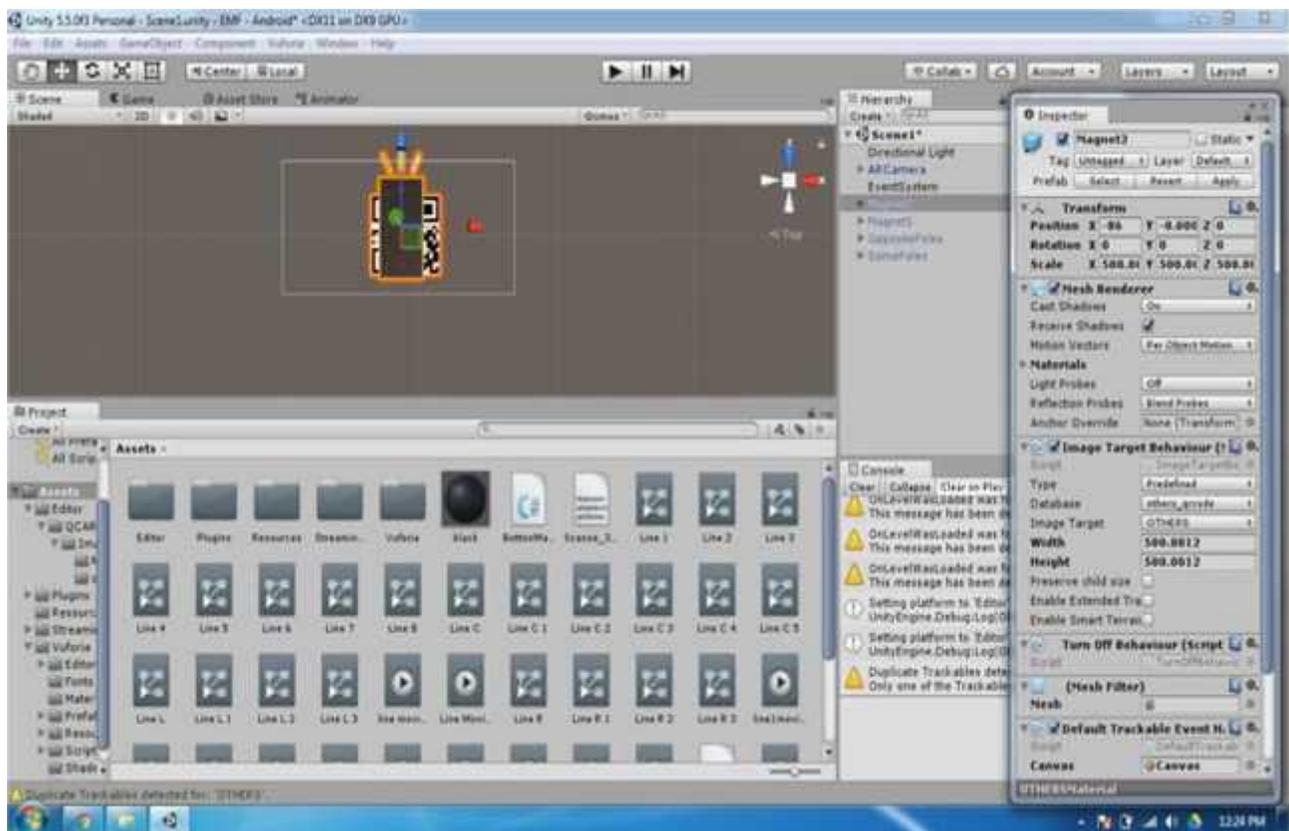

fig.no 1.9 EMF of single magnet

EMF OF TWO MAGNETS(SAME POLES):

