

FINAL YEAR PROJECT
AR VIRTUAL CAR SHOWROOM

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This Report Presented in Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science in Multimedia and Creative Technology

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DAFFODIL INTERNATIONAL UNIVERSITY

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APPROVAL

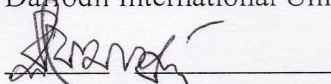
This Project titled “AR Virtual Car Showroom”, submitted by Md. Jubayer Al Hasan to the Department of Multimedia and Creative Technology, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Multimedia and Creative Technology and approved as to its style and contents. The presentation has been held on 26th December, 2019.

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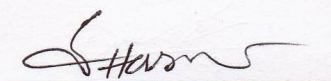
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We hereby declare that, this project has been done by me under the supervision of Md Salah Uddin, Lecturer, Department of MCT. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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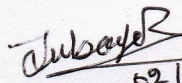
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ABSTRACT

Augmented Reality is changing the way of using smartphones. Nowadays most of people (young and parents) own smartphones and tablets. The possibility of combining Augmented Reality and smartphones for trade, advertising, instruction, entertainment is huge, though it still need to be entirely discovered. AR, in various ways, could grant users extra digital information about any product or subject, and make complex information easier to understand and choose from. When we talk about the business perspective of introducing AR in your mobile application; you can unlock many opportunities that take your (companies) trade and marketing to the next level. . That's why I am designing and developing an interactive AR app for showcasing valuable products with features and their facilities. The primary objective of mine is to create a 'Real World' augmented reality application, mixed reality app that can be used to boost (car) sales by impressing the client so much, they will have to share the application with everyone they know to showcase the features in a very easy way. Majorly I have used three influential technologies to create a Augmented Reality application also voice controlled to an online AI bot brain using Unity. User can record their voice in unity and automatically send the voice command to my trained online AI bot service. My created AI bot going to acquires and developed user voice command request, recurring commands to the c# code in Unity. Using the reply, of ai brain then i operate the scene. The added advantage of this is that user will send and receive information from an app to a website API where I created the bot. To make these happen successfully at first i model a 3D car with different parts animations of the car to response according button trigger or voice command. Then i use vuforia AR technology to superimpose car model with real world to showcase the real life showroom experience of Cars.

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CHAPTER 1

Introduction

1.1 Background

Augmented reality is a new tools of todays technology that works on computerized visualization-based recognition processes to augment sound, video, graphics and other sensor-based inputs ideas on real world environment using the camera of our device. It is a worthy way to render real world information and present it in an interactive way so that virtual objects converted into part of the real world.

Augmented reality demonstrates superimpose data in our field of view and can take us into a new world where the real and virtual worlds are closely shared. Most importantly it's not just restricted to desktop computer or smartphone devices. A modest 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 what showed on our camera screen.

Augmented reality is shifting the mobile app, game marketing in a major way. Precisely, it's transforming the way consumers interact with marketing promotions, products, and brands. Product-based companies-brands can show off their products with AR in 360° views in a communicating way to experiences and test products. Service-Providers can create AR tutorials of their brand services, showing customers exactly how much benefit they're getting for their buck before they even purchase. Because the device we independently use on our head like glasses, a visor or a helmet as a head-mounted display. Most of people can access AR for the first time with the general device we use every day like our smart mobile phones.

There is no limit to how this technology can shape product visualization and mobile marketing in a whole new level and it's all started.

1.2 Motivation

As a Multimedia and Creative Technology department student i have introduced and learned about different kind of new world technologies. Also learn to combine our 3D modeling, animation and graphics art knowledge with software programming, gaming and technology like virtual reality-augmented reality. My basic purpose of this project is to make a Virtual product showcasing application by using 3D model visualizations and Augmented Reality. Because almost every Car dealer and Car lover (and owners) have a smartphone in their hand, I decided to apply my Product-Showcasing idea on Car Showroom to make something which helps to boost sales of different product in this case Car sales and also to help buyer(customer) to experience their desired Car from anywhere without going to shop and showroom.

AR brings works sheets or flashcards to our life. It can represent static images in a magical way while simplifying and visualizing complex ideas, making them easier to understand. For example, a flower bud on a printed page could bloom in AR slowly.

The mobile AR offers numerous possibilities that can take any business to the pinnacle of success. A visually attracting application or game is enough to engage users towards your product in a way that it generates enormous revenues. Attracting potential clients is now a decisive part of trading in the digital world. Some of the well-known games that have ultimately set a standard in the market are specially based on augmented and virtual reality.

If we talk about smart applications, AR has taken the mobile utility applications to the next level. Some of the renowned AR-based applications are providing the ease of access to the users in a way that simplifies the job. For instance, one can witness the features like face recognition and object recognition, which can quickly help you in making decisions, which isn't possible with any other technology instead of AR.

Most of the businesses like the one dealing in furniture are now providing an AR-based feature that lets the customers clearly visualize how their furniture would look like on their smartphone. These kinds of features attract clients instantly, and as per the reports by Mobile App Development Services providers, most of the retailers and gamer are working precisely on finding the ways to invoke AR to enhance their businesses.

AR is a Blessing for Retail Industry. Developing an Android application that is purely based on augmented reality is the perfect way to enhance your online sales. There are a lot of businesses that have already invoked augmented reality in their businesses through smart applications that let users feel the things that augment their decision.

These are the facts that motivated me to create an application for a company to showcase their product attractively to clients for better sales and also for customers satisfaction. The Different car racing games and Furniture showcasing augmented reality applications also motivated me to come up with this project (idea).

My main motive to make a properly usable augmented reality application prototype what can be used for others products too.

By completing this project, it will give us more opportunity to show and share what we have learned till now as a student of Multimedia & Creative Technology department of Daffodil International University. This will improve my confidence and skills for the job market as well.

1.3 Objectives

The objectives of the project are to:

1. The primary objective to create 'Real World' Augmented Reality (AR) application to picturize product for impressing User(customer) to boost sale and that impress company.
2. Develop “AR Virtual Car Showroom” application for smartphones.
3. Developing Voice Controlled Product Showcasing application.
4. Creating a Car-showcase app. Projecting a full size vehicle in the real world.
5. Using voice commands, open the car doors, change the colors etc.
6. Provide detailed 3D Car models for Augmentations.
7. Making and Providing Animations of Car parts for better showcasing.
8. Even view a car promotional video on an augmented reality video screen placed on the dashboard of the car.
9. Provide the simplest User Interface to experience smoothly.
10. Give consumers the chance of learning information their own suitable time.
11. Show the possibilities of modernization of smart technology.

12. It helps customers to know at a low cost, short time from anywhere and in an interesting way.

Above all, the principal objective of the project is to create 'Real World' voice and touch controlled augmented reality applications, mixed reality apps that can be used to boost sales by impressing the client.

CHAPTER 2

Background Study

2.1 Introduction

Now a day's people are more likely to use smart phones and technology. They want all facilities o their phone. From that think, we decide to make the augmented reality app "AR Virtual Car Showroom". The concept of making augmented reality & virtual reality apps we get from our survey and from my supervisor Md. Salah Uddin. I share my idea with him and he counsels me to make it successfully. From that guidance and our survey analysis, we decide to make my app, after that i share my idea to our head of the department and he tells us to do that. He contributed with various ideas, suggestions and requirements. Then I start working.

2.2 Survey Report

Before start working i want to make a survey to know about companies, dealers and customers - users' requirements. Because we want to make the apps useful for company as well as for customer also wanted to make it user-friendly, attractive and interactive to them the survey helps us to know about their need, wants psychology and help us to improvise this project.

2.2.1 Requirements Analysis from Showroom: First,

I select well-known Car company brands and contact communicate with their dealer - showroom to complete my survey. After that, we give them a form with a few questions. We name that "Requirements Analysis from Showroom". Here the results of our survey report.

Interest in using mobile application per 20 people



Figure 2.1: Result of Customers and Employees Using Smartphones

From this survey, we know from the Car showroom employees and Car buyers that most of them owned a smartphone.

Smartphone Uses By showroom employees and Customers per 20 people



Figure 2.2: Result of their interest in using mobile application.

From this survey, mostly they love to get services through mobile apps.

Interest in mobile application with Augmented Reality

per 20 people

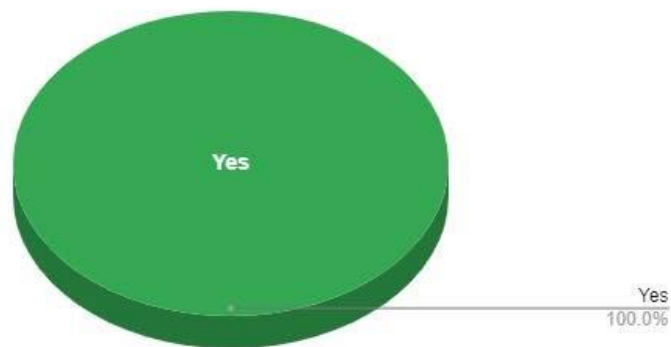


Figure 2.3: Result of Interest in AR and Virtual Technology

From this survey, we know that everyone love the augmented virtual reality feature in their smart phone. They amazingly like this technology.

