A PROJECT REPORT
on

"AR IN E- COMMERCE"

Submitted to
KIIT Deemed to be University

In Partial Fulfillment of the Requirements for the Award of

BACHELOR'S DEGREE IN
COMPUTER SCIENCE AND COMMUNICATION ENGINEERING

BY

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UNDER THE GUIDANCE OF
PROF. RAJDEEP CHATTERJEE

SCHOOL OF COMPUTER ENGINEERING
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KALINGA INSTITUTE
OF INDUSTRIAL TECHNOLOGY
Deemed to be University U/S 3 of the UGC Act, 1956

CERTIFICATE

This is to certify that the project report entitled
" **AR IN E - COMMERCE"**

submitted by:

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in partial fulfillment of the requirements for the award of the **Degree of Bachelor of Technology** in **Computer Science and Communication Engineering** is a bonafide record of the work carried out under my guidance and supervision at School of Computer Engineering , Kalinga Institute of Industrial Technology, Deemed to be University.

PROF. RAJDEEP CHATTERJEE

.....

The Project was evaluated by us on

EXAMINER'S NAME:

SIGNATURE:

ACKNOWLEDGEMENT

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SAUBHAGYA ASHISH
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ABSTRACT

Augmented reality (AR) carries with itself a range of fascinating features which could be implemented by firms across different industrial sectors to enhance user experience and add business value. The acceptance of AR can be viewed from two perspectives, viz. the acceptance by the user and acceptance by firms as a technology.This study evaluates the effectiveness of augmented reality (AR) as an e-commerce app. In this app we have tried to show the customer, a model of wrist watch with an interactive UI. A 3D wrist watch is made using the concept of Augmented Reality.

The model is made using mainly two platforms i.e, Unity and Vuforia frameworks.This model is proposed to run on the android platforms. So, an android application is developed for the customers in which a customer can see virtual wrist watch on their hand and select different watches and color. The app enhances the physical real-world environment with superimposed computer-generated images, thus changing the perception of reality by placing a watch on the wrist. The application works only with the camera equipped smartphone android device. When a user points the device and looks at an object, the software recognizes it through computer vision technology, which analyzes the video stream.

The model shows that AR provides effective communication benefits by generating greater novelty, immersion, enjoyment, and usefulness, resulting in positive attitudes towards the medium and purchase intention, compared to the web-based product presentations.

Keywords - Augmented Reality, E-commerce, Unity, Vuforia.

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Chapter 1

Introduction

Augmented reality is the technology that expands our physical world, adding layers of digital information onto it. Unlike Virtual Reality (VR), AR does not create the whole artificial environments to replace real with a virtual one. AR appears in direct view of an existing environment and adds sounds, videos, graphics to it.

A view of the physical real-world environment with superimposed computer-generated images, thus changing the perception of reality, is the AR.

The term itself was coined back in 1990, and one of the first commercial uses were in television and military. With the rise of the Internet and smartphones, AR rolled out its second wave and nowadays is mostly related to the interactive concept. 3D models are directly projected onto physical things or fused together in real-time, various augmented reality apps impact our habits, social life, and the entertainment industry.

There are four types of augmented reality today -

- Marker-less AR
- Marker-based AR
- Projection Based Ar
- Superimposition Based Ar

1.1. Problem Statement

Today E-commerce is the one of the major fields of internet and our lives. There is continuous buying and selling of goods taking place every minute using the service of the internet. Every minute a customer purchases some goods. The problem arises when the product does not meet the satisfaction of the customer and they return the product which leads to extra cost for the resources.

This report is about how to attract a customer for purchasing right product with the help of augmented reality, so that the customer can check the product they want to purchase.

1.2. Scope And Objectives:

The importance of this model is to help the companies and the customer to sell or buy the right products and to gain profit. It can be aimed towards the following objectives -:

- Technology is unique and noticeable
- Elimination of confusion
- To improve the content quality
- Interactivity
- customer reliability

1.3. Proposed Model

In this work, we will build augmented reality try on watch using unity and vuforia frameworks. The model works on the concept of Marker Based AR. The application will work for an updated android version 8.0 or more with having android package level 27 or more. The app runs on an android smartphone. When we point the camera towards the image that is on the wrist it replaces it with a watch. Also, the model should have an interactive UI in which someone can choose which watch model to wear or change the color of the model.