The next idea is to show the viewer about the functionality of two magnets magnetic lines of force such as the action of same poles and opposite poles of two magnet. In this step, the action of magnetic lines of force is shown if the poles are in same direction. The appropriate QR code (image target) must be shown to the camera for which the corresponding model assigned to that QR code is visible to the user. In this module the multi target execution is visualized by the user which explains[4].
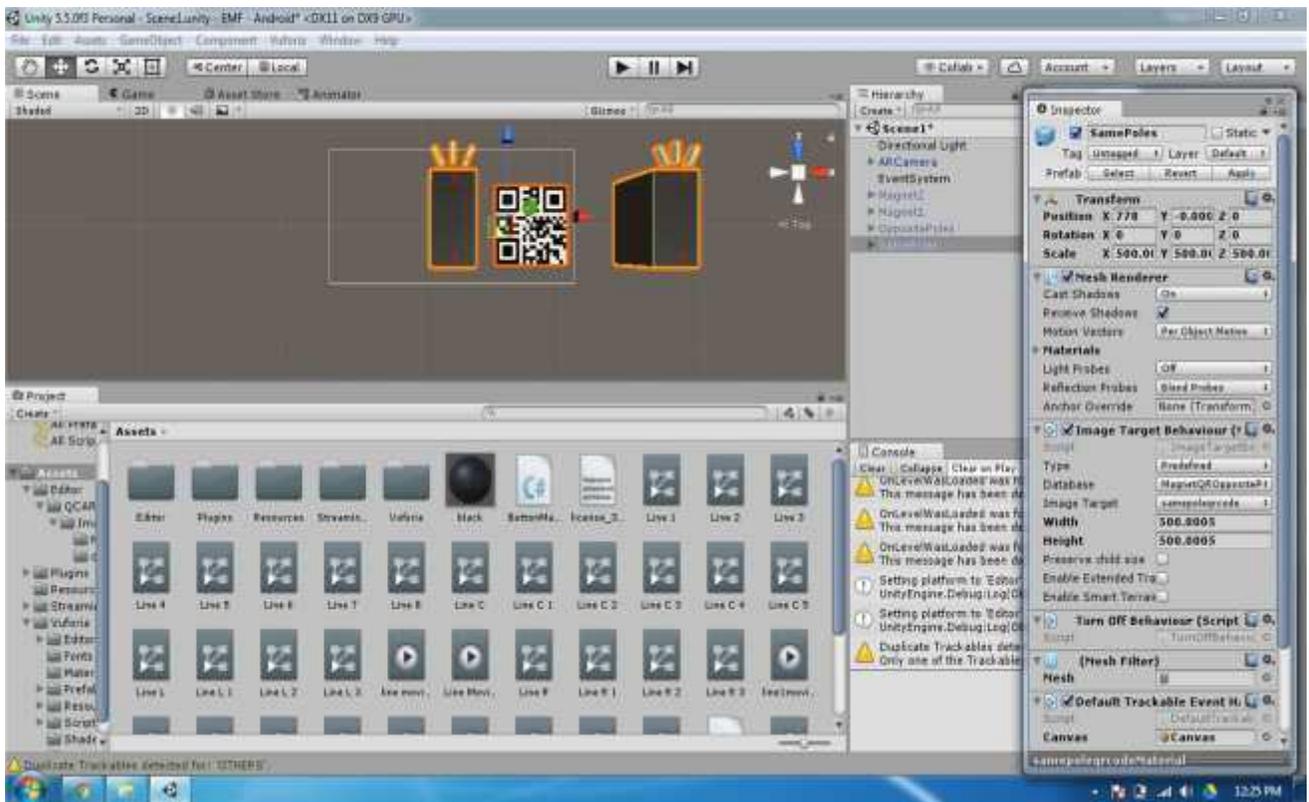

fig.no 2.0 EMF of two magnets (same poles)

EMF OF TWO MAGNETS (OPPOSITE POLES):