Age vs Interest to own a car

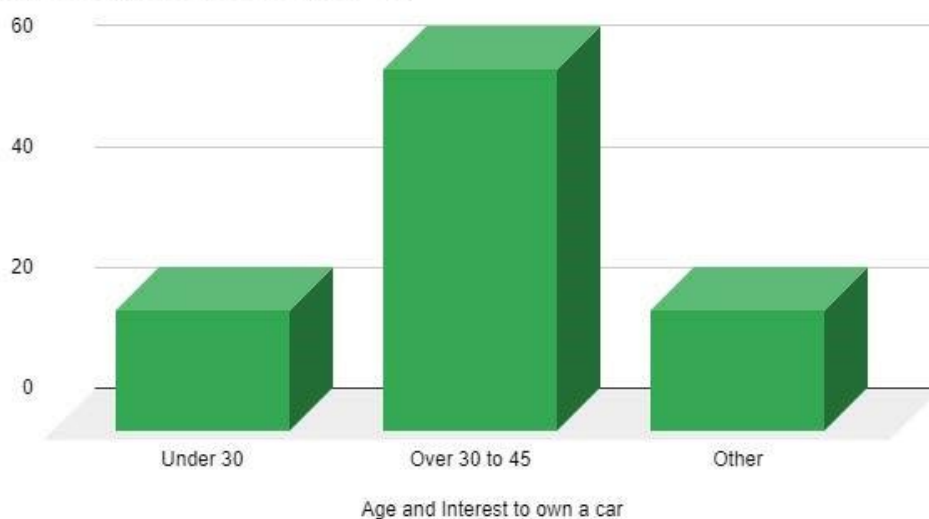


Figure 2.4: Result of buyers' interest according to age

Survey reveals those under 30 are passionate about car collecting and from 30 to 45 years old buys the car most.

Do you have/know about Augmented Reality

per 20 people



Figure 2.5: Result of idea about AR

From this survey, we know that 50% of them know about AR and 50% not know about VR.

Interest to use AR VR

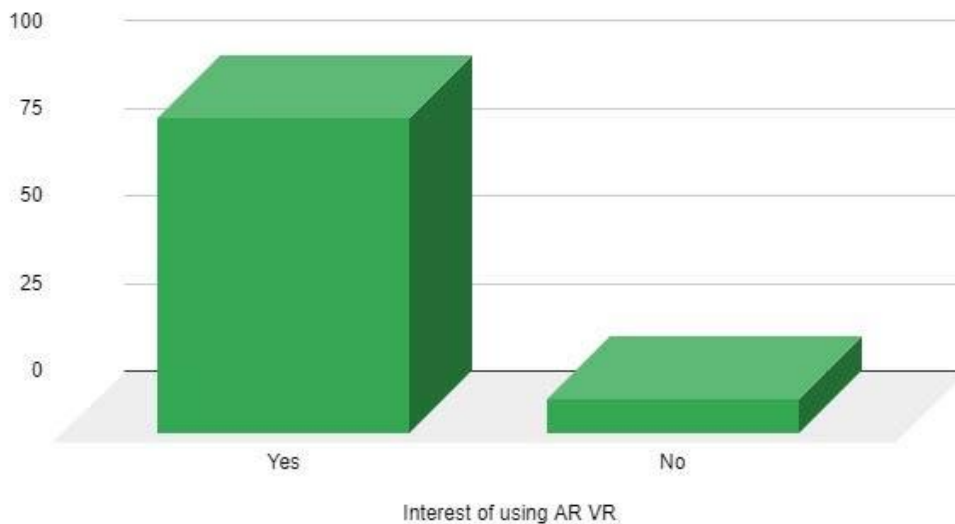


Figure 2.6: Result of accessibility and interest in AR Virtual Technology

From this survey, we know that majority of users wants to use AR and most of them already introduced with AR-VR.

2.2.2 Customer Requirements Analysis: After that we ask few question to the marketing managers what customers really wants and customers about their requirements. We named the survey is “Customers Requirements Analysis”. Here the results of our survey.

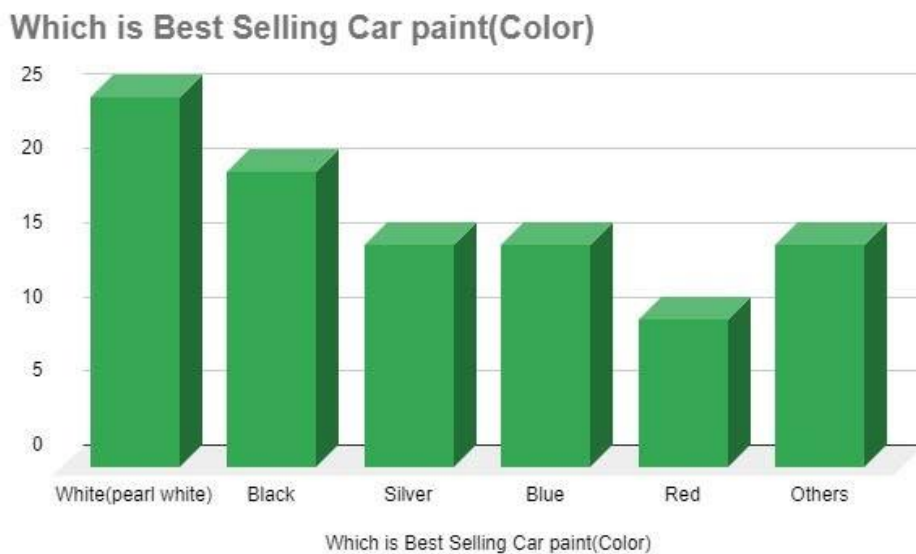
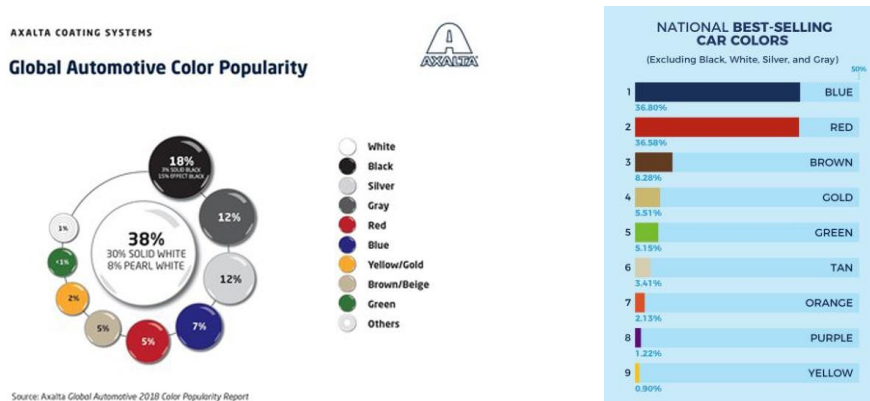
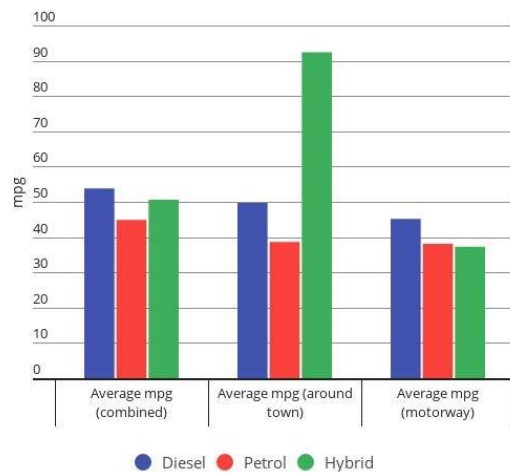


Figure 2.7: Result of customer favorite car color

Form this survey, we learn about the color choice of customer. I have found most of the buyer like White, Grey, Silver, and Black mostly. If I percentage according to colorful color they mostly like Blue then Red and then other car paint. It helps me about color sense for my car model design and also customer needs color changing options feature in my application

Diesel vs Petrol vs Hybrid: Best and worst fuel economy



Data from Which? independently tested cars between 2012-2016.
Numbers tested: 222 diesel engines, 174 petrol engines, 20 petrol hybrids



Diesel Car vs Petrol Car vs Hybrid Car

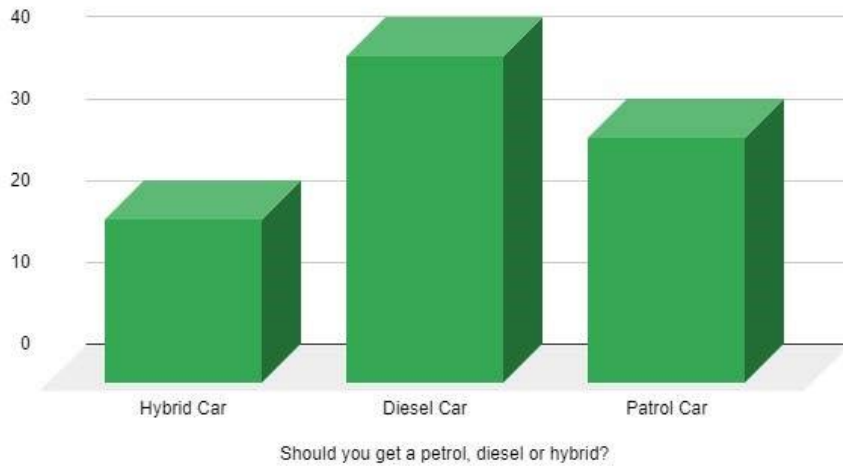


Figure 2.8: Result of Diesel Car vs Petrol Car vs Hybrid Car

Form this survey, we learn about Concerns over air pollution and higher taxes has increased interest in petrol and hybrid cars. Although Diesel Car is much cheaper in use.

