INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

Analysis and Implementation of Augmented Reality in Providing Real Life Experience of a Product Virtually

Dr. Amar Nath Singh[1] (Member IEEE), Mr. Kumar Abhijeet[2],

Department of CSE, Amity University, Jharkhand, India[1]

Department of CSE, Amity University, Jharkhand, India[2]

ABSTRACT: A lots of Ecommerce website is not able to provide its customer the trail features that they get in an onsite shopping because of which lots of people still prefer to buys things from there local sellers or nearby malls, stores etc especially for products like watches, clothes, furniture and ornaments. In this paper I will beimplementing an AR based application which will overcome this limitation of online shopping and will provide onsite like trail features in online shopping by integrating the virtual 3D images with the real-world environment. This application was built using Vuforia and Unity3D which is a cross platform game engine developed by Unity technologies. We can further integrate Unity-Vuforia project with android apps. I have conducted an open-ended survey to analyse people's perspective on this and have also collected the data from world wide statistics. I have also Implemented a small application which works only with watches for better understanding this can further be improved to work with a huge number of products. Based on all those references it is proved that Augmented Reality can be used in providing practical post-purchase customer service.

KEYWORDS: Augmented Reality, Ecommerce, Vuforia, Unity3D, AR Watches.

I. INTRODUCTION

There are two ways people can buy things, one is onsite shopping and another is online shopping. Onsite shopping is something in which people visit nearby stores, Malls or shops to buy things, whereas Online shopping is a shopping in which people can order anything from anywhere by using various ecommerce websites and application. Advantage of onsite shopping over online shopping is people can interact with the products before buying it whereas advantage of online shopping over onsite shopping is that it provides vast variety of products as well as it saves a lot of time of the customers making their life easier.

Although Ecommerce is in boom but still many people prefer onsite shopping as the buyer can interact with the products before buying it which is rarely possible in ecommerce website. Buying things such as clothes, watches, ornaments, shoes and furniture in absence of product's texture, its appearance in real world, fit or sound may result in disappointment. As there is hardly any interaction between the buyer and the products a lot of people prefer to choose onsite shopping for buying clothes, watches, furniture etc.Not only that but it also causes loss to many Ecommerce site as people unhappy with the received products may raise a return or exchangerequest and the company has to bear all the delivery charges without making a successful deal. These types of limitations can be tackled with the help of Augmented Reality, it is one of the most advanced and trending technologies of current era. Augmented Reality can enhance a person's view by mixing up the real-world environment and the computer-generated virtual objects. These AR systems overlays the 3D virtual objects in the real-world environment to increase the user's virtual experience by providing more details than a normal two-dimensional picture helping them to achieve their task in more natural way[4,3].So, it has a wide range of applications in human-computer interaction, industry maintenance, multimedia computing, medical and military training.

There certain things to keep in mind while designing the 3D virtual object of the products.
* The dimension of the virtual object must align with the original object.
* The colour and design must be same.
* Virtual object must be designed in such a manner, so that it can give feel of a real objects.

Overlaying a virtual object onto a real-world environment must be accurate, it should show accurate moments along with the moments in the real-world environment which depends upon tracking technologies. In this paper the

implemented model uses a marker-based tracking technologies but to maximize the efficiency of an AR application we can use a combination of marker as well as marker-less tracking systems.

A detailed information on the implementation of a small application i.e., a watch selling website using AR technologies developed using Unity3D and Vuforia will be discussed in this paper.

II. TECHNOLOGIES USED

- **Unity 3D**
  Unity is one of the most popular cross-platform game enginedesigned by Unity technologies. Earlier it was used for creating 2d and 3d games but now a days it is also used for creating VR and AR applications. Unity made applications can be easily deployed in any of android, iOS and windows system. It uses C# scripts. Popular AR application implemented using unity is Pokémon Go.
- **Vuforia**
  Vuforia is an augmented reality, software development kit used to create AR applications. It uses computer vision technology to attach virtual 3D object to images, real objects or even flow or tables.
  Vuforia offers various tracking modes such as Tracking Images, Tracking Objects and the last one is tracking environments. Other Vuforia features are Vuforia fusion, Device tracking, Cloud recognition service, Recording and playbacks, Driver frameworks and external camera.
  Vuforia Images tracking takes four types of target images target, cylinder targets, Multi targets and VuMarks. Vuforia Images tracking recognises the target and overlays the virtual 3d objects on it.
  Vuforia Objects tracking tracks two types of target Model targets(recognize objects by shape using pre-existing 3D models) and object targets(Created by scanning an object with the Vuforia Object Scanner), the app recognises the objects and overlays 3d information on top of that.
  Vuforia environment tracking provides two tracking targets: Area targets and ground planes, Area targets allows us to scan augmented real environment using Vuforia Area target creator app whereas ground plane enables you to place content on horizontal surfaces in the environment like tables and floor.