1.4. Organization Of Study

- Chapter One starts with an introduction about the importance of AR in E-commerce. The problem statement, objectives, significance and scope of the model.
- Chapter Two describes the study of the existing systems and techniques taken into account to prior the development of the proposed model.
- Chapter Three provides a detail walk through of the software engineering methodologies adopted to implement the model, the concept of AR, what AR is all about, methods to implement try on watch and how its UI will made.
- Chapter Four describes different techniques used to develop the model. The various modules are depicted using relevant descriptive diagram.
- Chapter Five describes the implementation of model step wise. It gives a detail walk through of the implementation part

- Chapter Six includes the describes the testing of the model to make it error free, results and observations.

- Chapter Seven shows the screenshots of the application made.

- Chapter Eight includes the conclusion along with the future scope. Answers to many observation are presented in this chapter.

Chapter 2

Literature Review

Writing survey is basically writing down the past work which is important for the theme of the project. This section considers the past research work from the certain facts can be drawn. This section consists the group of involving theoretical information and methodologies.

Augmented reality technology was invented in 1968, with Ivan Sutherland's development of the first head-mounted display system. However, the term 'augmented reality' wasn't coined until 1990 by Boeing researcher Tim Caudell.

Kashif Arbar in his journal "Impact Of AR on customer Intention"[1], wrote that "If the consumer is literate enough to interact online via smart devices and applications, it is generally understood that the customer can discover the pros and cons of any item before making a purchase by reviewing information, specifications which in turn will influence engagement with a brand and increase purchase intention or vice versa. Similarly, augmented reality does not limit customer brand engagement and purchase intention".

Digital Marketing Institution in there article "How Augmented Reality Is Transforming Retail[2]" concluded that online retail opportunities continue to expand as more consumers begin their purchasing decisions through online portals. To remain competitive and profitable, it is no longer enough just to have an online presence. Our online shopping experience must now be personal and interactive to help ease buyer uncertainty and drive profit through consumer satisfaction.

According to Apple CEO Tim Cooke, Augmented Reality is the core technology and will be big technological step forward, which is similar to the release of smartphones.

IKEA[3] is known for their great sense of intuition in leveraging technology and e-Commerce for their customer experience. In 2013, IKEA created an AR app, IKEA Place to help customers physically visualize how a certain piece of furniture would look in their home.

In 2000 a Japanese scientist Hirokazu Kato developed and published ARToolKit[4] – an open-source SDK. Later it was adjusted to work with Adobe. In 2004 Trimble Navigation presented an outdoor helmet-mounted AR system. In 2008 Wikitude made the AR Travel Guide for Android mobile devices.

Wei Zhu and Charles B Oven in there research paper "Design Of The Promopad[5]" made a promopad using concept of Augmented Reality. It stated that the goal of this design is an intelligent shopping aid that provides shoppers automatic and meaningful help when needed, as well as minimizing human interference and effort.

2.1. Summary:

The summarized Literature review explains about what is augmented reality,how it started and the influence of Augmented Reality in different area. We also describe the approaches for gaining customers with the help of AR.

Chapter 3

Basic Concepts/Technology Used

3.1. Augmented Reality:

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory.

Augmented reality (AR) is one of the biggest technology trends right now, and it's only going to get bigger as AR ready smartphones and other devices become more accessible around the world. AR let us see the real-life environment right in front of us—trees swaying in the park, dogs chasing balls, kids playing soccer—with a digital augmentation overlaid on it. For example, a pterodactyl might be seen landing in the trees, the dogs could be mingling with their cartoon counterparts, and the kids could be seen kicking past an alien spacecraft on their way to score a goal.

There are as many uses for AR in our everyday lives, here are just a few examples:

- Enhanced navigation systems use augmented reality to superimpose a route over the live view of the road.
- During football games, broadcasters use AR to draw lines on the field to illustrate and analyze plays.
- Furniture and housewares giant IKEA offers an AR app (called IKEA Place) that lets you see how a piece of furniture will look and fit in your space.
- Military fighter pilots see an AR projection of their altitude, speed, and other data on their helmet visor, which means they don't need to waste focus by glancing down to see them.
- Neurosurgeons sometimes use an AR projection of a 3-D brain to aid them in surgeries.
- At historical sites like Pompeii in Italy, AR can project views of ancient civilizations over today's ruins, bringing the past to life.

