AUGMENTED REALITY BASED LEARNING APPLICATION FOR CHILDREN WITH AUTISM

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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DECLARATION

We, hereby jointly declare that the project work entitled **"AUGMENTED REALITY BASED LEARNING APPLICATION FOR CHILDREN WITH AUTISM"** submitted to the Anna University Project Viva voce-April 2019 in partial fulfillment for the award of the degree of **"BACHELOR OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING"**, is the report of the original project work done by us under the guidance of **Mr.D.MAGESH, M.E.,** Assistant Professor, Department of Computer Science and Engineering, Hindusthan College of Engineering and Technology, Coimbatore.

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ABSTRACT

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People can learn through seeing (visually), hearing (auditory), and/or through touching or manipulating an object (kinesthetically or 'hands-on' learning). For example, looking at a picture book or reading a textbook involves learning through vision; listening to a lecture live or on tape involves learning through hearing. Modern technologies deliver great educational tools to help physically challenged people to learn and teach, like Braille Reader and audio books for blind people. But in the case of children affected with autism there are limited support available because of the difficulty in creating learning tool for them. Some hyperactive autistic children do not know that speech is used for communication. Language learning can be facilitated if language exercises promote communication. If the child asks for a cup, then give him a cup. This process is tedious, costly and not safe to handle for autistic children but creating virtual objects is cheap and safe to handle. Hereby the developing application uses augment reality to interact with virtual object in real world so that children and even professionals can learn quickly and more interactively.

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ACRONYM	**ABBREVIATION**
AR	AUGMENTED REALITY
SDK	SOFTWARE DEVELOPMENT KIT
OBJ	WAVEFRONT OBJECT
APK	APPLICATION
CS / C#	C SHARP
IPK	IPHONE APPLICATION ARCHIVE
FBX	FILMBOX
API	APPLICATION PROGRAM INTERFACE

CHAPTER 1

INTRODUCTION

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INTRODUCTION

Augmented reality is a technology that works on a computer vision based recognition algorithms to augment sound, video, graphics, and other sensor based inputs on real world objects using the camera of your device. It is a good way to render real world information and present it in an interactive way so that virtual elements become part of the real world.

Augmented reality displays superimpose information in your field of view and can take you into a new a world where the real and virtual worlds are tightly coupled. It is not just limited to desktop or mobile devices. Google Glass a wearable computer with optical head-mounted display is a perfect example.

A simple augmented reality use case is: a user captures the image of a real world object, and the underlying platform detects a marker, which triggers it to add a virtual object on top of the real-world image and displays on your camera screen.

AR can be considered a technology between VR and telepresence. While in VR the environment is completely synthetic and in telepresence it is completely real, in AR the user sees the real world augmented with virtual objects.

When designing an AR system, three aspects must be in mind:

(1) Combination of real and virtual worlds;

(2) Interactivity in real time;

(3) Registration in 3D.

Wearable devices, like Head-Mounted Displays (HMD), could be used to show the augmented scene, but other technologies are also available. Besides the mentioned three aspects, another one could be incorporated Portability. In almost all virtual environment systems, the user is not allowed to go around much due to devices limitations. However, some AR applications will need that the user really walks through a large environment. Thus, portability becomes an important issue.

So, in this application we reduced the above limitations by using the AR technology and improved the quality of learning especially for children with autism. Modern technologies deliver great educational tools to help physically challenged humans to learn and teach like Braille Reader and audio books for blind people. Language learning can be facilitated if language exercises promote communication. For children with autism there are limited support available because of the difficulty in creating learning tool for them. Some hyperactive autistic children do not know that speech is used for communication.

1.1 OBJECTIVE

The main objective is to help the children to understand the concepts which are complex at their age level especially for children with autism. To provide the improvised learning which will be interactive and easier to understand how the concepts are really it is. This project is not only for children also helpful to higher level students like engineers and medical students. The range can be varied according to the framing of syllabus.

1.2 PROBLEM DESCRIPTION

Autistic individuals are not well equipped to navigate the ‘grey areas’ of thinking. Their intellectual style tends to be fixed and rigid: they ‘seek the truth’ which is often limited to finding the right answer, the exact meaning, and a clear cause or reason for everything. So, understanding the nuances of argument and weighing the merits of various reasons (as in a logic/philosophy course) is extremely challenging for this student.

It may help to use a visual diagram in which the premise, argument, and exemplars (reasons?) are delineated. This will give concrete structure to the concept. Some people on the Autism Spectrum have difficulty communicating their needs or desires, or what is going on in their lives, and may view their behaviour as a means of communication. Also, many people on the Autism Spectrum are very concrete in their thinking, and may have a harder time understanding when certain rules don’t need to be followed.

1.3 OVERVIEW OF THE PROJECT

The overview of the project is to overcome the problem of autism children and unavailability of study resources in the education field. A solution is proposed to learn in interactive way using AR technology. We improvised new technology of learning which is completely interactive.