III. MARKER-BASED AUGMENTED REALITY

Marker based AR uses some sort of image target to get triggered. A user can scan these images easily with their smartphone's camera through an AR application, an AR application overlays the content on the top of the marker [7, 9]. A content can be any of text, images, videos, animation, audio, 3D objects or a 360º video. It is recommended to use a unique marker with details over a range of scales as it will give more robust tracking. This type of augmented reality is generally used in places where a user wants to retrieve information of a particular thing or activities indulge in particular place or object for example retrieving the details of a company or organization using their logos.

Marker Database can be hosted either in local or in cloud, marker databases can be stored on device and recognition also happens on device. The databases can also be stored on a cloud and recognition happens on a server; phone is only sending point clouds to server. Marker database stored in device is usually faster than those stored in cloud, in AR application that uses cloud database takes couple of seconds to render augmented reality object as the content needed to be download from the server. Marker based AR supports a wide variety of devices, marker-based AR provide quality experiences and tracking is very stable.

IV. MARKER-LESS AUGMENTED REALITY

Marker-less AR scans the user's environment such as floor, table, chairs and in rare cases vertical surfaces such as walls, the AR systems then analyse the environment to find co-relation and differences in the pixels and then interpret the virtual co-ordinates with respect to real environment [8, 9,10]. For better efficiency the scanned surfaces must have some kinds of natural or artificial patters such as lines, spot or textures. It is really difficult to use white background or a plain background to get your AR application works fine.

Marker-less AR have low device support as compared to Marker-based AR, Marker-less AR is compactible with devices having iOS version 11 or higher or with the devices having android version 4.4 or higher than that. This type of Augmented Reality is used where the user needs to place 3D objects in the real environment or to try the products on a person.

V. USING UNITY FOR IMPLEMENTATIONS

5.1) Some Basic Tools& layout of Unity to get familiar with:
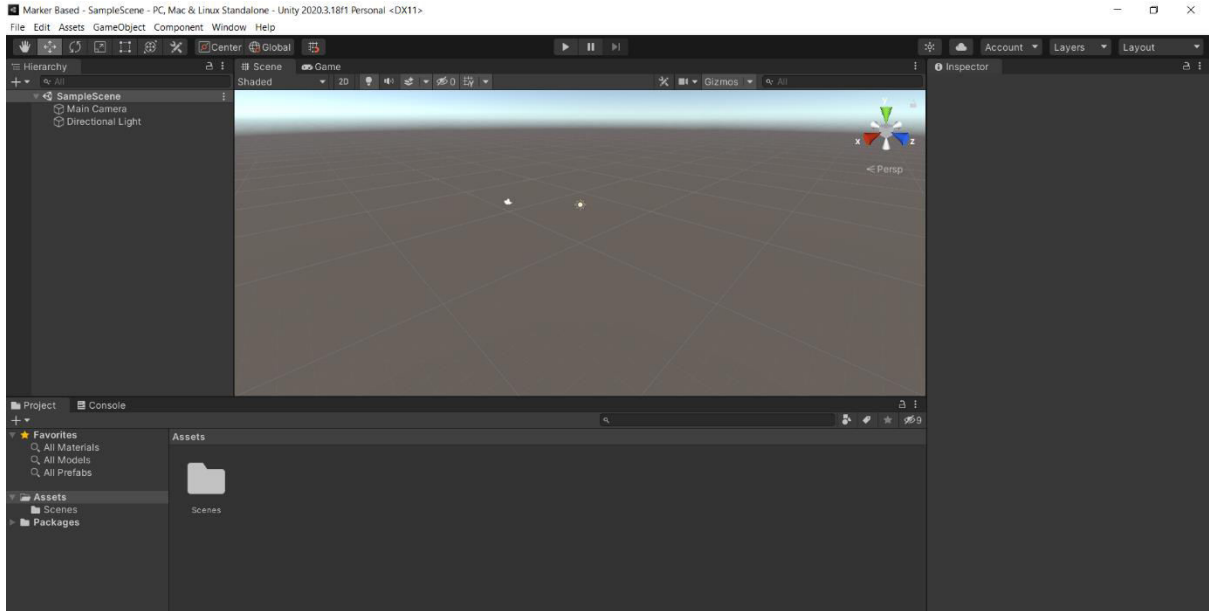
- **Scene:** Scene (the middle portion of the picture) is the interactive view of the environment you are creating. You can use scene window to customize all types of GameObjects.Scene contains all the visual stuffs inside an application, example All the visuals UI, buttons, 3d objects etc. It is used for manipulating, modifying and selecting GameObjects.
- **Hierarchy:** Hierarchy (The left-hand side portion of the image) contains the list of objects that are present in the Scene view such as models, cameras or prefabs. It is used to create nested parent-child GameObjects.
- **Project Window:** Project Window (the bottom left side of the image) contains all the files of your projects, it is the standard ways to navigates through your project such as assets, files, images, video or 3D models.
- **Inspector:**Inspector Window (the right-hand side of the image) list all the properties of object in Hierarchy window. Developer can use the inspector window to manipulate the properties and setting of GameObjects, Assets, Unity Component, Materials and many more.
- **Game:** (Click on the tab beside Scene tab to open Game window) Game window renders stuffs that the application camera sees. It represents your final, published application.