- Ground crew at Singapore's airport wear AR glasses to see information about cargo containers, speeding up loading times.

Types of AR:

There are 4 types of augmented reality today:

1. Markerless AR
2. Marker-Based AR
3. Projection Based AR
4. Superimposed Based AR

1. Markerless AR - Some also call it to image recognition, as it requires a special visual object and a camera to scan it. It may be anything, from a printed QR code to special signs. The AR device also calculates the position and orientation of a marker to position the content, in some cases. Thus, a marker initiates digital animations for users to view, and so images in a magazine may turn into 3D models.

2. Marker-Based AR - A.k.a. location-based or position-based augmented reality, that utilizes a GPS, a compass, a gyroscope, and an accelerometer to provide data based on the user's location. This data then determines what AR content you find or get in a certain area. With the availability of smartphones this type of AR typically produces maps and directions, nearby businesses info. Applications include events and information, business ads pop-ups, navigation support.

3. Projection Base AR - Projecting synthetic light to physical surfaces, and in some cases allows us to interact with it. These are the holograms we have all seen in sci-fi movies like Star Wars. It detects user interaction with a projection by its alterations.

4. Superimposed Based AR - It replaces the original view with an augmented, fully or partially. Object recognition plays a key role, without it the whole concept is simply impossible. We've all seen the example of superimposed augmented reality in IKEA Catalog app, that allows users to place virtual items of their furniture catalog in their rooms.

3.2. 3D Modelling:

3D modeling is the process of creating a 3D representation of any surface or object by manipulating polygons, edges, and vertices in simulated 3D space. We can see the results of 3D modeling in movies, animations, and video games that are filled with fantastical and imaginative creatures and structures.
Commonly used 3D modelling software is Blender.It is used in big industries for 3D modelling.

Blender- Blender is the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, video editing and 2D animation pipeline.

3.3. ARToolKit:

ARToolKit is an open-source computer tracking library for creation of strong augmented reality applications that overlay virtual imagery on the real world. In order to create strong augmented reality, it uses video tracking capabilities that calculate the real camera position and orientation relative to square physical markers or natural feature markers in real time. Once the real camera position is known a virtual camera can be positioned at the same point and 3D computer graphics models drawn exactly overlaid on the real marker. So ARToolKit solves two of the key problems in Augmented Reality: viewpoint tracking and virtual object interaction.

The current version of ARToolKit supports Microsoft Windows, Mac OS X, Linux, iOS, and Android platforms. Other versions of ARToolKit have also been ported to Symbian, and Windows Phone to support mobile AR applications.

ARToolKit is also available as a plugin for the Unity game engine for example to align a virtual camera within Unity with a real-world camera relative to a tracked marker target and taking care of communicating with the camera. The plugin supports Unity on OS X, Unity on Windows, Unity on Android, and Unity on iOS.

3.4. Unity:

Unity provides powerful tools to make rich,deeply engaging AR experiences that intelligently interact with the real world. It is an end-to-end creation platform. Unity has custom resources to bring immersive vision to life. It provides unified workflow across devices.

Unity has now developed a new architecture that improves the support for existing and future augmented reality and virtual reality.

For creating AR, Unity provides different windows. Some creative windows are-

- Scene- It contains all the visual entities inside the AR application like UI, buttons, 3-D models.
- Game- It shows whatever the main camera inside the Scene windows depicts.
- Project- It contains all the assets and props such as images,videos or 3-D models and all the things that are needed inside our application. It acts as a storeroom.
- Hierarchy- It lists all the objects that are present inside the Scene window.
- Inspector- It shows all the properties of the object that are present inside the Hierarchy window.

Unity being so versatile can be used to create games as well as apps. It is a highly important term in augmented reality as well as virtual reality. It provides a suitable base for interactive experiences.

3.5. Vuforia:

Vuforia framework uses computer vision technology to attach virtual 3-D objects to images,real objects or even floors or tables. It is an augmented reality software development kit (SDK) for mobile devices that enables the creation of augmented reality applications. It recognizes and tracks planar images and 3D objects in real time. This image registration capability enables developers to position and orient virtual objects, such as 3D models and other media, in relation to real world objects 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 target. It thus appears that the virtual object is a part of the real-world scene.