CHAPTER 2

SYSTEM ANALYSIS

CHAPTER 2

SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

- Power Point Presentations
- Audio Books
- Video Tutorials
- VR Simulators
- 3D Models Demos
- Augment Reality for constructions and shopping

2.1.1 Disadvantages

The system, Multimedia Augmented Reality System for E-Learning, works by scanning a marker from a page and superimposing a virtual 3D image on the marker. The over dependence on markers make this system obsolete. The new system that will be developed will search for shapes drawn on the page and understand the shapes itself to superimpose a virtual image on the object drawn. The fineness in the edges of the marker depends upon the intensity of the marker light, if not properly lit the threshold process gives jagged edges and makes it difficult to distinguish between the contours. The system fails during occlusion, i.e., the covering of the marker by an external object. This system when made using OpenGL software takes a longer time to create as the objects have to be coded, the same thing can be done using blender that reduces the rendering time. As far the developed educational application on AR Technology having limited functionality and lacks versatility and level upgrades. Also, most of the applications requires a QR Booklet and pre-designed books to use AR on them. Lack of a well-structured syllabus to teach. In traditional approach, teacher used Power Point Presentations for displaying shapes and performing various operations on it. Due to this, students do not get to understand the shapes the way they want to. Their understanding is one - dimensional and is restricted to whatever the teacher will display on the projector screen. The students don’t get any practical experience of performing operations.

Sometimes teachers use physical samples of cubes, spheres and other such shapes while teaching, to help students visualize the structure in a 3D space. But it is inconvenient for the teacher to carry the specimens around. It is difficult for the teacher to provide personal attention to the students in a class of approximate 60 students. Hence, it is very rare that a student gets a specimen to himself/herself to analyse and it's not feasible for every student to get a specimen to himself. This results in inability to perform operations like slicing through the shape, increasing/decreasing dimensions etc.

2.2 PROPOSED SYSTEM

Using augmented reality to help the user understand the intricate concepts present in the static form of geometry, where the teaching and learning techniques are still limited to 2D visualization. Use of Augmented Reality can complement a student’s understanding of 3D Geometry. Since it works directly in 3D, it will enable a user to comprehend the 3D Geometry concepts faster and better. Develop game based syllabus to interact with virtual objects and apply motion animations to objects.

2.2.1 Advantages

This relatively new technology has shown rapid growth in recent years and has already been successfully implemented in advertising, marketing and the entertainment industry, but its use in Education is just starting to increase. Thick textbooks of Learning Materials are being replaced by augmented reality, and Children can use it to help their Object from a distance; special glasses with augmented reality help the visually impaired to cope more easily with their daily tasks. However, the world is just now beginning to speak about the invaluable help that augmented reality can be of children with disabilities.

2.3 LITERATURE SURVEY

2.3.1 Traditional Approach

A common method used for learning geometry is with the help of power point presentations. A teacher will display the shape and the operations done on the shape on the screen with the help of a projector and the students learn from what the teacher explains. The teacher can either create videos of the operations to be performed on the object or can perform the operations in front of the students. Some other existing systems are as follows:

2.3.2 Geometry Learning Tool for Elementary using Augmented

This tool supports the creation of augmented reality based applications by detecting and registering the virtual objects in real time [2]. One can use this tool to teach the elementary children to measure angles using a protractor. Four coloured cards are used viz., red, blue, green and lime. These coloured cards act like markers. The red card is used as the pivot point, the green and blue card will act as a target point and the lime card will be used to show how big the angle. Pivot point should not move because it will become the centre point of the coordinate system. After the web cam detects the red marker card, now the students can show the blue or green marker to the web cam. If it is a blue marker, then the intersect line will appear from the positive x coordinate. If it is a green marker, then the intersect line will appear from the negative x coordinate. After displaying the intersect line, now with help of protractor, student can measure the angle between the intersect line. To check the correctness of their answer, a lime marker is shown. This trigger the function, which displays the measure of angle on the screen.

2.3.3 Interactive E-Learning System using Pattern Recognition and Augmented Reality

This is an interactive e-learning system, which uses pattern recognition and augmented reality [3]. At the time of learning, the system provides realistic audio-visual contents to students. The system has various components such as image recognition, colour and polka-dot pattern recognition, and augmented reality engine with audio-visual contents. The system uses web camera to capture the current page of textbook on PC. Then the system identifies the images on the page, and augments some audio-visual contents on the monitor. For interactive learning, the system uses the colour-band or polka-dot markers. One is supposed to put this marker to the end of a finger, which is used as the mouse cursor to indicate the position in the textbook image. As soon as the marker is located on the predefined image objects in the textbook, appropriate interactive audio-visual contents are augmented on it. This e-learning system is used in the educational courses in the elementary school and found satisfactory results.

2.3.4 Multimedia Augmented Reality Interface for E-Learning (MARIE)

MARIE is closely related to Magic Book, a powerful augmented reality interface. The system is built using a lightweight Head Mounted Display (HMD), a small camera and a computer. The system uses some of the functionality of the AR-Toolkit and computer vision techniques to effectively compute the real camera position and orientation relative to predefined marked cards. A custom built see-through HMD is provided to user. As per the learning context, the user places a set of predefined markers on the table and looks at the markers through the HMD so that multimedia information is mixed with the real environment in real time. The teaching material presented to student is divided into appropriate units and a marker was created for each unit. This helps in users to select right markers associated with the teaching material.

2.3.5 Issues in Existing Systems Some of the issues in the existing systems

1) In traditional approach, teacher used Power Point Presentations for displaying shapes and performing various operations on it. Due to this, students do not get to understand the shapes the way they want to. Their understanding is one-dimensional and is restricted to whatever the teacher will display on the projector screen. The students don't get any practical experience of performing operations.