- **Hand tool:** Hand tool allows user to pan around the scene.
- **Move tool:** Move tool allows user to move GameObjects in x, y and z axis.
- **Rotate tool:** Rotate tool allows user to rotate the GameObjects in various directions
- **Scale tool:** It allows user to scale the GameObjects in x, y and z direction.

5.2) Setting up the Vuforia environment:

The developer needs to have a Vuforia account in Vuforia developer portal to work with Vuforia, if they don't have, they can create one for free.
- **Creating an image target**

Image target is necessary to trigger an Augmented reality object in a marker-based application [3,7]. The dimension and the orientation of a target image directly affect the deploying of an augmented object. Vuforia provides a 5-star rating system for the target images, ratings of an images are directly proportional to the number of features, images

having higher number of features or rating is more efficient to tracking. So, it is recommended to create an image with higher number of features, generally QR codes types of images have higher rating.

Once the image is created, it should be uploaded into Vuforia Target Manager Page. To upload the image in Vuforia Target Manager: Select the database -> Target Manager -> Add target.
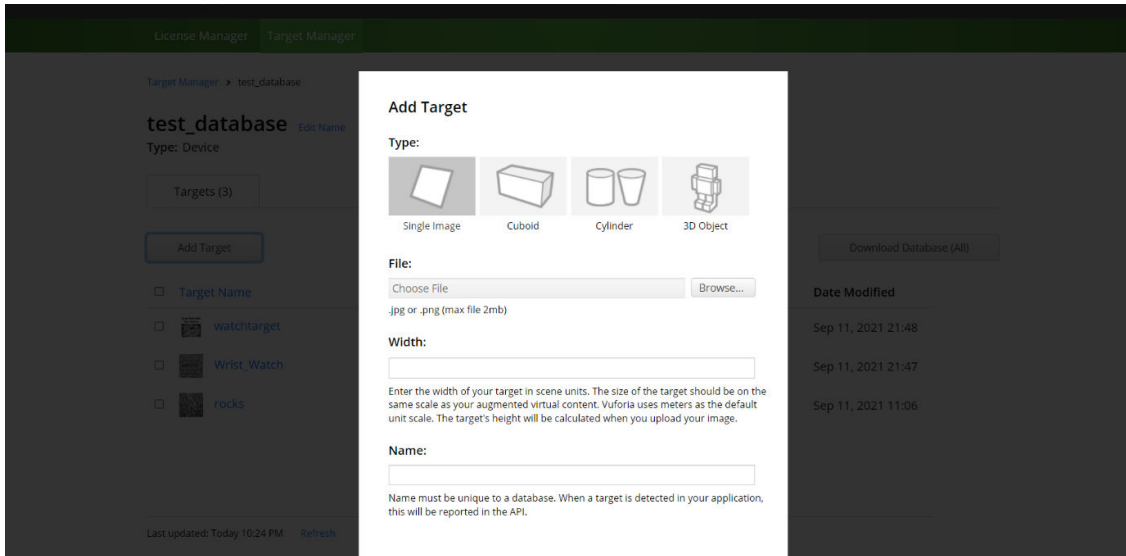
A pop-up appears as shown in figure above fill all the required field as per your requirement and click on "Add". In this paper I added a single image type target name "wrist_watch" of width 4.
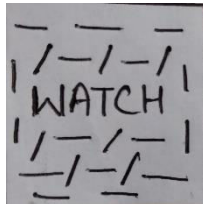
FIG: My image target.

After adding the target image, we need to import it to the unity application. For this Click on an option "Download Database" in the left side of the blur background, move the downloaded file to Unity assets folder and import it to Unity [2,5].