Few examples of tracking include -

- Vuforia Image Tracking
- Vuforia Object Tracking
- Vuforia Ground plane Detection

In this project, we have used Vuforia Image Tracking where we pre feed an object into our unity project and attach some virtual object to it and then we build a unity project into an application and when that application finds the exact same image in the environment,it overlays that 3D virtual object on top of that.

3.6. SDK(Software Development Kit):

A software development kit is a collection of software development tools in one installable package. They ease creation of applications by having a compiler, debugger and perhaps a software framework. They are normally specific to a hardware platform and operating system combination. An augmented reality software (software development kit) is the core technological software engine that powers the development and creation of new AR apps and experiences. The role of the AR SDK is to perform the non-trivial task of fusing digital content and information with the real world.The capabilities of the SDK will ultimately underpin the features and functionality within the AR application, so it’s essential to choose the correct platform based on the requirements of the project.

The AR SDK is responsible for many components of the applications, which are currently available, including content rendering, AR tracking, and scene recognition. Content rendering relates to the digital information and 3D objects that can be overlaid on top of the real world, tracking represents the ‘eyes of the application,’ and the scene recognition element acts as the central nervous system of the

application. Each AR SDK is equipped with its own unique properties that enable it to recognize, render, and track the application in the most optimal manner possible. This project has the use of Vuforia which is an augmented reality SDK that enables businesses and app developers to quickly spin-up high fidelity, mobile-centric, immersive AR experiences.

3.7. E-Commerce:

In this project, E-commerce plays a pivotal role in terms of marketing scenario. It is the activity of electronically buying or selling of products on online services or over the Internet. E-commerce helps create new job opportunities due to information related services, software apps and digital products. E-commerce brings convenience for customers as they do not have to leave home and only need to browse websites online, especially for buying the products which are not sold in nearby shops. It could help customers buy a wider range of products and save customers' time. Consumers also gain power through online shopping. The use of E-commerce provides a platform to showcase the app to a large audience.

3.8. 6-Degree Of Freedom:

Six degrees of freedom (6DoF)[5] refers to the freedom of movement of a rigid body in three-dimensional space. Specifically, the body is free to change position as forward/backward (surge), up/down (heave), left/right (sway) translation in three perpendicular line axes, combined with changes in orientation through rotation about three perpendicular axes, often termed yaw (normal axis), pitch (transverse axis), and roll (longitudinal axis).