2) Sometimes teachers use physical samples of cubes, spheres and other such shapes while teaching, to help students visualize the structure in a 3D space. But it is inconvenient for the teacher to carry the specimens around. It is difficult for the teacher to provide personal attention to the students in a class of

approximate 60 students. Hence, it is very rare that a student gets a specimen to himself/herself to analyse and it’s not feasible for every student to get a specimen to himself. This results in inability to perform operations like slicing through the shape, increasing/decreasing dimensions, etc.

3) The system, Multimedia Augmented Reality System for E-Learning, works by scanning a marker from a page and superimposing a virtual 3D image on the marker. The over dependence on markers make this system obsolete. The new system that will be developed will search for shapes drawn on the page and understand the shapes itself to superimpose a virtual image on the object drawn. The fineness in the edges of the marker depends upon the intensity of the marker light, if not properly lit the threshold process gives jagged edges and makes it difficult to distinguish between the contours. The system fails during occlusion, i.e., the covering of the marker by an external object. This system when made using OpenGL software takes a longer time to create as the objects have to be coded, the same thing can be done using blender that reduces the rendering time.

Looking at the various issues in the existing systems, it was decided to develop an e-learning system using augmented reality for effectively teaching three-dimensional geometry.

2.4 FEASIBILITY STUDY

2.4.1 Economical Feasibility

This project is economically feasible in the sense of hardware and software requirements. As smart phones becomes one of the essential thing in everyday life of people it is easier to implement this project. Also marketing and selling of software application in two major platform Android and iOS is economically beneficial in terms of the market and reach.

2.4.2 Technical Feasibility

As Augment Reality is an glooming technology computer systems with decent graphics and RAM are enough to develop AR applications. Future release of software and hardware are targeted to develop and test AR/VR apps.

The mobile device with Gyroscope enabled are suitable for ground plane concept and all other devices support at least Image Target technology. All upcoming flagship mobiles are excellently supports AR and VR.

2.4.3 Social Feasibility

3D concept is not new to modern people exposed to movies and video games. However it is new in the field of education. People already adopts VR/AR technology through applications like Pokémon Go, YouTube 360 videos. With the availability of 4G and smartphones people adopts trends. Learning evolves from palm scripts to books to audio to video now its evolved into the form of AR and VR applications.

CHAPTER 3

SYSTEM ARCHITECTURE

CHAPTER 3

SYSTEM ARCHITECTURE

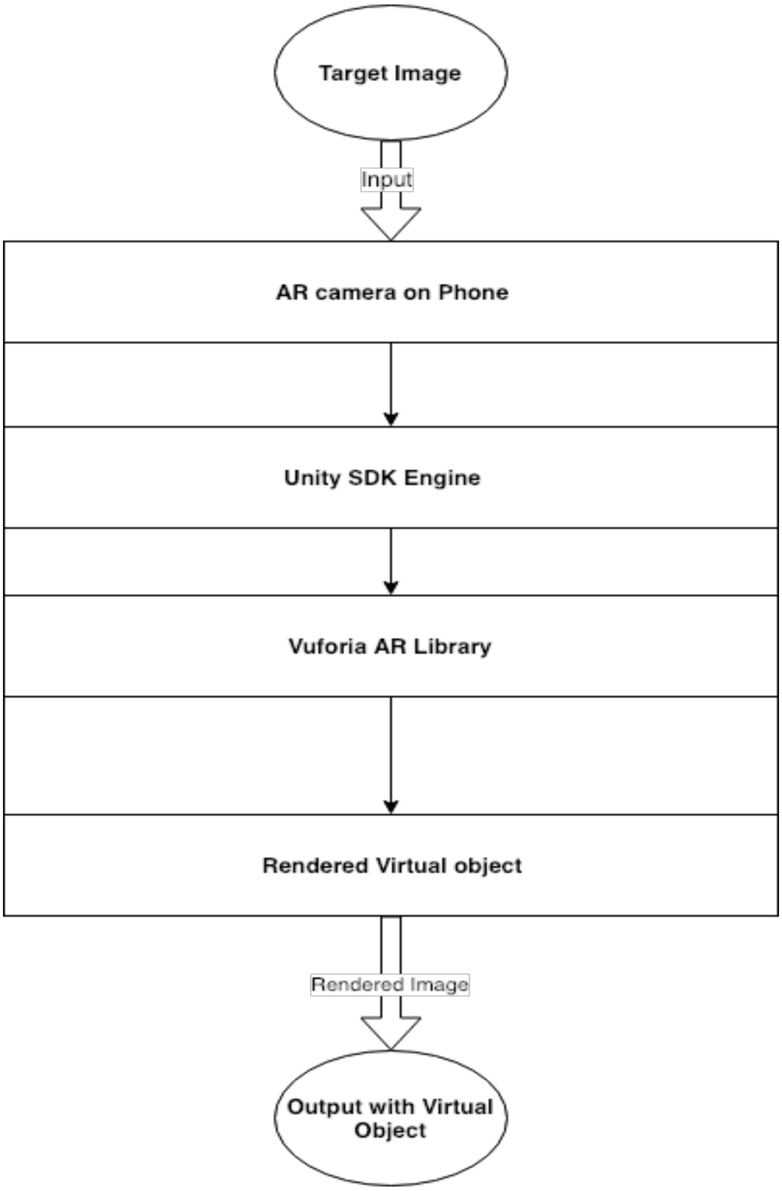

Fig 3.1

3.1 UNITY SDK ENGINE

The game Engine used here is UNITY. APK for android and IPA for iPhone are developed and built using UNITY. Target Images are fed as assets from the Vuforia database as trained model Image targets. Plane stage and scaling of the object with respective scenes are built on this platform. With Vuforia support enabled on XR settings on build platform configuration unity support the AR libraries such as Vuforia and AR Core / AR Kit. See **Fig.3.1**.