2.2.3 Customer/Client Satisfaction Analysis:

Based on my research, after completing design and development again I have asked them four questions to know how they are accepting my developed application or not? Below is the result of four questions survey accordingly:

A. How User Friendly the Design is?

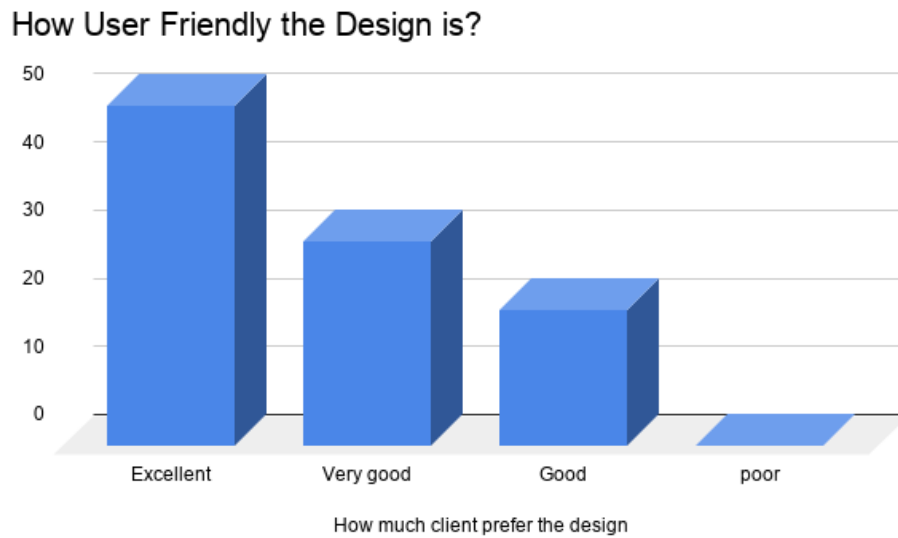


Figure 2.9: How much customer satisfy with the app design

Majority of them said the design is very user friendly and for AR app every function should be accessible from on screen, that's what I did.

B. Is the App Helpful enough?

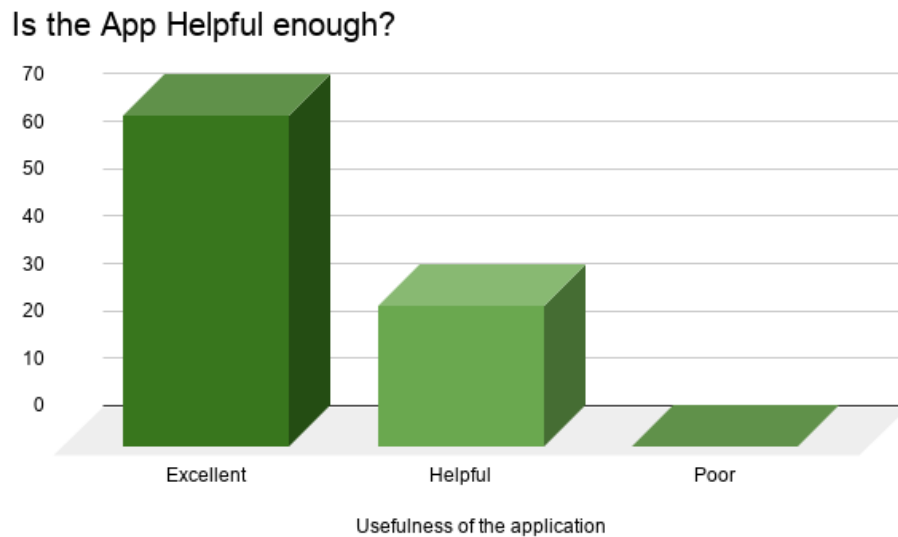


Figure 2.10: How much the app is useful to users

From the users and showroom survey I am delight to found that for showcase solution my AR virtual showroom app is very helpful to salesman and also to users as they can experience real view of their cars with useful information.

C. How User Friendly the Design is?

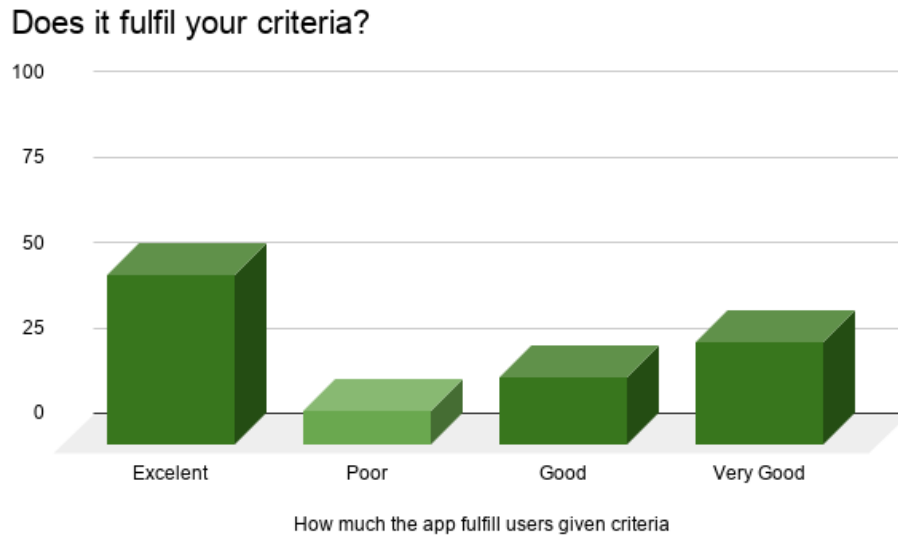


Figure 2.11: How much the app fulfil clients criteria

D. Are you going to use the app?

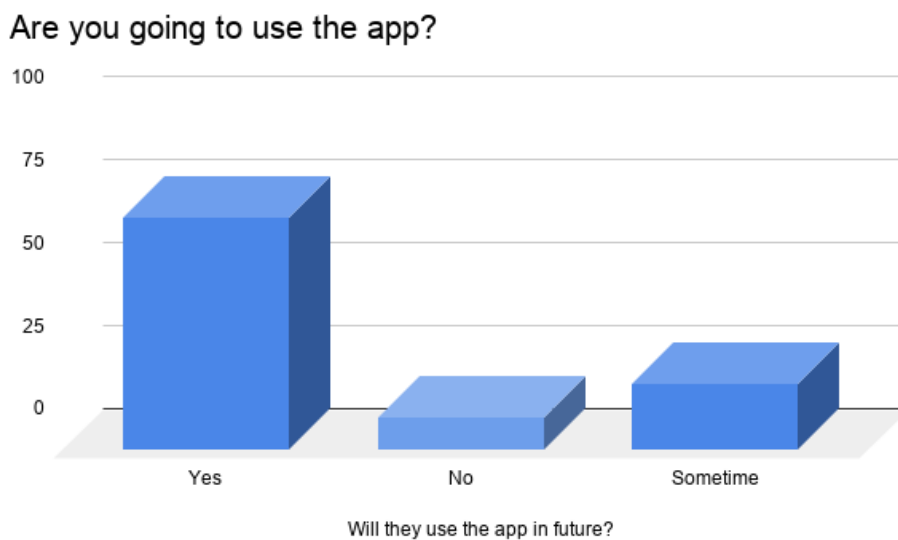


Figure 2.12: How many of them wants to use the app in future

2.3 Augmented Reality

Typically, developing an AR application for a novice is very tough because it fundamentally includes pattern recognition, image processing, object rendering, interaction ability and so forth. All these procedures have to be done altogether then only it is able to show a virtual object in a real environment. Therefore, developing AR applications in a custom way can be time-intensive and niggling. However, few AR enterprises such as Metaio, Vuforia, Wikitude, ARMedia, Layar and many more have advanced AR Software Development Kit (SDK) which enables AR application to be developed effectively and some SDKs do not actually need any programming skills. We are work AR Vuforia SDK.

2.4 Virtual Reality

Virtual Reality is also using in many important sectors. Among them scientific imagining, manufacturing design and architecture, learning, healthcare, video game and more. In VR mode users can freely move around the floor. It will give him/her the real flavor of being inside that floor. All these processes have to be done altogether then only it is able to display a virtual environment. Developing VR applications use VR Software Development Kit (SDK). Such as Oculus Rift, Gear VR, Vive, Google VR and many more. We use Google VR SDK.

2.4 Mixed Reality

Mixed reality (MR) is a significant progression of augmented reality (AR). **MR** is the merging of virtual and real worlds to yield new surroundings and conceptions, where physical and digital things co-exist and cooperate in real time. Mixed reality does not entirely take place in either the physical or virtual world, but is a mixture of reality and virtual reality, surrounding both augmented reality and augmented virtually via immersive technology.

CHAPTER 3

Methods of Development

3.1 Introduction

This chapter will be explaining the process of developing the “AR Virtual Car Showroom” application and necessary 3D model animation also others aspects of my project. The explanation will be divided into two major sections; the first section demonstrates the work-flow of the “3D Car Modeling” and design. On the other hand, the second section put across the work-flow of the “AR App” development.

3.2 3D Car Modeling, Animation and Render Work-flow

In this section, i will explain the work-flow process of the "Car Modeling", Texturing, Animation and Rendering. So the major work-flow discussion as followed:

3.2.1 3D Modeling of Car: First At the very beginning step before start Audi R8 car modeling, I have to collected possible reference image of particular model from different view. Mostly modeler need at list four different angle of reference image for make the proper proportional model similar with real world Audi r8. So, after collect the Top, Left and right, back reference image I start to Autodesk Maya 2018 for start modeling.