- **Building and importing Vuforia**

    Download Vuforia from Vuforia developer portal double click the downloaded file, a pop-up will appear as shown in below click on "import"[1,11]. After importing add the AR Camera by right click on hierarchy window go to Vuforia engine then AR camera. Click on AR camera then in inspector window click on "Open Vuforia Engine configuration" add app license key then click on "Add License".
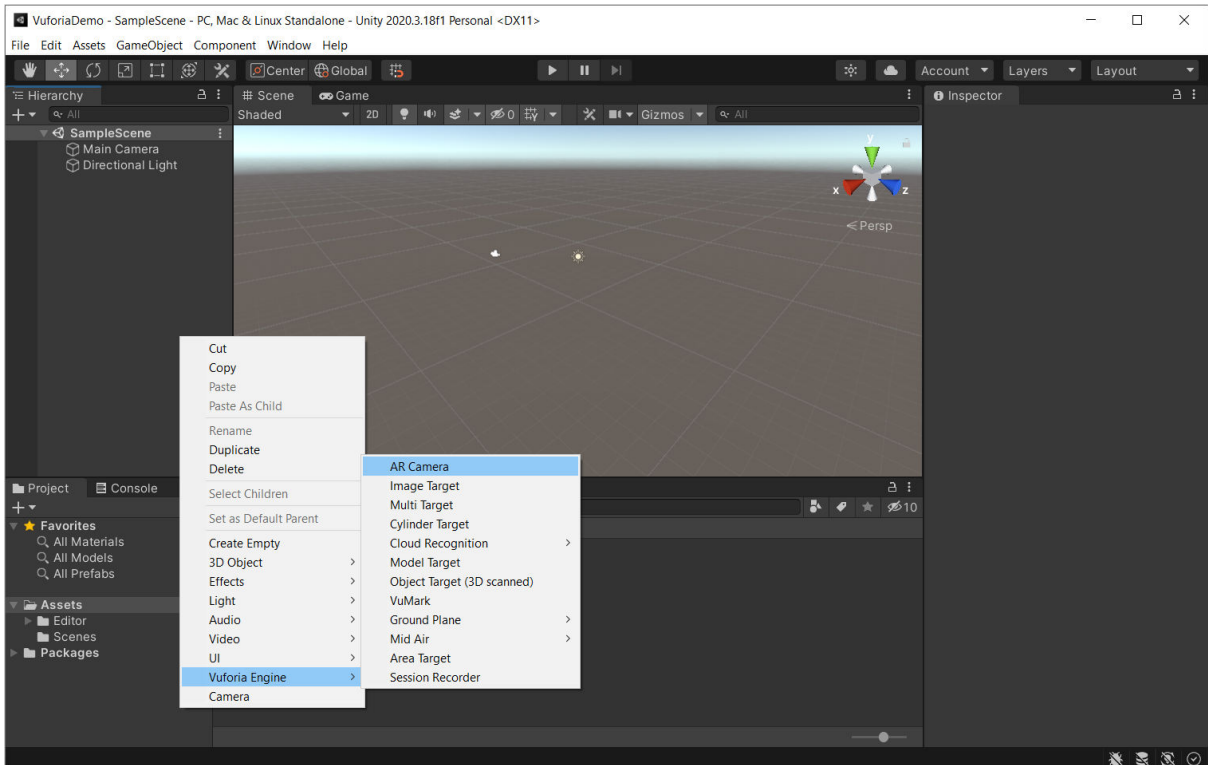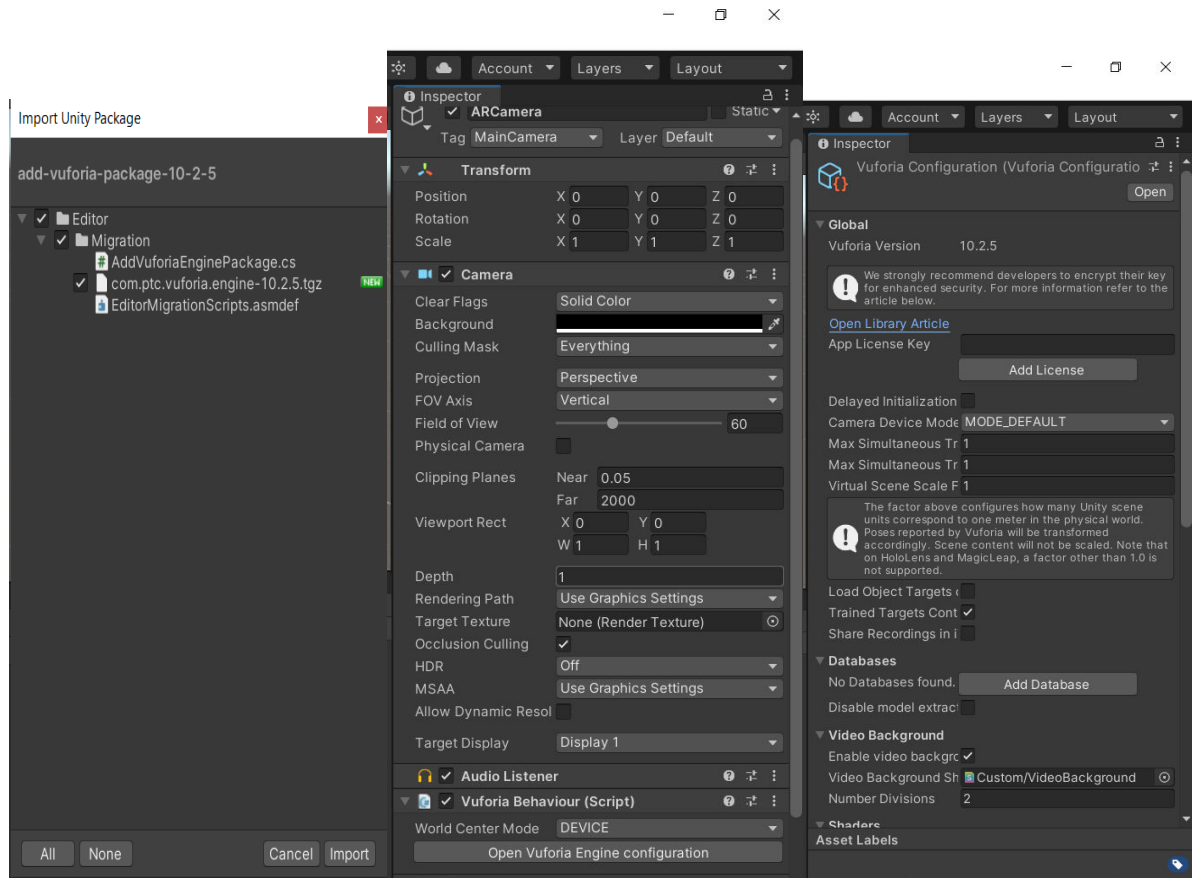
Fig: Showing all the steps mentioned above for reference.