Chapter 4

System Architecture

4.1. System Architecture

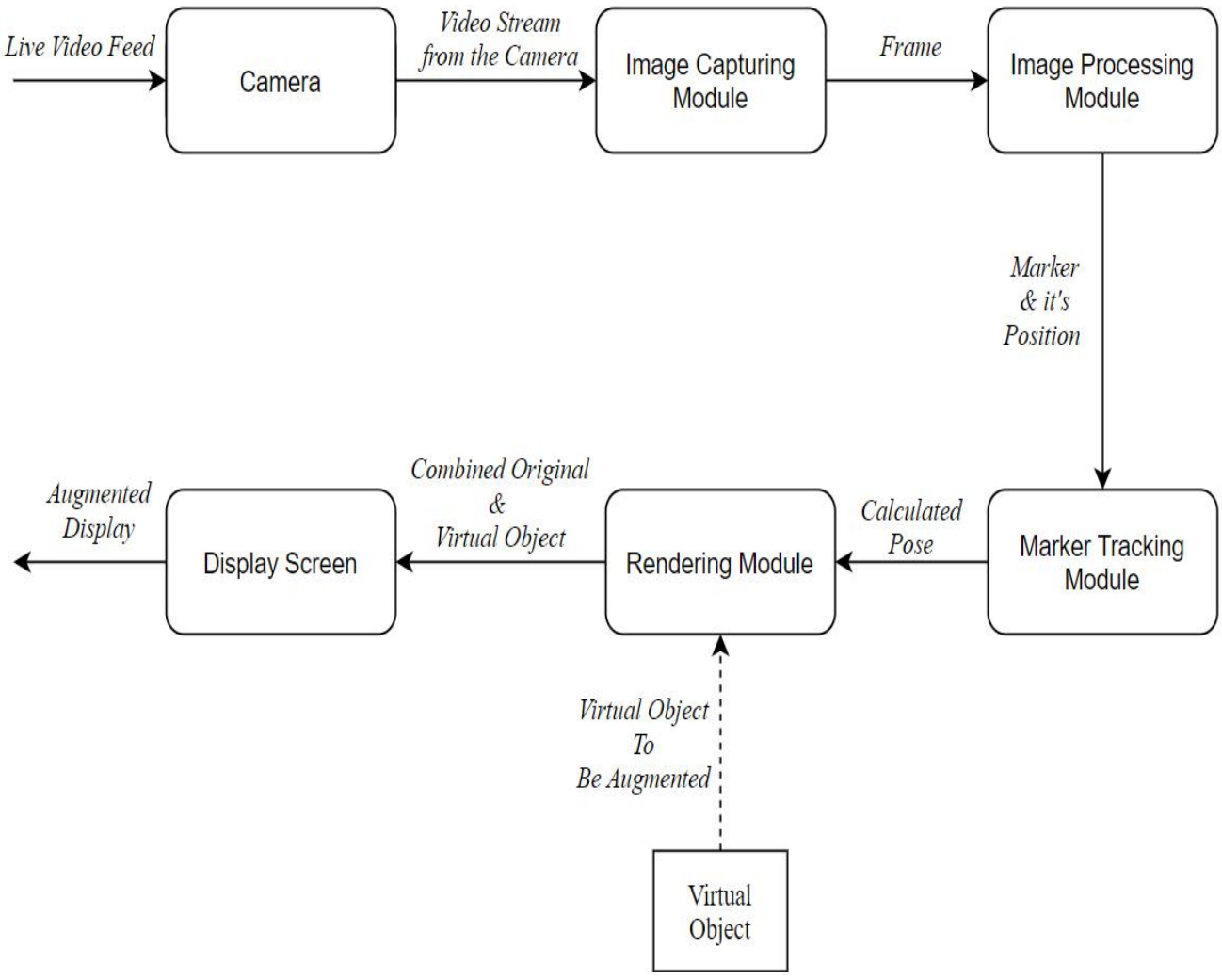

Fig. 1. Architecture Of Proposed Model

The proposed system is a marker based system and its architecture as shown in Fig. 1 contains following modules.

1. Camera
2. Image Capturing Module
3. Image Processing Module
4. Rendering Module
5. Display Screen

1. Camera

A real-world live video is feed as an input from the laptop camera to the Camera module. Displaying this live feed from the laptop camera is the reality in augmented reality. This live video stream is given as an input to the Image Capturing Module.

2. Image Capturing Module

The input to Image Capturing Module is the live video feed from the camera of a mobile device. This module analyses the camera feed, by analyzing each frame in the video. This module generates binary images i.e. a digital image that has only two possible values for each pixel. Typically the two colours used for a binary image are black and white. These binary images are provided as an input to Image Processing Module.

3. Image Processing Module

Inputs to Image Processing Module are the binary images from Image Capturing Module. These binary images are processed using an image processing technique to detect the AR Marker. Detection of AR Marker is essential to determine the position, where to place the virtual object. Once the AR Marker is detected, its location is provided as an input to the Tracking Module.

4. Marker Tracking Module

The tracking module is “the heart” of the augmented reality system. It calculates the relative pose of the camera in real time. The term pose means the six degree of freedom (DOF) position, i.e. the 3D location and 3D orientation of an object.

5. Rendering Module

There are 2 inputs of rendering module. First is the calculated pose from the tracking module and other is the Virtual Object to be augmented. The Rendering Module combines the original image and the virtual component using the calculated pose and renders the augmented image on the display screen.

Chapter 5

Implementation

Implementation is the process of converting the designed system architecture into working modules where it is made sure that all the functional and non-functional requirements are met.

The implementation section is divided into two parts-

- Creating the core functionality
- Creating User Interface

5.1. Creating the core functionality

In creating the core functionalities we start with importing the raw 3D wristwatch models in Unity. So, here we are using a total three watch model. After that, each watch model is imparted with its material colour to the dial, buckle, band, case, glass, etc.