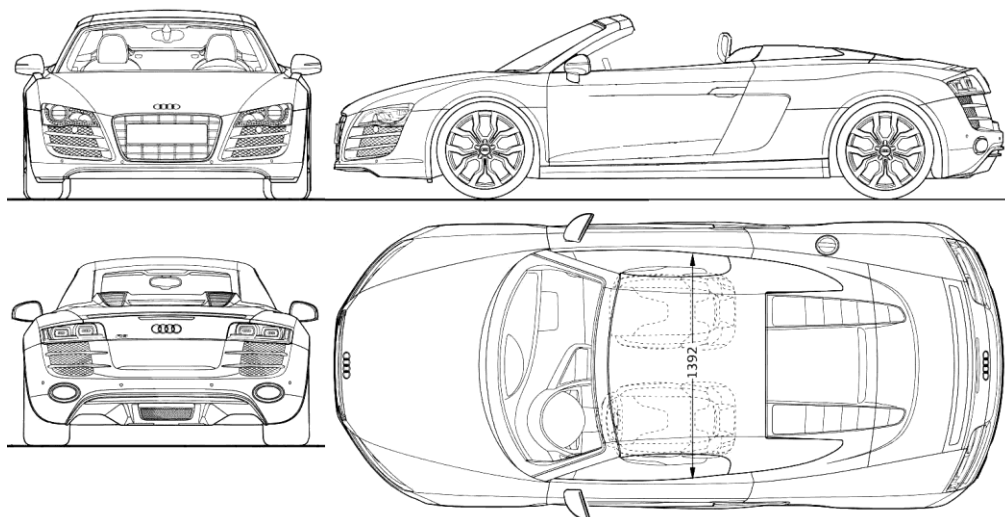


Figure 3.1: Reference images setup for Car modeling in Maya

After opening the software I set the reference image from the 4 different angle to get the exact same angle of each

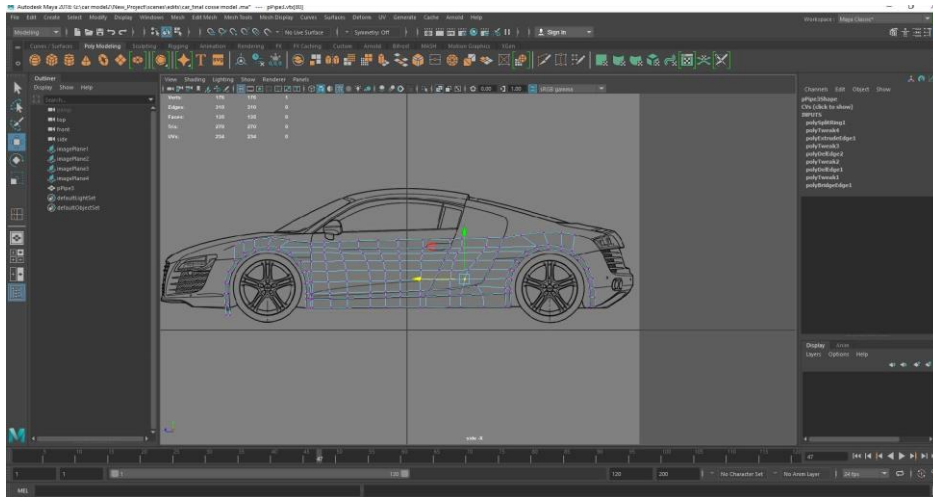


Figure 3.2: Set the reference image from the 4 different angle

After set the reference image I start with a plane from the left view.

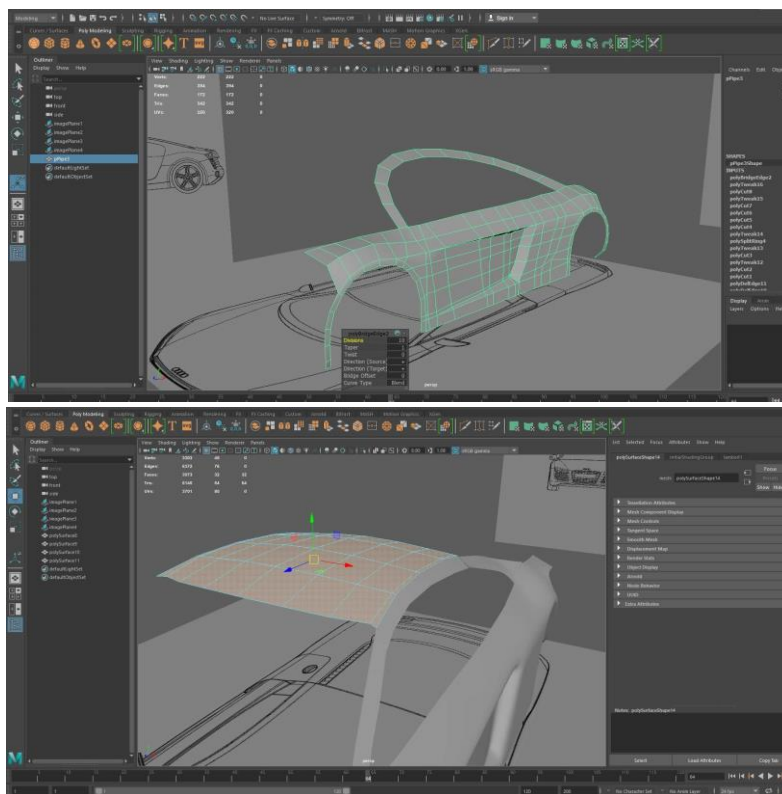


Figure 3.3: Ar Car Modeling: 01

Gradually I spread the plane according the shape of the car as I take the reference image. During spread the shape I carefully try to match every angle of the car properly.

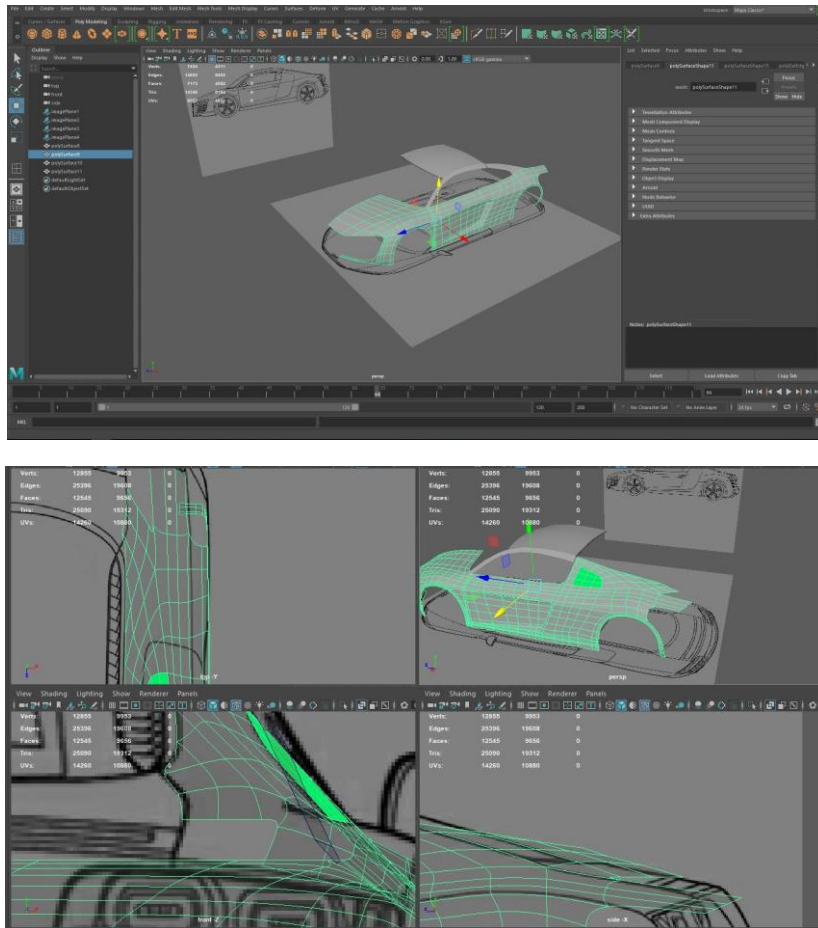
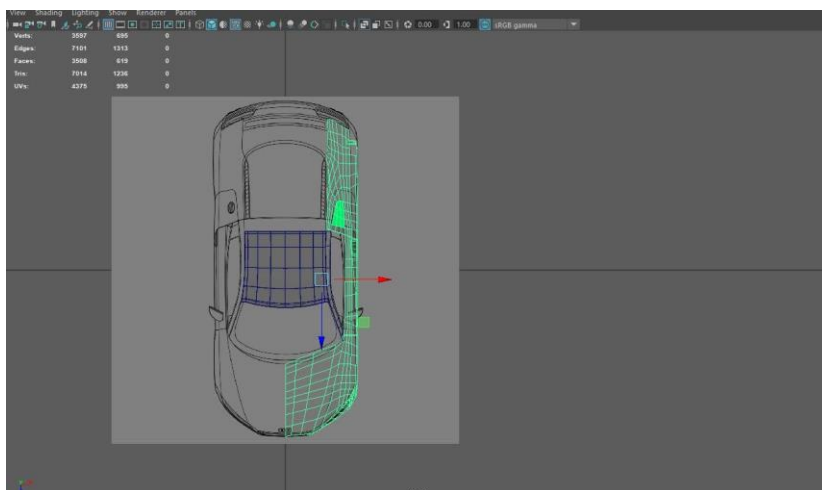
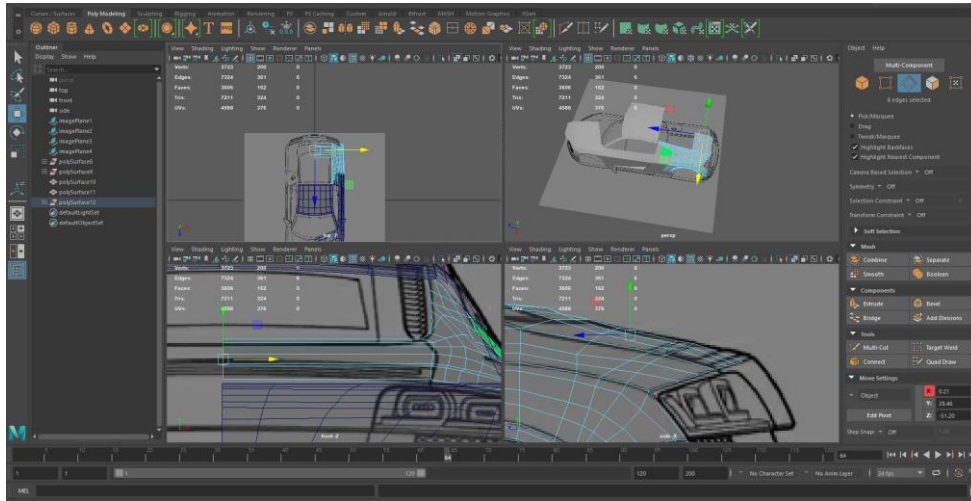