5.3) Deploying the Watch-model & triggering it using the target image.

3D Watch models:
Create the exact 3D replicas of the products available in the ecommerce site in my case it's a small implementation of online watch store so, I am just making the 3d watch objects with as low difference as possible with the actual physical one to give a better AR experience. There are various applications available over the internet to make 3d objects some of them are: blender, cinema4D, Autodesk Maya etc. 3D objects comes with various extensions some of the regular used extensions are: .OBJ, .FBX, .MAX and .DAE.
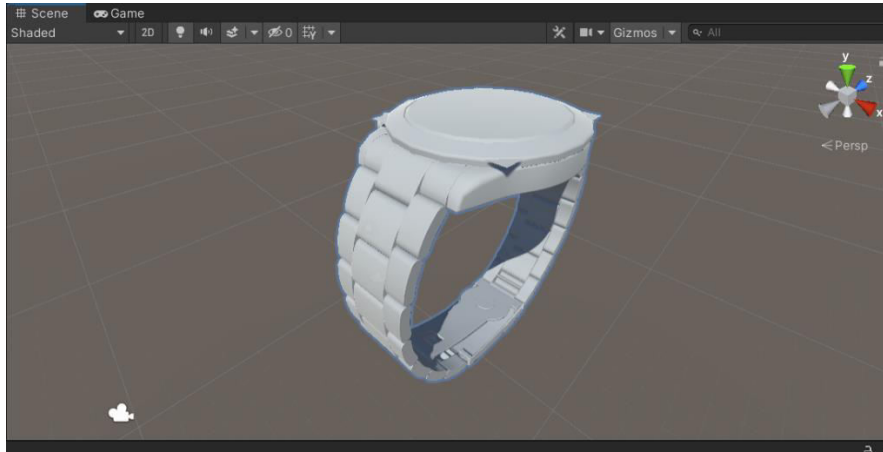

When a 3D object is imported to Unity it will look somewhat similar to the image shown above, we can customize the watch further by applying the materials to give it a required look.

- **Attaching images target to 3D models**
 As discussed above an image target is used to trigger Augmented reality objects, so we need to attach every AR object with its respective image target so that whenever the device camera detects the image target it will deploy the corresponding AR objects attach with it.
 To attach an AR object with the image target, we need to make that object as a child of an image target. Positioned the AR object at the proper coordinates with respect to the target images to trigger the augmented object at the correct coordinates in the real world, for example in my case the bottom portion of the watch must coincide with the target image.
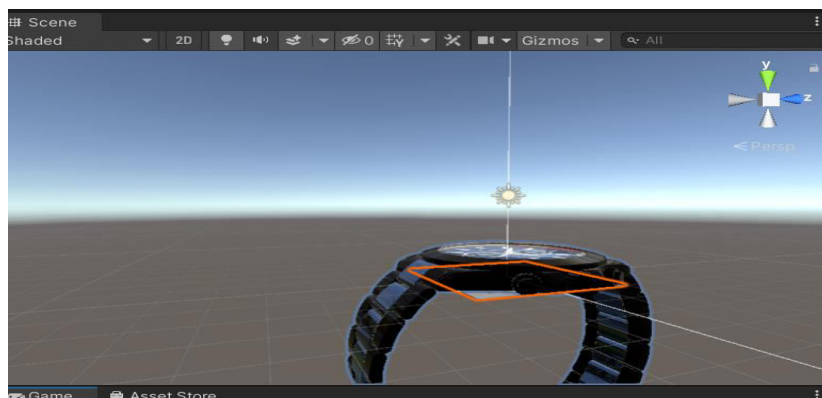

Fig: showing the attached AR object with image target.

5.4) Designing UI and animations of the app.

User Interface

User interface is the medium by which humans interact with the computer application or a website over the internet. It the things easy for the users by hiding the complex implementations. A well-designed user interface of the application gives the best user experience provides the great interaction experience to their users.