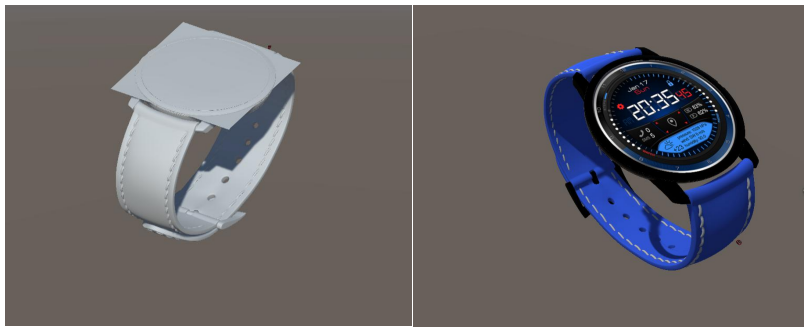

Fig.2. 3D watch model before and after imparting its material colour

After applying the material colour the second part is to set the target image or marker. So, in the next step, we will make an AR-based marker. Here the marker should have multiple feature points. Having multiple feature points helps computer vision to easily recognize.
Fig.3 shows an image of the marker taken. The yellow dots indicate the feature points of the image. The multiple feature point helps the application to distinguish from other images.

Fig.3. Image Target(Marker)

After choosing the marker now we have to import it in Unity. We have to place the watch model on the surface of the marker such that it can overlap on each other. Fig.4 shows the overlapping of the image target to the watch model.

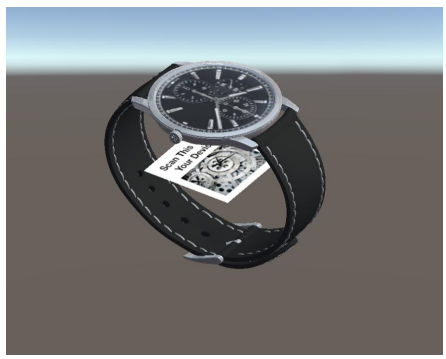

Fig.4. Overlapping the Watch to the Image Target

Now, after overlapping of the image we use Vuforia Engines. Here Vuforia Frameworks will help to attach virtual 3-D watch to image.

After that, we need an occlusion of a hand so that when the camera points on the image the watch model should fit on the hand.

Fig.5. Watch Model without occlusion

Here, in Fig.5 the watch model is shown without occlusion. We need occlusion because it makes the application and the watch more realistic and makes it more user friendly to the user. So we create an occlusion of the hand.
So, for creating occlusion of the hand. First, we have downloaded a 3D model of a hand. After that, we imported the hand model to Unity. And then we finally positioned the image target, the watch and the hand overlaying each other as shown in Fig.6.

Fig.6. Creating an occlusion of the hand

So, for creating an occlusion we require a special type of shader called Mask Shader. The Mask Shader is a small scripts that contain the mathematical calculations and algorithms for calculating the colour of each pixel rendered, based on the lighting input and the Material configuration.

So finally, our all watch models and occlusion of the hand are made for the application. Now the next steps cover to make an interactive UI for the application.

5.2. Creating User Interface

User Interface refers to creating an interactive environment in which an user can interact with the computer system easily.

So, we are having a total of three watches models. For an interactive UI, we create three UI buttons for each watch. When the user clicks on any of the watch buttons the 3D watch is formed on the image target and a window slides into the mobile screen showing the watch model, watch model's name, price, two colour buttons and a cross button. The colour buttons are used to change the material colour of the watch. And the cross button is used for closing the watch model window. When the user clicks on the cross button the window slides out of the screen.

So, first, we are going to create three watch buttons for each watch respectively. Here, Unity provides special features for creating UI buttons.

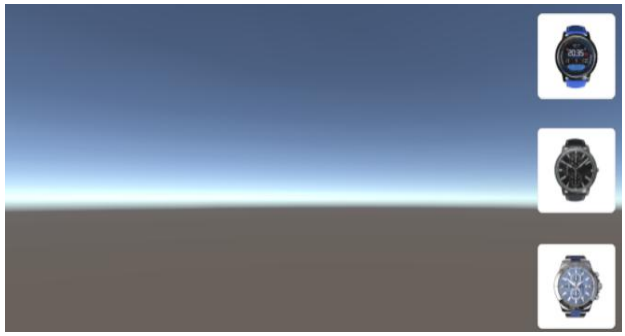

Fig.7. Creating watch buttons

After creating watch buttons we need to create a window with some description of the watch. The window is made in such a way that if a user clicks on any of the UI buttons the window will slide into the screen with having the name of the watch, its price, and two more UI buttons to change its colour. There is also a cross button on which if a user clicks the window will slide out of the screen.