Figure 3.4: Ar Car Modeling: 02





After completing the car body I separate the part into few part because in my project, I have to move few part of my car body as animate it in my application and also in my production video render.

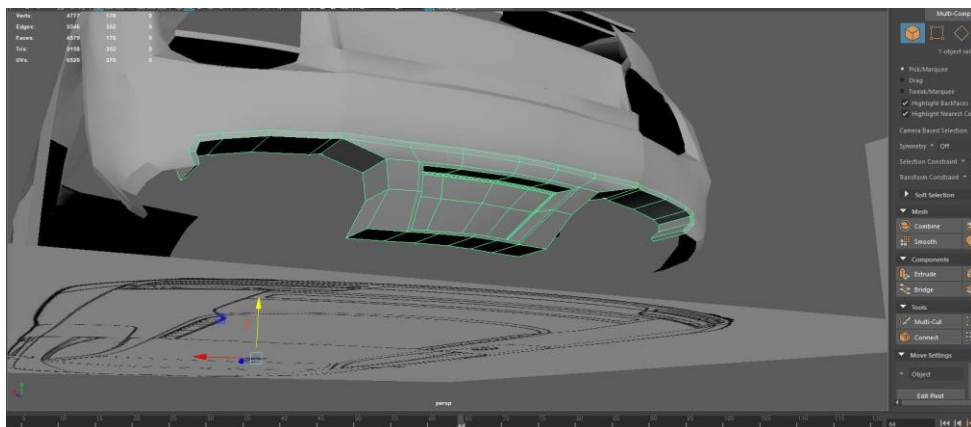
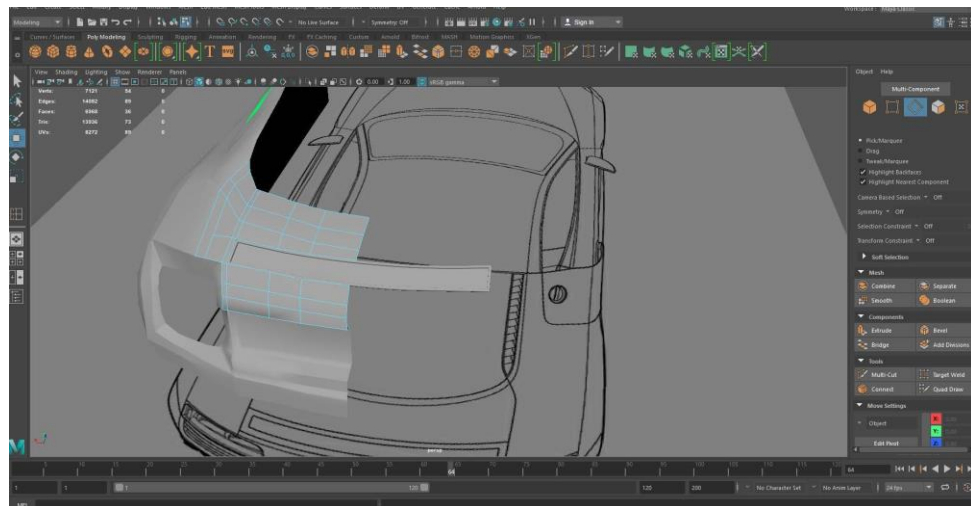


Figure 3.5: Ar Car Modeling: 03: Separating the car part into few parts

So that I use extract tool of Maya to cut it into different piece. For this at first I select the desire area of car in face mode and extract them. After the main body complete I move to make the Audi interior part.

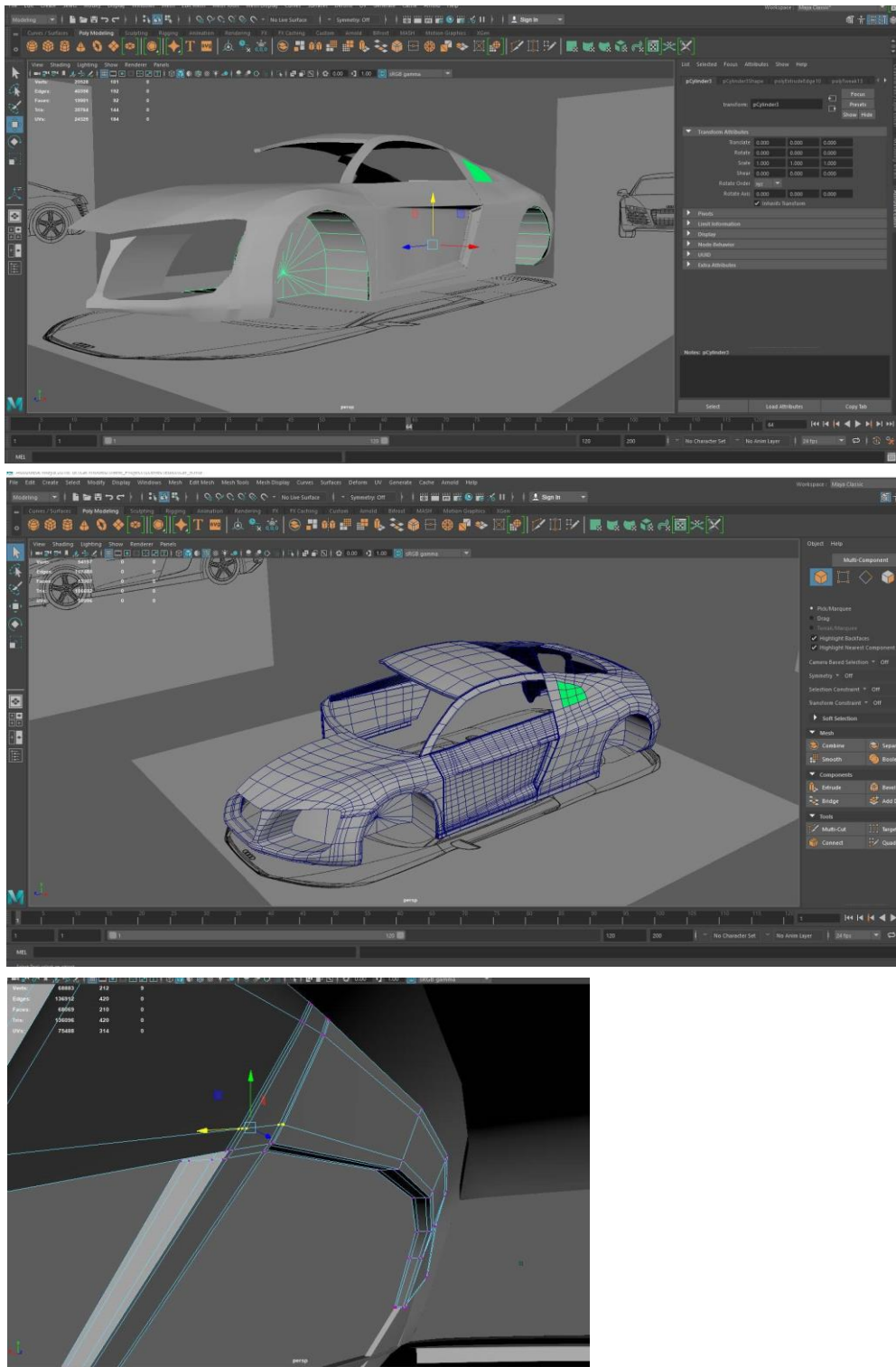


Figure 3.6: Ar Car Modeling 04: Detailing

To make car seat I used box poly and gradually I turn it into shape. For the time rushing I can't give very deep details of seat. After that I make driving steering and rest if the interior .