Unity provides a UI toolkit for creating user interface for the application developed in unity. UI toolkit is a GameObjects-based UI system, it uses components and game view to design the user interface. Unity provides various features such as canvas, text, buttons, images, etc. A canvas is the area which contains all the UI elements inside it, all the UI elements must be the child of a canvas.
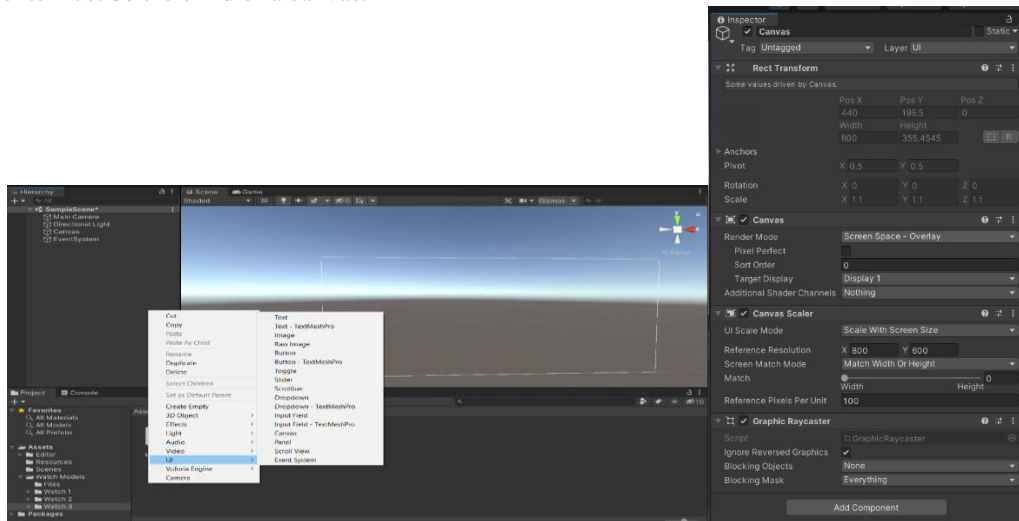

Fig showing add UI in unity and customizing it

Animations

Unity comes with an animator control asset that allows developer to create annimations for the GameObjects.

We can create animation by clicking on the "Add Component" button in the inspector window, search for animation and click on add it will add the animation component. Now select the GameObject for which you want to create the animation, go to window then animation and click on animation(1). A window for creating animation will appear (2). Now you can create the animation as per your requirements. Drag the created animation in the animation field of animation component.
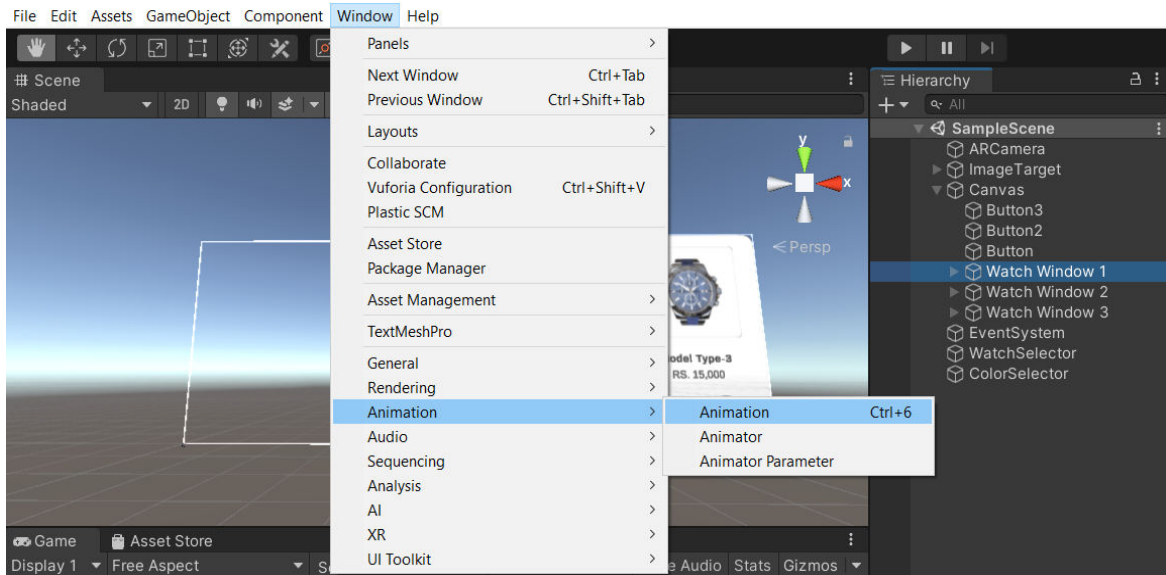
Fig(1) of the above instruction
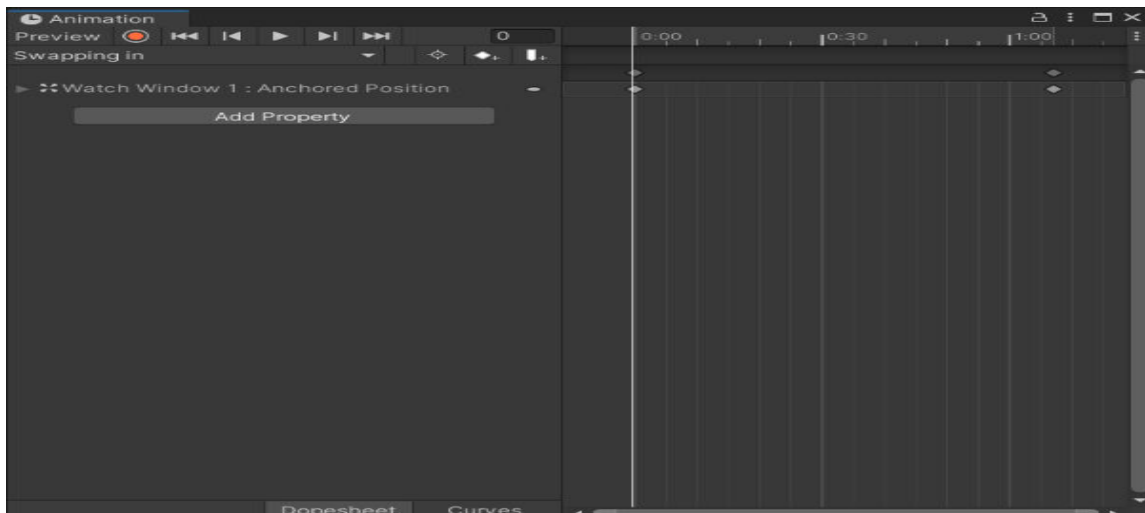
Fig(2) of the above instruction