3.2 VUFORIA AR LIBRARY

3.2.1 Ground Plane

Ground Plane feature enables the user to create a ground plane stage and a plane finder. Any virtual objects placed on the ground plane stage will be rendered through the plane finder. The virtual object has to placed and scaled to the ground plane stage. While pointing a ground plane on the AR Camera and touching the screen Vuforia will recognize the plane surface and place the virtual object on the plane surface.

3.2.2 Image Target

Image Target feature enables the user to define a target image to use it as AR plane. The target image will be uploaded to the Vuforia developer portal. The image will be trained and pixel points will be marked. It is then import to unity as unity asset package and will be used in the unity studio. Any 3D object marked as the component for the target image will be rendered over the image when AR Camera detects the image.

3.2.3 Mid Air Positioning

Mid Air positioning is similar to Ground Plane detection except that it will detect a mid-air position and place the virtual object above the ground in the air.

3.3 GYROSCOPE SENSOR

The target device should have the Gyroscope sensor. Gyroscope sensor helps to measuring and maintaining orientation and angular velocity. When rotating the device orientation of the axis is unaffected by tilting or rotation of the mounting according to the conservation of angular momentum. AR and Virtual Reality applications needs Gyroscope to run it on the target device.

3.4 ANDROID SDK

Android SDK is the process by which new application are created for devices running the android operating system. The Android **SDK** provides you the API libraries and developer tools necessary to build, test, and debug apps for **Android**. Android Studio with latest Android API installed should be present in the development machine along with the Unity SDK. In the Unity Build settings switch the platform to Android and choose the highest installed Android API version installed. Build and Run option will build an **apk** file in the project folder.

3.5 VUFORIA

Vuforia is an Augment Reality SDK for mobile devices that enables the creation of augmented reality application. It uses Computer vision technologies to recognize and track planar images (Image Targets) and simple 3D objects. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world images when they are viewed through the camera of a mobile device. The virtual object then tracks the position and orientation of the image in real-time so that the viewer's perspective on the object corresponds with the perspective on the Image Target. It thus appears that the virtual object is a part of the real-world scene.