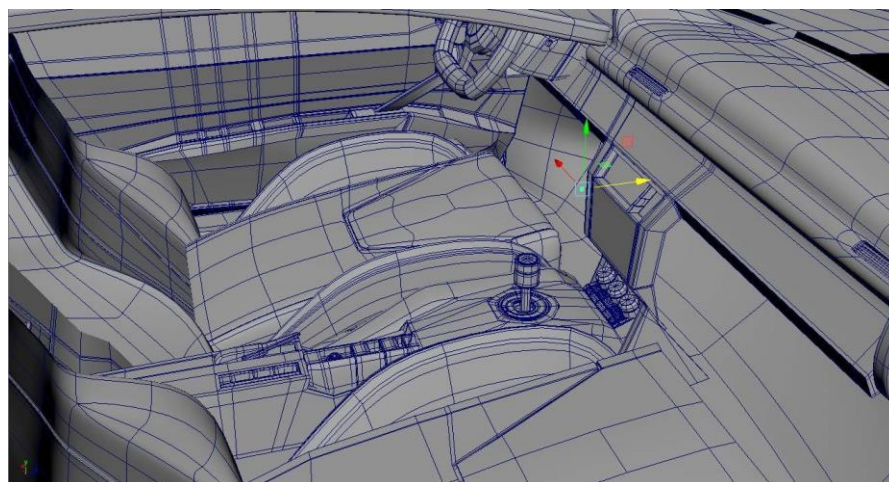
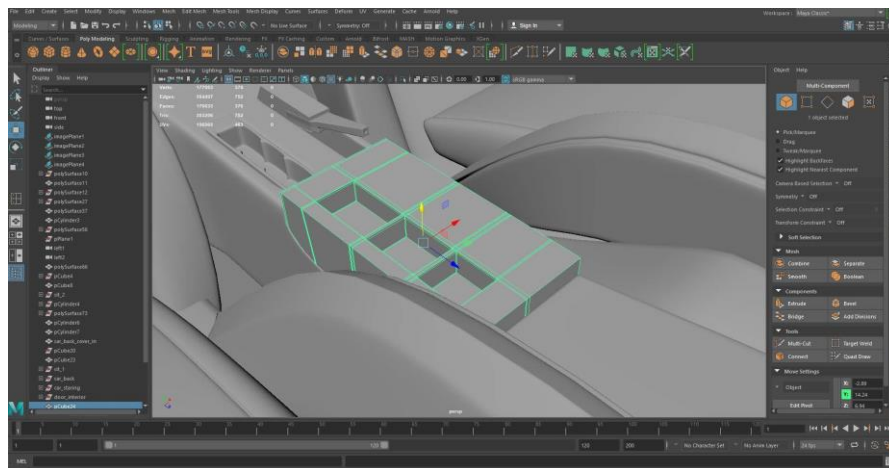
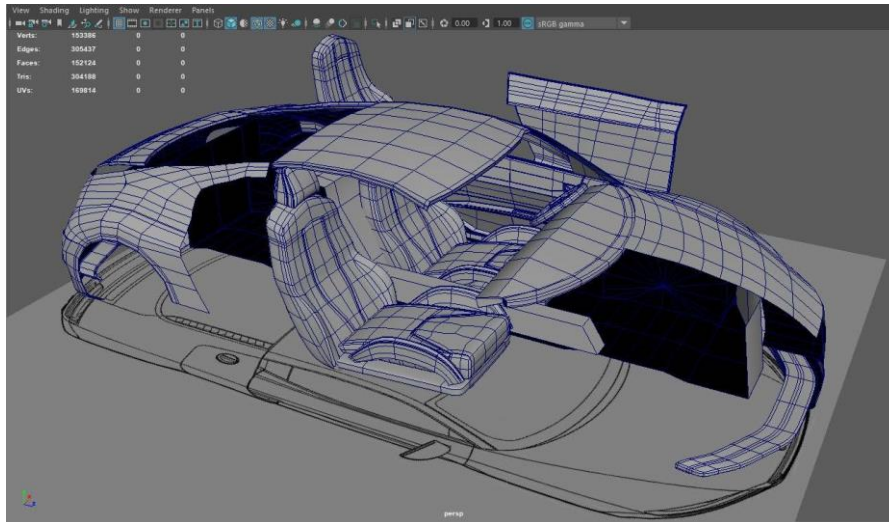


Figure 3.8: Ar Car Interior Modeling part02

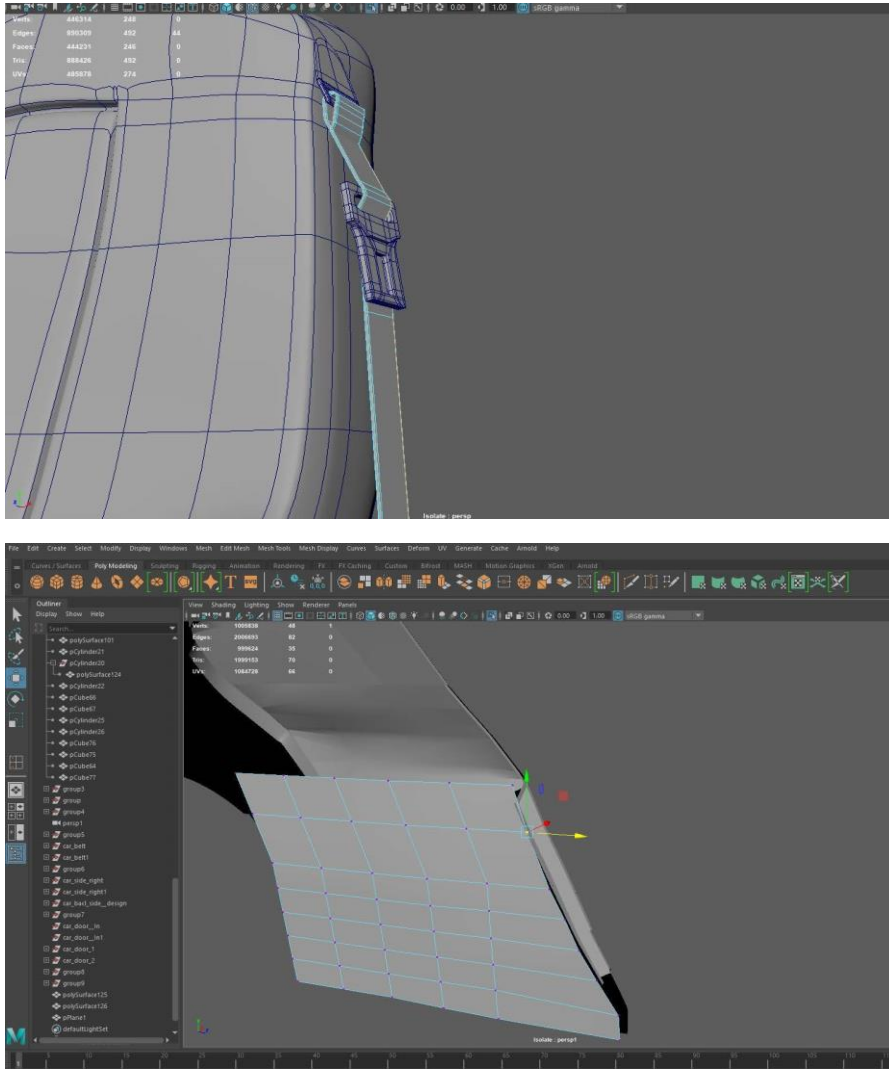


Figure 3.9: Ar Car Interior Modeling part03

Now I move to wheel. I just make clutch disk and clutch cover of car wheel in details. For wheel tire I use a very simple cylinder and make it gap in the middle

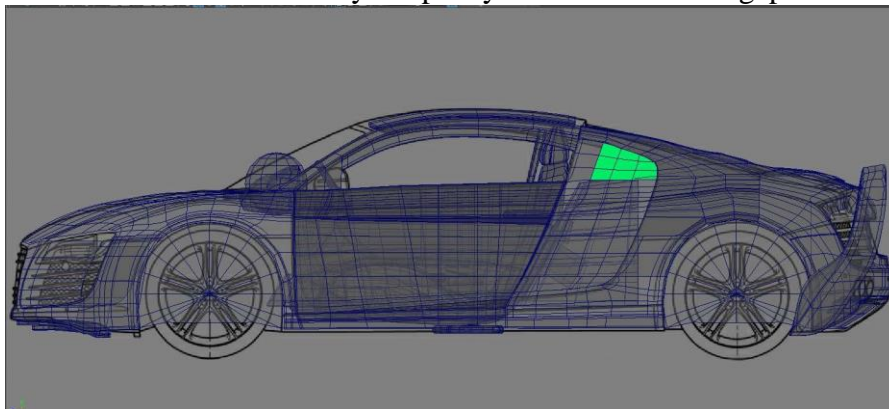


Figure 3.10: Ar Car Wheel, Tier Modeling

3.2.2 Material and Texturing of Car: To get the exact same Material as the car have in real life, I take reference from the real car. Audi r8 comes into multiple colors. Most it has 7 different colors.

At first I decide to make it white color but after testing the color I find this color it difficult to focus toward the consumer. So finally I choose blur color for my project video commercial of this application.