5.5) Creating scripts

Scripts are created by the developers to controlls the behaviour of the GameObjects, for example closing the window, selecting the watches, changing its colour and many more. Unity also allow its developer to create their own components using scripts. Scripts also allows its user to trigger game events, manipulates the objects properties and can handle and executes the user inputs as per their choice. Unity uses C# and javascript(UnityScript) as their scripting language.

5.6) Occlusion

The most difficult and complex part of AR is creating occlusion, occlusion is augented reality means hiding the virtual objects behind the real object so that it won't overlaps the real objects, the actual application of AR is to bring virual objects in real environment and to build up the interaction of virtual objects with the real surrondings, So if the condition arises where the virtual objects is overlaping real life environment without actuallly interacting with it will make the AR application fail as it fails to provide the real life experience. So to deal with such type of problem occlusion is needed.

The goal of occlusion is to preserve the rules of line-of-sight when creating AR scenes. That means any virtual object that is behind a real object, should be "**occluded**" or hidden behind that real object.

We can create occlusion in by creating the 3d object as the child component of image target for example in my implementation model, I don't want my augmented watch model to overlap on my wrist. So, I made a 3d hand object as the child component of image target wrap the augmented watch around the fake 3d wrist and applied occlusion material to it results in hiding the portion of the augmented watch wrapped in the back side of the wrist.

VI. WORKING OF THE MODEL

The model is implemented using marker-based augmented reality, a marker is used to trigger the watches model, this type of AR model is also known as recognition-based AR. Marker-based AR application works by scanning the marker and deploying the 3d models associated with it. All these process needs a good working camera, a marker and the AR applications developed by the AR developers installed in your smart devices. Open the application, grant all the permission required by the app to work efficiently, now scan the marker from your device camera, the application will recognise the marker and will trigger the augmented objects associated with it. The main limitations of these types of system is that it works only when the marker is in the field of view of device camera.

In my implemented model of AR-watches we created a easily accessible user interface of the application and can be accessed with less skills. The application opens with a pop-up requesting its users to grant the permission for using their phone camera, after allowing it the screen open with $7/8^{th}$ part of the window showing the surrodings device's camera is capturing and the rest $1/8^{th}$ portion of the screen is showing the three buttons with different watch images,
Click on the buttons of watches of your choice the click watch will be deployed on your wrist which can be sceen in the $6/8^{th}$ part of the window in your phone screen and the rest $2/8^{th}$ part will be showing the specifications of the watch and the colour buttons, you can click on these button to customize the band colours of the selected watch. These system provides the better ways to interact with the products the user is actually buying, as the deployed AR watch shows moments with respect to the wrist i.e. if you move your hand the watch will also move along with your hand.

The selecting of the watch and changing the band colour of the watches is programmed using the unity scripting language that is C#. We can create a script file by right clicking on the project window -> create -> C# script. Open the file, A file will open with the starter code as show below:

```
usingSystem.Collections;
usingSystem.Collections.Generic;
usingUnityEngine;

publicclassNewBehaviourScript :MonoBehaviour
{
// Start is called before the first frame update
voidStart()
    {

    }


// Update is called once per frame
voidUpdate()
    {

    }
}
```

Start function in unity is invoked before the update function is invokes for the first time. This function get invoked as soon as the gameplay begins. It is an ideal place to do any initialization.
Update function contains frame update handling code such as moment, triggering actions, responding to user input etc.

VII. HOW TO USE

- Download the image target cut it at size of 3cm width and 3cm of length.
- Place the target image at the middle area of your wrist.
- Open the application in your android or iOS device grant all the permission ask by the app to work efficiently.
- Scan the image target with you device camera using the AR applcation select the watch you want to try.
- AR app will deploy the selected watch on your wrist with a window showing its specs and colour band option.
- You can change the colour of the band by clicking on the colour buttons.

VIII. USABILITY EXPERIMENT

8.1) Primary Data

The primary data is collected in the form of open ended survey consists of variety of questions related to Augmented Reality to learn about the audience perspective on the topic. The was conducted with 50 participants (62% male and 38% female), at first they were given the traditional ecommerse site and in second time there where given the ecommerce application with augmented reality support, baed on their experience they are provided with 12 question to answer. After going through the responses we found that 46% of audience are aware of AR and have used AR relatedapps before. 46% of the audience are also aware of AR but didn't used it before, 6% audience are not aware of AR but have used AR apps before, rest 2% of them are neither aware nor used AR. 96% of the audience love to do online shopping and they agreed there should be some kind of interaction with the products, 98% of the audience believe that the ecommerce must provide the try-on features to theirs apps for better interaction with the products, just like lenskart provides with their apps, 98% audience thinks that it's a great features, although only 78% of the people actually used it, when asked a question what will they prefer Buying a watch, ornaments or clothesfrom a website that gives you a ARbased platform to have a virtual trial ofthose stuffs or without AR features, 98% of the audience actually chosen AR over traditional one. 94% of the audience agreed on the point "integrating AR with Ecommerce website will attract more peoples in future toward online shopping".