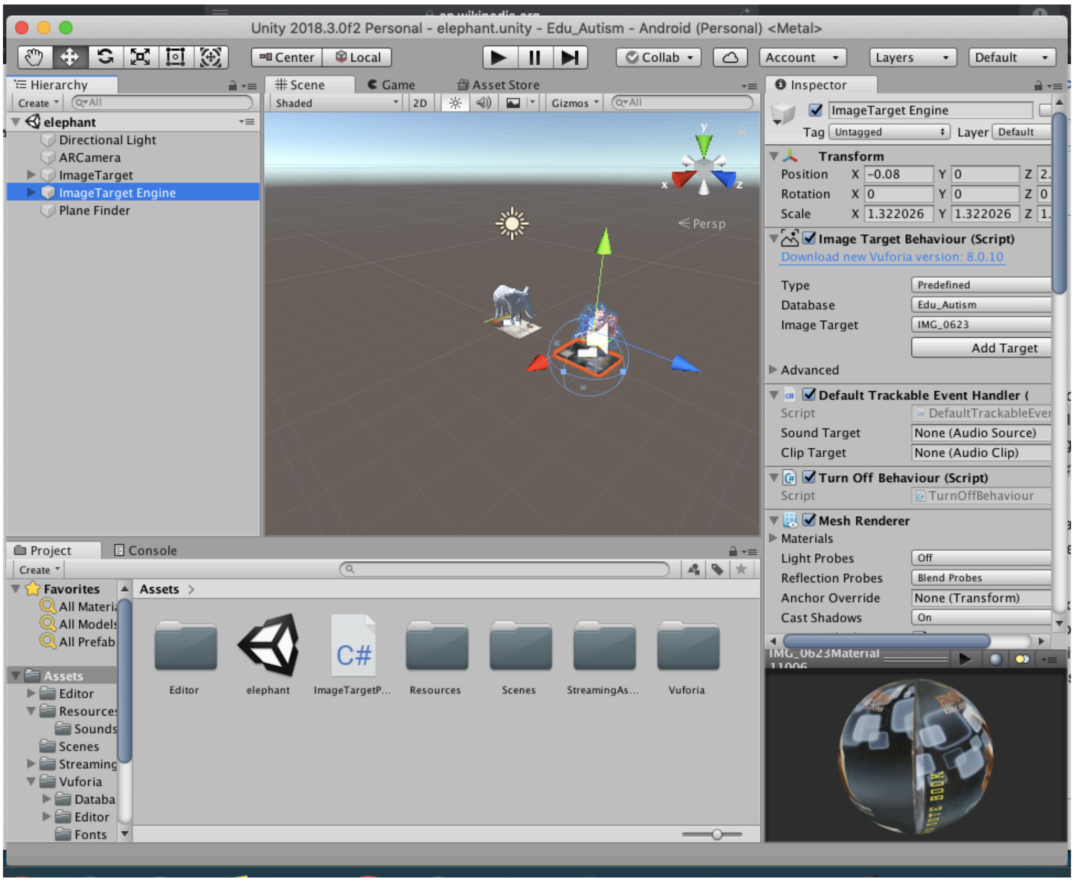

Fig 3.1.1

3.6 RESULT

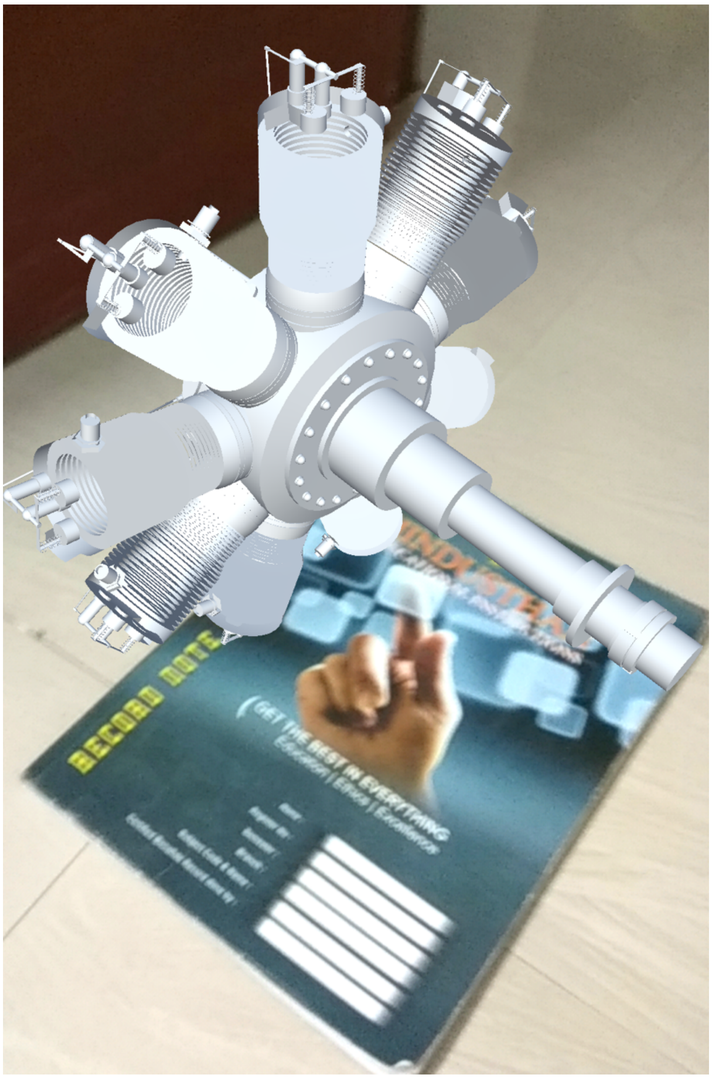

Fig 3.1.2

CHAPTER 4

SYSTEM SPECFICATIONS

CHAPTER 4

SYSTEM SPECIFICATION

4.1 SOFTWARE SPECIFICATION

Operating System	: Mac OS 10.14.3
Language	: C# Sharp
Game Engine	: Unity version 2018.3.0f2
AR SDK	: Vuforia 7.5.26
Mobile SDK	: Android Studio / XCode
Android API	: Marshmallow **SDK** 6.0 and **API** 23
Code Editor	: Visual Studio

4.2 HARDWARE SPECIFICATION

Mobile Device	: Android / IPhone
Mobile RAM	: 3 GB
Mobile Processor	: 1.80 GHZ Snapdragon 650
Sensors	: Gyroscope
Development machine	: MacBook Air
Processor	: 1.8 GHz Intel Core i5
RAM	: 8GB
Graphics	: Intel HD Graphics 6000 1536 MB

CHAPTER 5

MODULE DESCRIPTION

CHAPTER 5

MODULE DESCRIPTION

5.1 IDENTIFYING IMAGE TARGET

In this module, the target area for AR is chosen. Target Area is either an Image or ground plane or QR booklet. Printed Booklets with predefined images can also be target. Any image with good quality of colors and details will be uploaded to the Vuforia developer portal. Vuforia trains the image and finds out the pixel coordinates and rates the picture for augment reality. It is then downloaded and imported as unity asset package into the unity studio.

5.2 SELECTING THE VIRTUAL OBJECT

In this module based on the syllabus level virtual objects are placed on the unity studio. User can choose an object manually or the application itself arrange the objects automatically based on the lesson level. Each object for each target will be chosen. For multiple image targets each image will be assigned with a 3D model. Unity can create multiple scenes.

5.3 PLACING VIRTUAL OBJECT ON REAL WORLD

With Vuforia AR Library virtual objects coordinates can be scaled, rotate and even can apply textures. These virtual objects are then bind on top of the targets. Virtual objects are made as the component for the target images and scaled to fit into the device display in decent distance. For Ground plane, virtual objects are made as children. Just above the ground level virtual objects are scaled and placed.

5. 4 APPLYING ANIMATION AND VIRTUAL BUTTONS FOR INTERACTION

To interact with virtual objects animations has to be applied. Functionalities can implement using C# Scripts. Virtual buttons are enabled for the ground plane feature. When user directs the AR camera over a plane surface and touches the device screen it will trigger the virtual button and place the 3D object over the plane surface. For multiple image targets each target is assigned with a motion animation and corresponding audio script. Such that when image target is found on the AR camera it will render the 3D object on the device over the target and will plays the corresponding audio script for the 3D object.