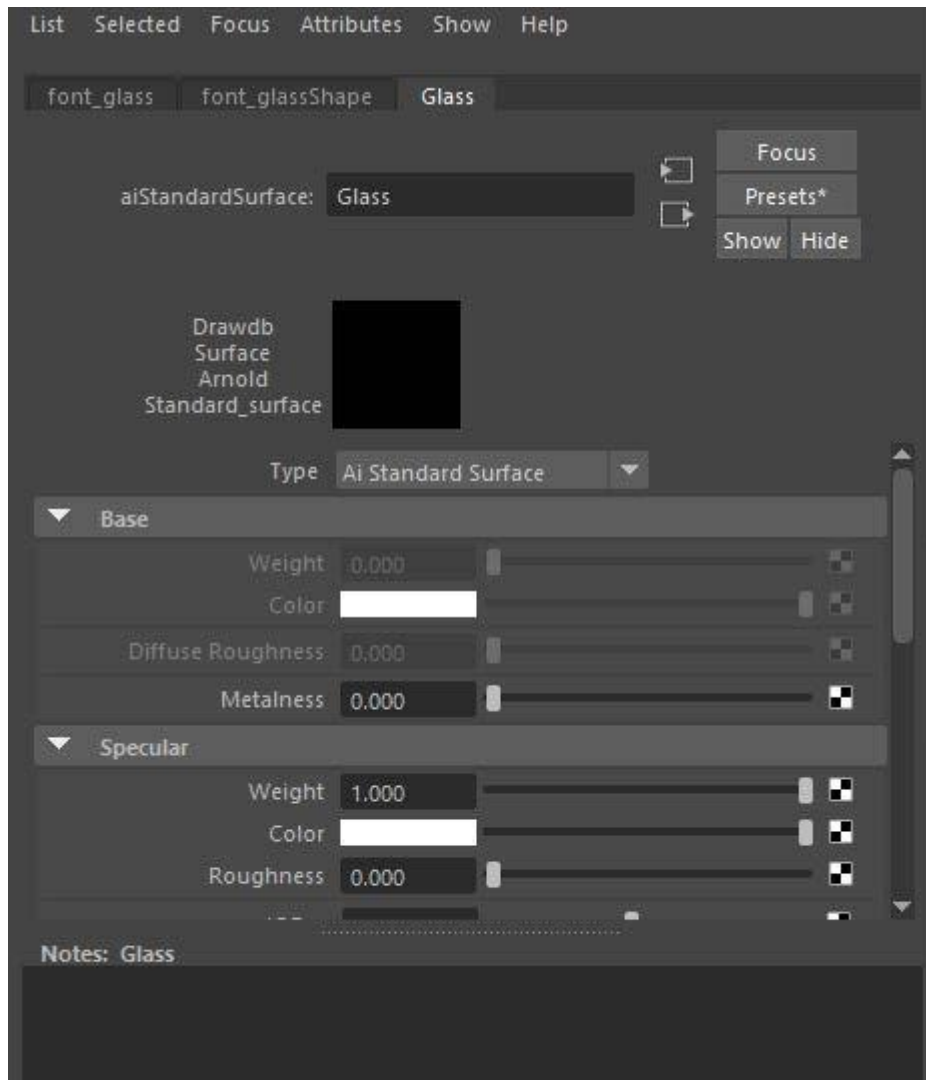


Figure 3.11: Applying Materials in car model 01

For texturing any model, the project owner should have to choose a fixed render engine. Here I choose Arnold render engine. I will discuss the reason later choosing this render engine in renderer chapter. To bring up the glass and looking glass feel in my car window, front-back glass and looking glass i have changed few parameter as like Roughness, material Type, Weight, Color etc.

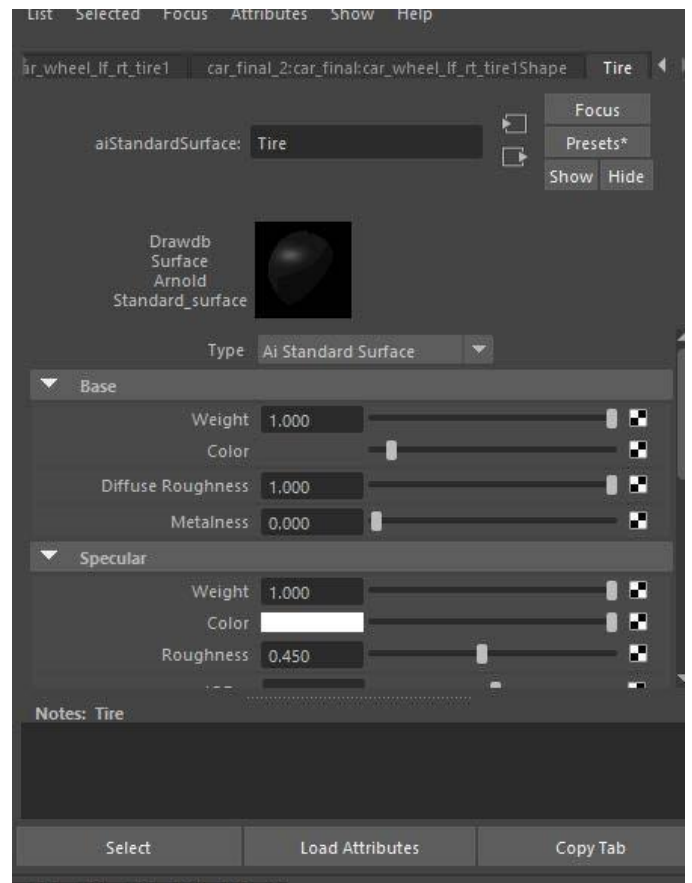
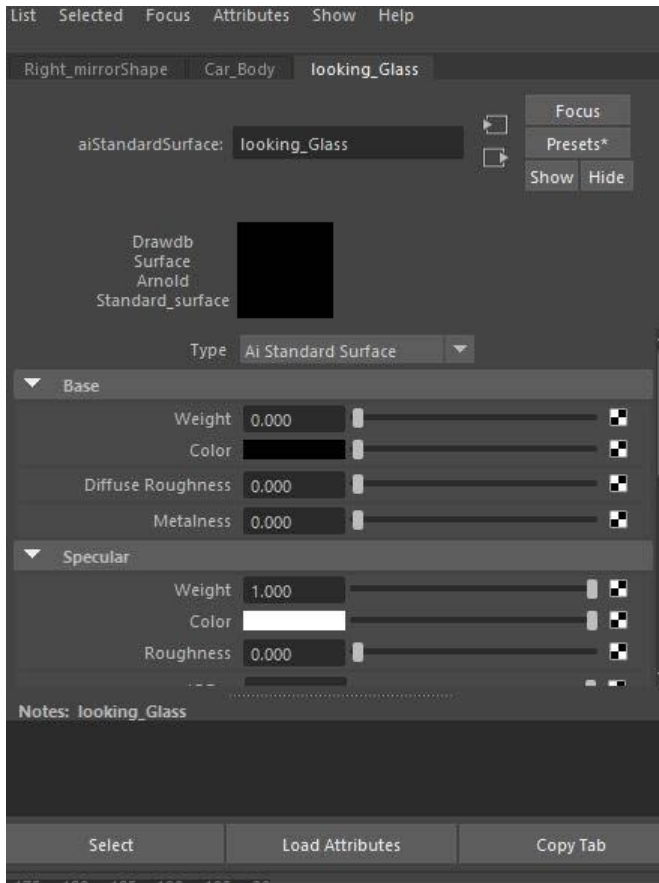


Figure 3.12: Applying Materials in car model 02

As the other render engine, Arnold also has its own material library. simplify I select the object part of car and right click on it, choose assign new material> choose Arnold > choose aiStandardSurface. After that Go to the attribute . From the preset choose Car_paint . From their choose the blue color and keep the weight 1 and roughness 0.50 and IOR 5 and Metalness .50 . Do the process same for the other material too and differentiate the Metalness and IOR different for different material . For glass material IOR = 1.330 and weight = 1 . The the steel type material I choose chrome from the preset and their the weight =1 roughness =1.

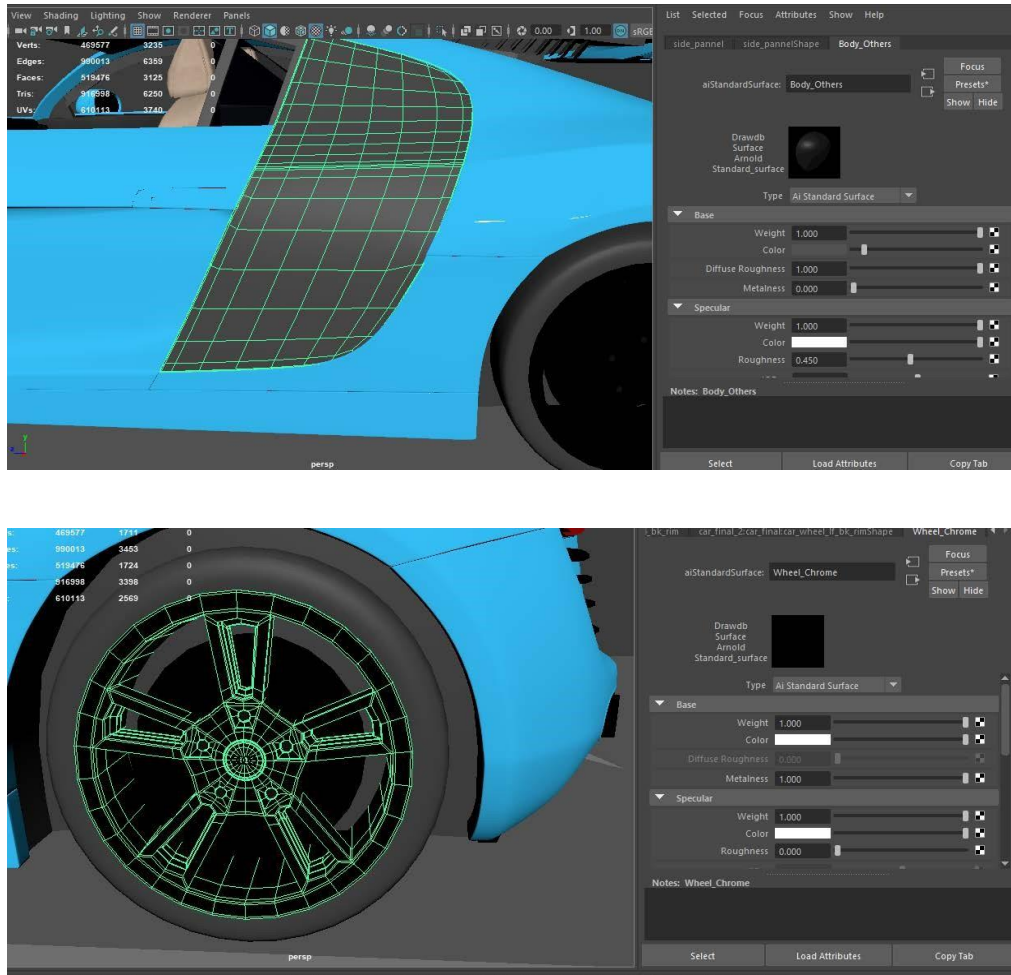


Figure 3.13: Applying Materials in car model 03

For car headlight and back-light I use the same material. And to get real life backlight filter effect i changed backlight's filter texture.