The another idea is to show the viewer about the functionality of two magnets magnetic lines of force such as the action of same poles and opposite poles of two magnet. In this step, the action of magnetic lines of force is shown if the poles are in opposite direction. The appropriate QR code (image target) must be shown to the camera for which the corresponding model assigned to that QR code is visible to the user. In this module the multi target execution is visualized by the user which explains[3]
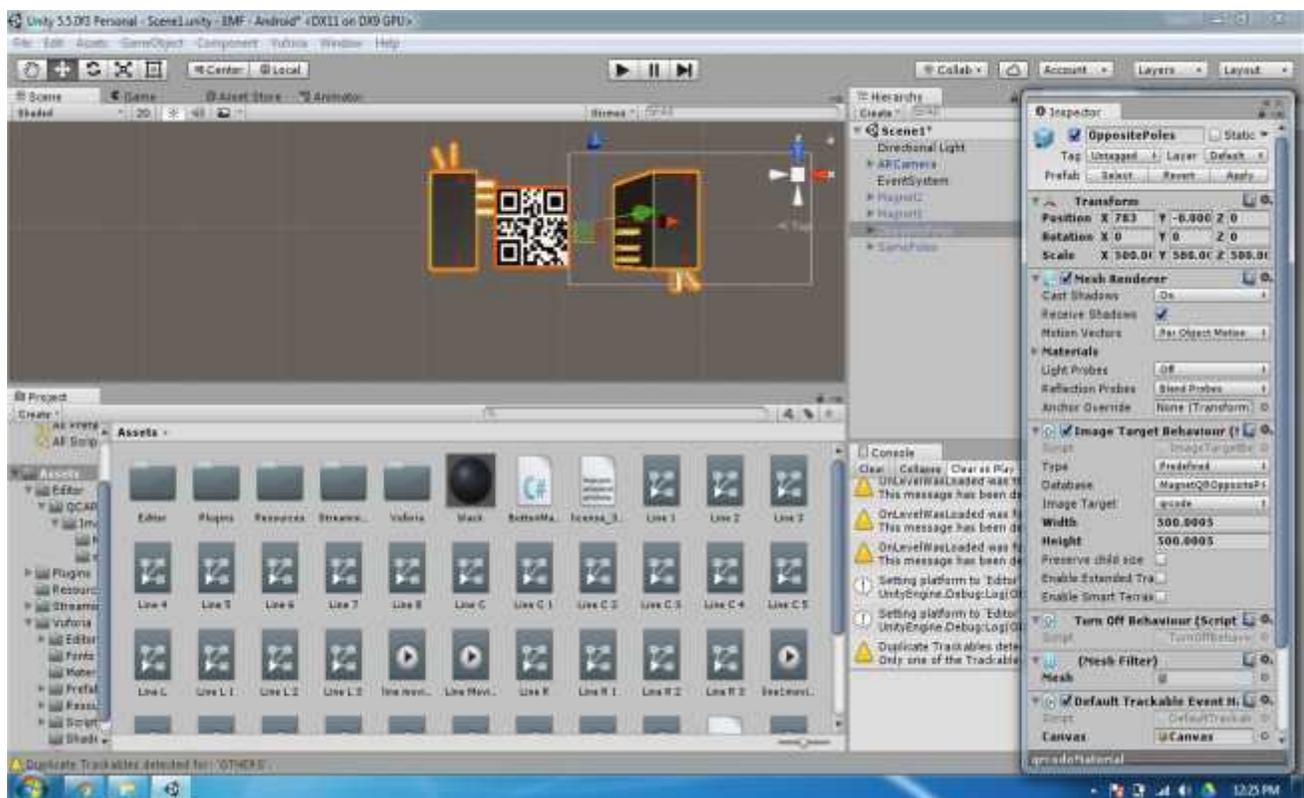

fig.no 2.1 EMF of two magnets (opposite poles)

FULL PROJECT VIEW:

In this step we are about see the output for multi target that is two target image is shown in front of the camera and the corresponding output will appear. The output of this module is the overall view of the marker based EMF project which involves every target image and along with the assigned models.
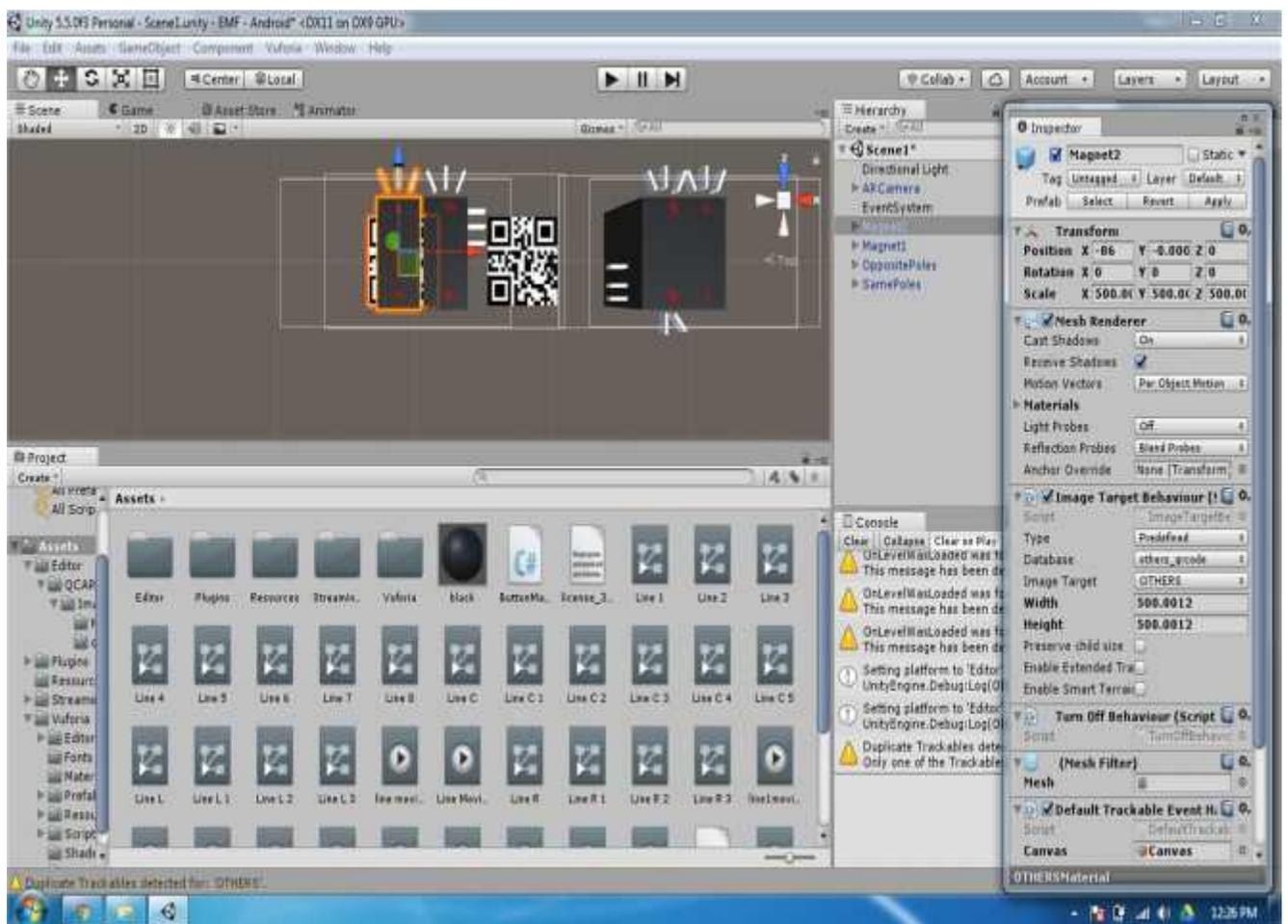

fig.no 2.2 Full view of project

CHAPTER-VI

CONCLUSION

This manuscript presents AR as a relevant technology for student education and introduces an AR based system designed to assist student to learning which initiates reading and introduces new experience. Some of the potential benefits are increased motivation and learning autonomy, given that this proposal enables the student to choose the learning contents by using markers on demand and conduct self-evaluations using the feedback provided by the application. Moreover, it might strengthen self-competence feeling as the student gets a confirmation feedback after each short activity. The learning system offers interactivity and uses visual, auditory and tactile stimuli and provides attractive opportunities for developing attention while learning new concepts. The student initiates observation and anticipation when he foresees the results of pointing at the markers and contrasts his own hypotheses with the results. Furthermore, it encourages exploration by means of the creative possibilities of learning and the object-attribute matching activities that result in a tridimensional model depicting the choice that the student wants to explore. Another potential benefit of this way of learning is that no negative feedback is provided to guide the child and that it leads to an error acceptance attitude. The system incorporates no instructions, no textual elements nor multiple active elements and it has been carefully designed to reach the required high standard of usability. In this paper an immersive real-time visualization system of 3D magnetic fields utilizing augmented reality technology suitable for educational purposes is presented. By utilizing the proposed visualization method, one can easily observe and perceive in real-time the magnetic field distribution generated by multiple sources or by single source and other magnetic or nonmagnetic object in an augmented 3D space.

CHAPTER-VII

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