CHAPTER 6

SYSTEM DESIGN

CHAPTER 6

SYSTEM DESIGN

6.1 UML DIAGRAM

The Unified Modeling Language (UML) was created to forge a common, semantically and syntactically rich visual modeling language for the architecture, design, and implementation of complex software systems both structurally and behaviorally. UML has applications beyond software development, such as process flow in manufacturing.

It is analogous to the blueprints used in other fields, and consists of different types of diagrams. In the aggregate, UML diagrams describe the boundary, structure, and the behavior of the system and the objects within it.

UML is not a programming language but there are tools that can be used to generate code in various languages using UML diagrams. UML has a direct relation with object-oriented analysis and design.

6.1.1 Use case Diagram

To model a system, the most important aspect is to capture the dynamic behavior. Dynamic behavior means the behavior of the system when it is running/operating.

Only static behavior is not sufficient to model a system rather dynamic behavior is more important than static behavior. In UML, there are five diagrams available to model the dynamic nature and use case diagram is one of them. Now as we have to discuss that the use case diagram is dynamic in nature, there should be some internal or external factors for making the interaction.

These internal and external agents are known as actors. Use case diagrams consists of actors, use cases and their relationships. The diagram is used to model the system/subsystem of an application. A single use case diagram captures a particular functionality of a system

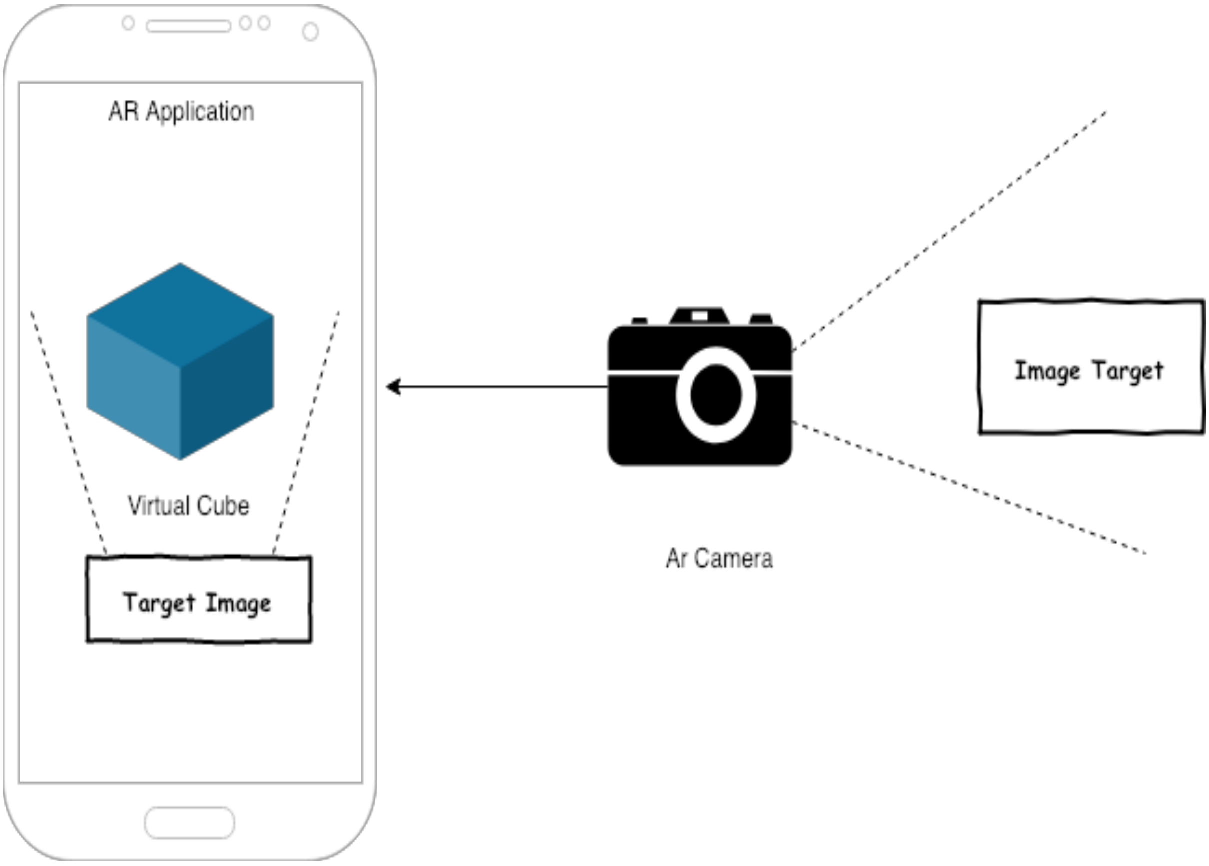

Fig 6.1.1

6.1.2 Sequence Diagram

A sequence diagram simply depicts interaction between objects in a sequential order i.e. the order in which these interactions take place. We can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function. These diagrams are widely used by businessmen and software developers to document and understand requirements for new and existing systems.