8.2) Secondary Data

Secondary Data is collected from 2021 statistics of Augmented Reality published in threekit according to the data present in threekit, the competition in engaging customers in shopping process is becoming tough day by day, so to attract more customers retailers are adopting the latest technologies. One of the most trending tech in 2021 is Augmented Reality.

According to the report around 1% of the retailers are using AR in their business, 52% of the retailers say they are not yet ready to integrate AR into their business as they don't have the skilled developer or partner so it will also increase job opportunities in future, 72% of consumers will shop more if retailers will use AR, 61% of consumers prefers AR retailers, also the 66% of the peoples in Japan wants the offline store to use AR. It is just the beginning of AR in 2021, the estimated market value of AR is $50Billion by 2024, more than 5% of retails will upgrade to AR by 2022, 40% people ready to pay more if they get an option to customize their products using AR, around $18.89 billion spent in AR/VR technologies in 2020. All these data shows that AR is in boom and will definitely be profitable in every aspect of life.

IX. CONCLUSION

Most of the ecommerce company failed to provide the post practical experience of the products to their consumers, it's the main reasons why most of the peoples still prefers to shop offline from the local markets, malls or shops. Things like shoes, furniture, watches clothes need some sort of interaction with the buyer. In this paper you tried to tackle such problem with the help of augmented reality technology. AR is integrated with these systems to provide post-purchase customer service. Buyers can now easily interact with products they wanted to buy before actually buying it.

The paper includes study of Augmented reality, various ways of tracking, using unity and Vuforia to implement a small model to show the actual need of this research and how can an AR be useful in providing the post purchase customer service. The keytasks carried in this paper are: creating an image target to trigger the augment reality, using Vuforia SDK and Unity for creating the application, adding occlusions, creating user-interface using unity user-interface toolkit, script coded using C# language. The experiment data validates the idea of research, people actually agreed that Augmented Reality can be useful in providing practical post-purchase customer service and will surely bring more people in ecommerce platform in future.

Although the AR technologies is useful in providing post-purchase customer service, it helps the consumers to interacts with the products they are buying but it also comes with a various limitations as the AR technologies are very expernive in maintanace as well as implementation is also coastly, the main limitation of AR setup is security and privacy concern

AR is deploying information and virtual images in real world, it's user totally dependent on the things shown by AR application, hackers can manipulate the data and imformations and can get your personal details such as credit card details, bank details and many more. Futher the model is implemented using marker-based AR technologies so it can be improved to marker-less AR technologies as well.

REFERENCES

1. Virtual and Augmented Reality 2020 by Lawrence Rosenblum, Naval Research Laboratory
2. Marker-Based augmented reality application for mobile learning in an urban park; Lúcia Pombo and Margarida Morais Marques; Research Centre Didactics and Technology in the Education of Trainers (CIDTFF) Department of Education and Psychology University of Aveiro Aveiro, Portugal
3. A study on marker-less augmented reality for picture books by Tai-Wei Kao and Huang-Chia shih; Department of Electrical Engineering, Yuan Ze University, Taoyuan, Taiwan.
4. Unity Documentation https://docs.unity3d.com/Manual/index.html
5. Vuforia Documentation https://library.vuforia.com/
6. Augmented Reality Game development Game development using Unity and Vuforia;
7. V.G.KARTHIGA, BENIEL.D, ARAVIND KUMAR.M, SIVA SHANKAR.S; International Journal of Advance Engineering and Research Development Volume 5, Issue 03, March -2018
8. A Study on Tracking and Augmentation in Mobile AR for e-Leisure; Seong-Wook Jang , Junho Ko, Hun Joo Lee, and Yoon Sang Kim; Hindawi Mobile Information Systems Volume 2018, Article ID 4265352, 11 pages https://doi.org/10.1155/2018/4265352;
9. Augmented Reality E-Commerce Assistant System: Trying While Shopping; Yuzhu Lu and Shana Smith; Human Computer Interaction Program, Iowa State University, Ames, IA, USA
10. Threekit, 20 Augmented Reality Statistics You should Know in 2021 https://www.threekit.com/20-augmented-reality-statistics-you-should-know-in-2020
11. Why Occlusion is augmented reality is so hard? https://hackernoon.com/why-is-occlusion-in-augmented-reality-so-hard-7bc8041607f9
12. Various blogs, YouTube videos and wikipedia also played a important role in this research

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 7.542

doi® crossref

ISSN
INTERNATIONAL STANDARD SERIAL NUMBER
INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

📱 **9940 572 462** 🟢 **6381 907 438** ✉ **ijircce@gmail.com**