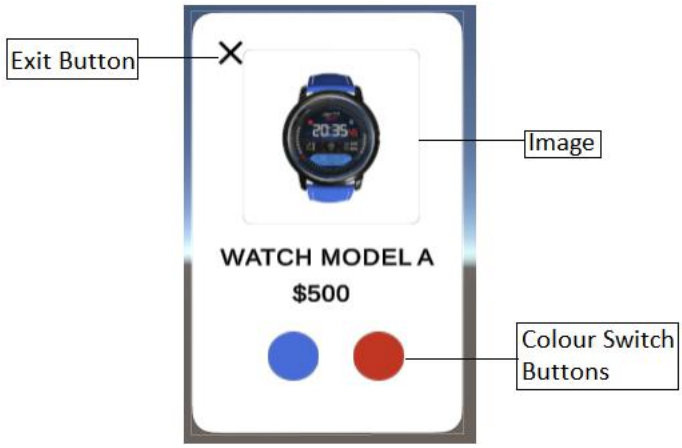

Fig.8. Watch Window

Fig.8. shows all the features of the watch window with having an image, colour switch buttons and exit button.
Now, after making of the UI window animation of slide in and slide out is added. So that if we click on UI buttons window will slide in and if we click the cross button the window will slide out.

Therefore, the final step is to link all the watches, the UI buttons and the watch windows to each other. Unity supports C-sharp programming language. So, we are going to link the UI with the program.

After that, we just going to create android application containing all the above functions with help of Unity, Vuforia and Android SDK.

Chapter 6

Testing, Results and Discussion

6.1. Testing

Testing is one of the way of assessing the system which helps to detect the quality of the software,the methods we follow and evaluate the expected output and the actual input. Verification and validation are the process in software testing where we verify various things and validate them. Some of the conditions are stated at the development phase which must be satisfied by the product is called verification. The requirement must be specified at the end of the development phase which assures the validation.

6.2. Results and Discussion

The results of various applied steps in making the application are presented here with the help of a table showing various functions of the application working or not.

The table consists of the various application functions working or not and the various watch models as the rows.

Watch Models	UI Buttons	Watch Windows	AR on wrist	Colour Switch Buttons	Exit Button
Watch Model A	Yes	Yes	Yes	Yes	Yes
Watch Model B	Yes	Yes	Yes	Yes	Yes
Watch Model C	Yes	Yes	Yes	Yes	Yes

Table 1: Performance Metric of Various Functions of Application

In Table1, all the performance metric are checked manually after the implementation of the application. All the functions of the application i.e. the UI buttons, Watch windows, AR watch on the wrist, Colour Switch Buttons and the Exit Buttons are working properly in comparison to the expected outcomes.

Chapter 7

Screen shots of the Project

Fig.9. Target Image

Fig.10. Watch Model B

Fig.11. Watch Model A

Fig 12. Watch Model C

Chapter 8

Conclusion and Future Work

The trying on watch app presents a a new method of interaction of humans with the real objects in their surrounding through the means of computer generated images using the concept of Augmented Reality. The main features of this application is that it is unique, noticeable, it eliminates the confusion, the content quality and interactivity is high compare to other e- commercial app.

Today, most online stores offer instructional video on several products in order to help the buyer understand the product. With Augmented reality not only can they interact with the product they can explore its functionalities as well. Typically an average online shopper spends roughly 2 minutes online before making a purchase, but with the AR experience that time grows and it has been showing that the more time a customer spends in a store the more likely they are to make a purchase.

The E- commerce app made using AR helps the seller to sell more number of goods in compare to other web based presentation image. It also attracts right customer and eliminate the confusion of buying the goods. Both the customer and seller gains maximum profit as there is less use of the other resources. Also, due to high interactivity it helps to retain more and more customers.

Therefore, Augmented Reality technology is a must-have in the business of eCommerce as it offers a lot of benefits from customer satisfaction and experience, increased sales, repeat business which will later lead to better conversion rates and revenues. In the world of eCommerce, it is vital that you continue to find innovative ways to interact with customers and Augmented Reality gives you that innovative edge.

Future Research Direction

The model can be further improved to a vast system through which a user or a customer can customize his own style of watch.The proposed models can be further enhanced, if the processes can be parallelized. This is feasible, by identifying operations that are independent to each other and propose a parallel architecture to improve the performance. The customer can then place their order on an e-commerce site. The model can also be connected to a local vendor or the maker for the sales order of a self customized unique watch.

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