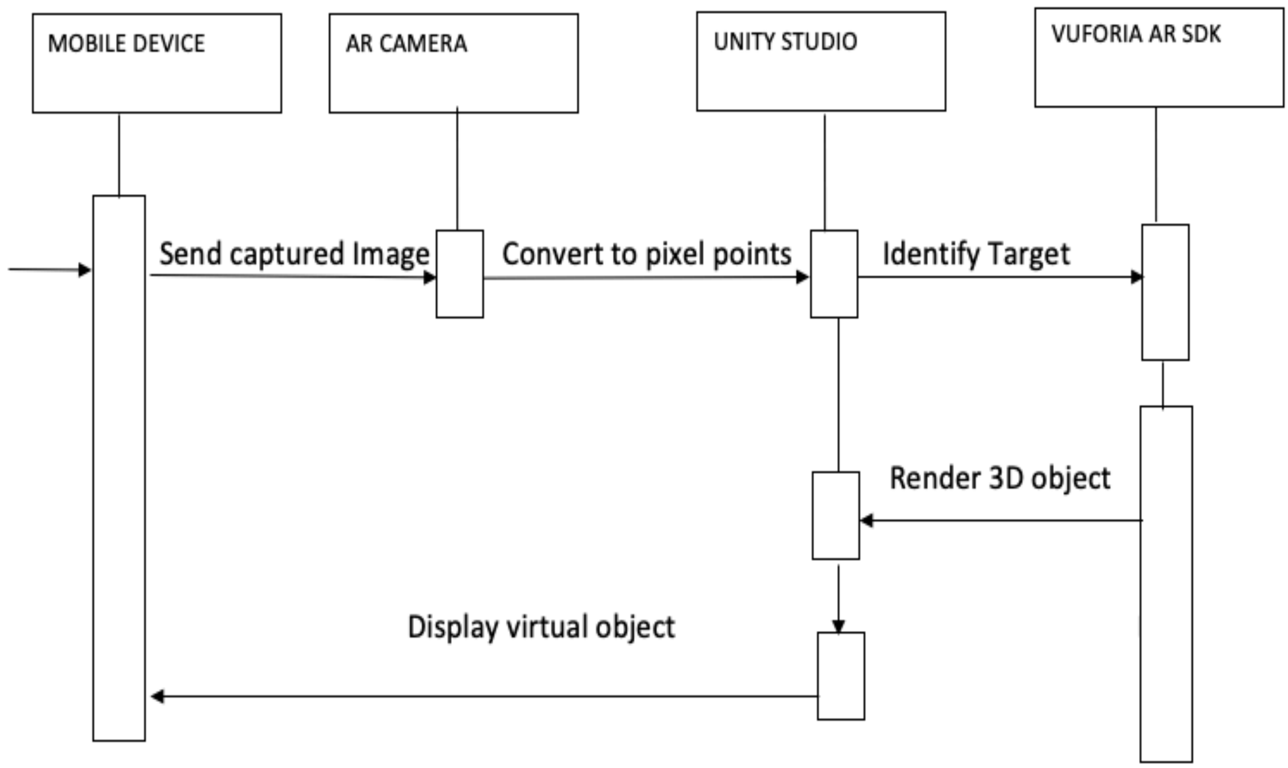

Fig 6.1.2

6.1.3 Activity Diagram

Activity diagrams are graphical representations of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modelling Language, activity diagrams are intended to model both computational and organizational processes (i.e., workflows), as well as the data flows intersecting with the related activities. Although activity diagrams primarily show the overall flow of control, they can also include elements showing the flow of data between activities through one or more data stores.

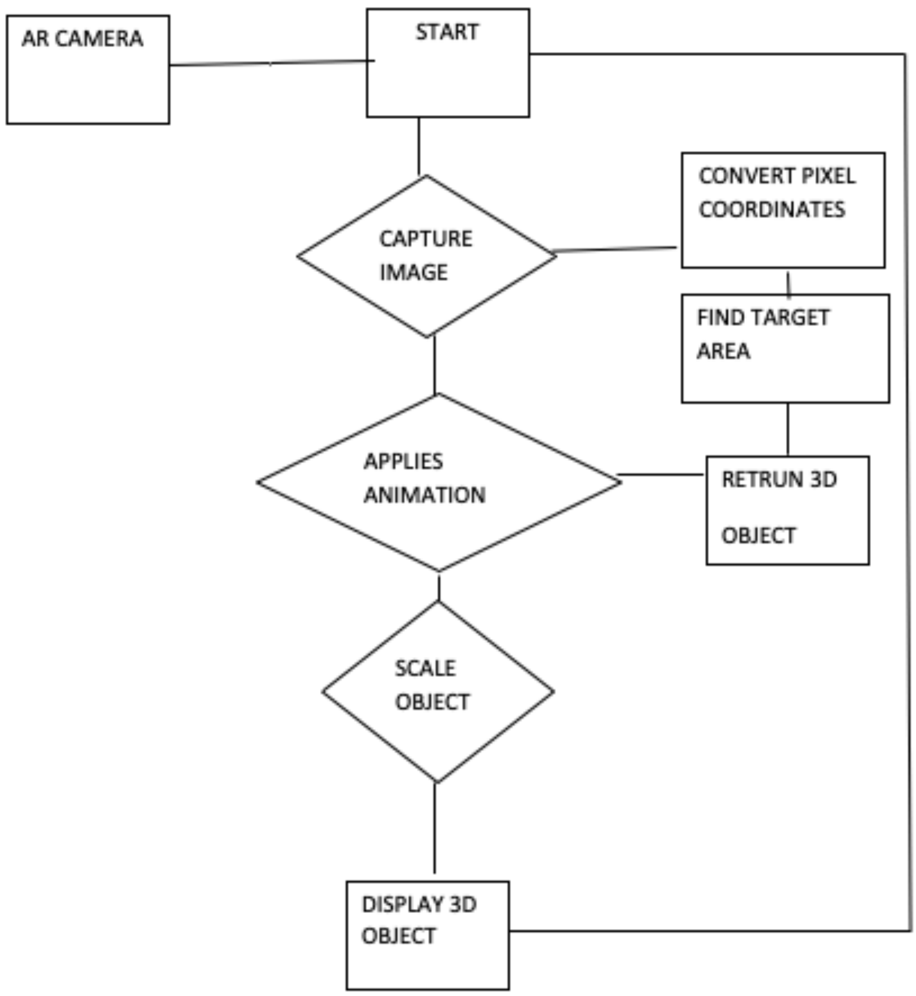

Fig 6.1.3

CHAPTER 7
CONCLUSION

CHAPTER 7

CONCLUSION AND FUTURE ENHANCEMENT

7.1 CONCLUSION

This application can help children with autism to understand things in a way which is comfortable for them. This application can help the professionals and students to understand complex 3D models. AR based syllabus from kinder garden children to Engineering students can be developed. Evolution of learning materials begins from palm scripts. Now it reaches the concept of AR applications. Though the methodologies differ from centuries to centuries the passion to learning remains the same. Hence this application will be the game changer to those who keeps on learning and it will be helpful to the children with autism to learn complex subjects.

7.2 FUTURE ENHANCEMENT

Automatic marking of parts for Engineering models as Augment Reality 3D text with markers targeting specific parts with description. Hyperlinks referring to the target model information that opens in a browser.

APPENDIX A

SOURCE CODE

APPENDIX A

SOURCE CODE

```
using UnityEngine;
//Add This script
using System.Collections;
using System.Collections.Generic;
namespace Vuforia
{
 /// <summary>
/// A custom handler that implements the ITrackableEventHandler  interface.
   /// </summary>
public class DefaultTrackableEventHandler : MonoBehaviour,
ITrackableEventHandler
   {
   //------------Begin Sound----------
       public AudioSource soundTarget;
       public AudioClip clipTarget;
       private AudioSource[] allAudioSources;
   //function to stop all sounds
       void StopAllAudio()
       {
           allAudioSources = FindObjectsOfType(typeof(AudioSource)) as
           AudioSource[];
```

```
 foreach (AudioSource audioS in allAudioSources)
          {
             audioS.Stop();
          }
       }
       //function to play sound
       void playSound(string ss)
       {
          clipTarget = (AudioClip)Resources.Load(ss);
          soundTarget.clip = clipTarget;
          soundTarget.loop = false;
          soundTarget.playOnAwake = false;
          soundTarget.Play();
       }
//-----------End Sound------------
#region PRIVATE_MEMBER_VARIABLES
 private TrackableBehaviour mTrackableBehaviour;
#endregion // PRIVATE_MEMBER_VARIABLES
#region UNTIY_MONOBEHAVIOUR_METHODS
void Start()
       {
          mTrackableBehaviour = GetComponent<TrackableBehaviour>();
          if (mTrackableBehaviour)
          {
             mTrackableBehaviour.RegisterTrackableEventHandler(this);
          }
```

```
//Register / add the AudioSource as object
soundTarget = (AudioSource)gameObject.AddComponent<AudioSource>();
}
#endregion // UNTIY_MONOBEHAVIOUR_METHODS
#region PUBLIC_METHODS

/// <summary>
/// Implementation of the ITrackableEventHandler function called when the
/// tracking state changes.
/// </summary>
    public void OnTrackableStateChanged(
                    TrackableBehaviour.Status previousStatus,
                    TrackableBehaviour.Status newStatus)
    {
      if (newStatus == TrackableBehaviour.Status.DETECTED ||
        newStatus == TrackableBehaviour.Status.TRACKED ||
        newStatus == TrackableBehaviour.Status.EXTENDED_TRACKED)
      {
        OnTrackingFound();
      }
     else
      {
        OnTrackingLost();
      }
    }
```

```
#endregion // PUBLIC_METHODS
#region PRIVATE_METHODS
private void OnTrackingFound()
{
Renderer[] rendererComponents = GetComponentsInChildren<Renderer>(true);
Collider[] colliderComponents = GetComponentsInChildren<Collider>(true);

// Enable rendering:
        foreach (Renderer component in rendererComponents)
        {
           component.enabled = true;
        }
// Enable colliders:
        foreach (Collider component in colliderComponents)
        {
           component.enabled = true;
        }

Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " found");

//Play Sound, IF detect an target
        if (mTrackableBehaviour.TrackableName == "elephant")
        {
           playSound("sounds/elephant");
        }
```

```
        if (mTrackableBehaviour.TrackableName == "engine")
        {
            playSound("sounds/engine");
        }
  }
  private void OnTrackingLost()
{
Renderer[] rendererComponents = GetComponentsInChildren<Renderer>(true);
Collider[] colliderComponents = GetComponentsInChildren<Collider>(true);
        // Disable rendering:
        foreach (Renderer component in rendererComponents)
        {
            component.enabled = false;
        }
        // Disable colliders:
        foreach (Collider component in colliderComponents)
        {
            component.enabled = false;
        }

Debug.Log("Trackable " + mTrackableBehaviour.TrackableName + " lost");
//Stop All Sounds if Target Lost
        StopAllAudio();
      }
      #endregion // PRIVATE_METHODS
    }}
```

APPENDIX B

SCREENSHOTS

APPENDIX B

SCREENSHOTS

CUBE

DRONE

ELEPHANT

RHONE ENGINE

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REFERENCES

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