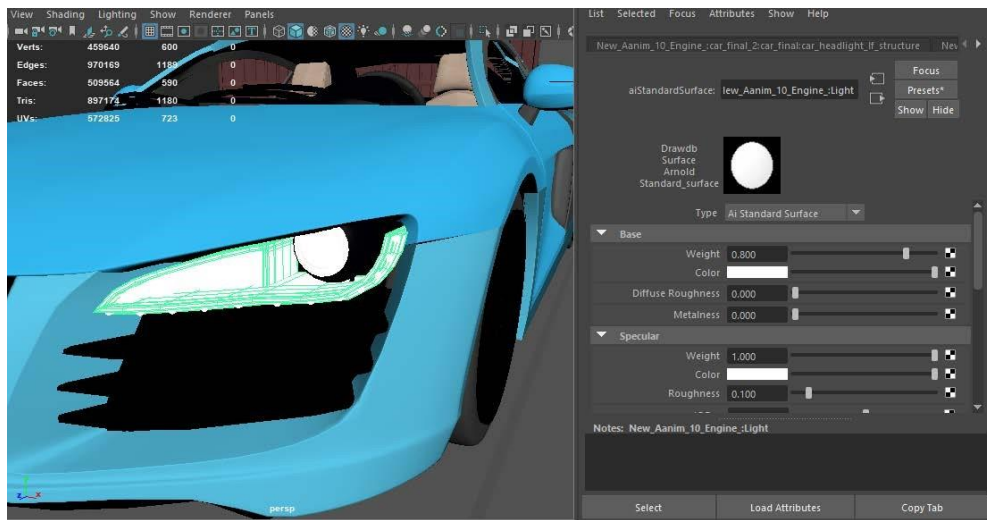
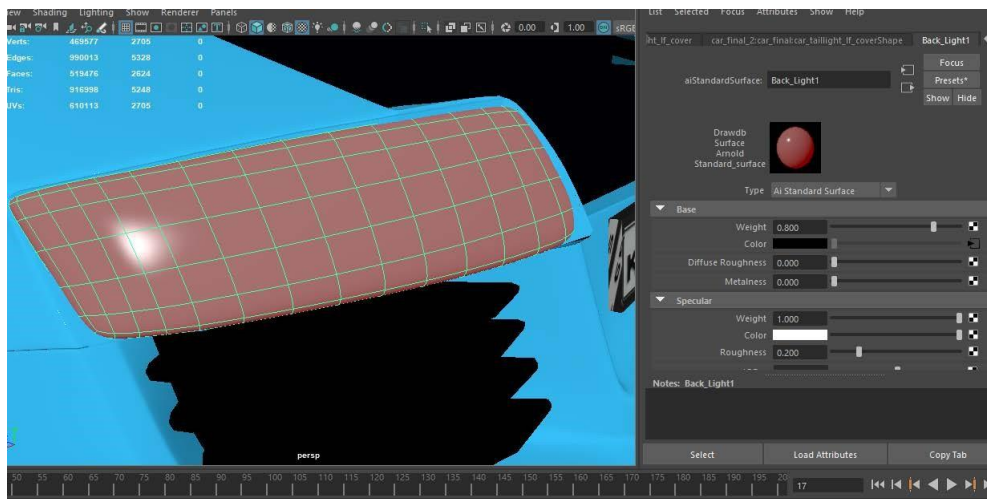


Figure 3.14: Applying Materials in car model 04_headLight-backLight

For the seat and other object which in in car interior object I apply texture. Simplify I select the Interior object part of car and right click on it, choose assign new material> choose Arnold > choose aiStandardSurface. After that go to the attribute. From there i changed my Texture image according to preferences for example car seats texture, leather texture, seat belt etc

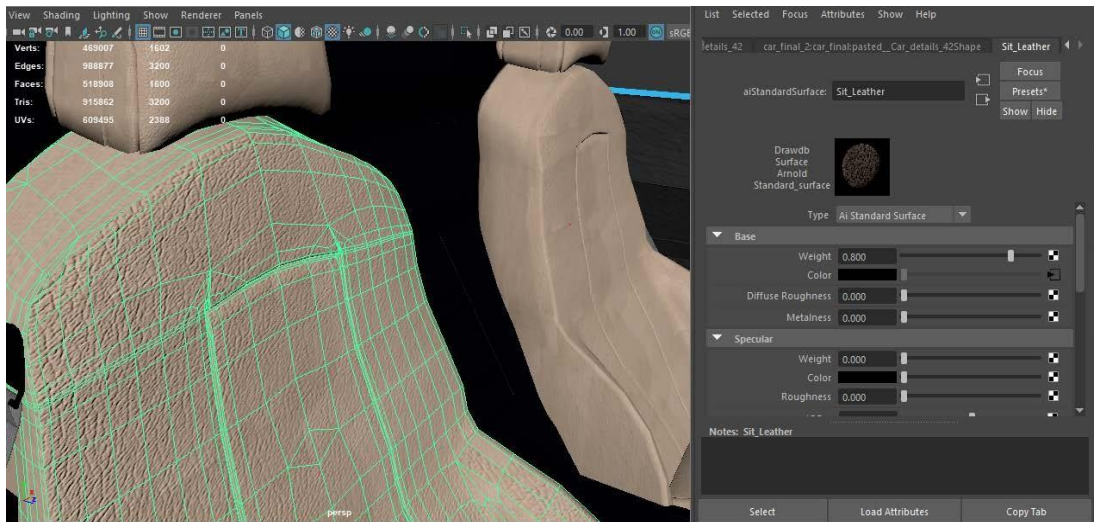


Figure 3.15 Applying Texture in car interior objects

3.2.3 Lighting in Car Scene:

For lighting I choose the simplest way . I just used aiSkyDome light and add here a HDRI image. I didn't create any kinds of physical light because of my time shortage. If I add more light I was afraid my render didn't finished before my dead line. After set the sky dome light I render light is pretty good to see so I decide to fix more in composition.

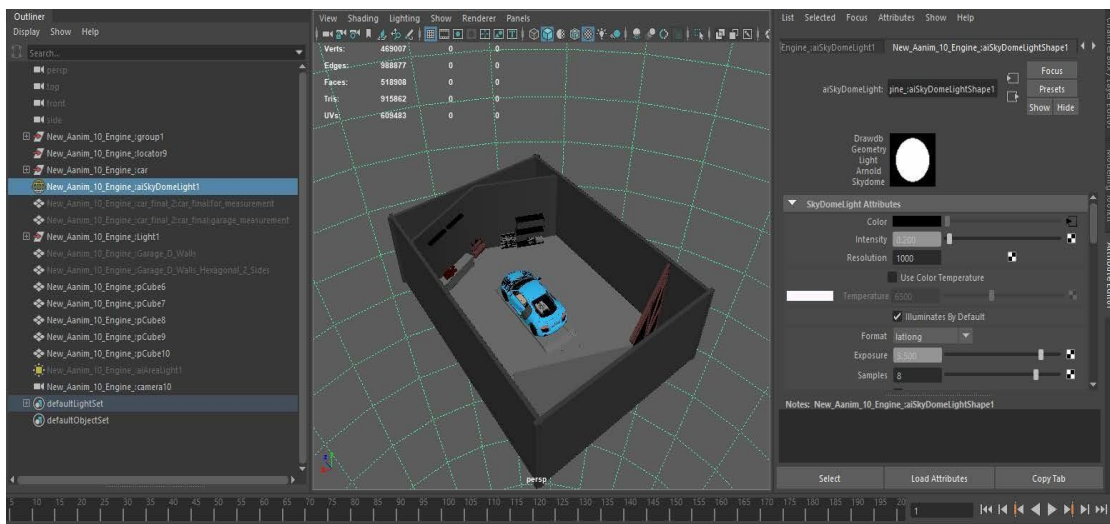


Figure 3.16: Lighting in Car Scene

3.3.1 Rendering of Car Animation Scene:

For rendering the Final video production I choose Arnold. Arnold is advanced ray tracing render system intentionally design for feature length animation and visual effect which co-produced by Sony picture image work .It is used by 300 render studio now. For batch render at first I set up and install the render engine in my CPU and set some render according my render demand.

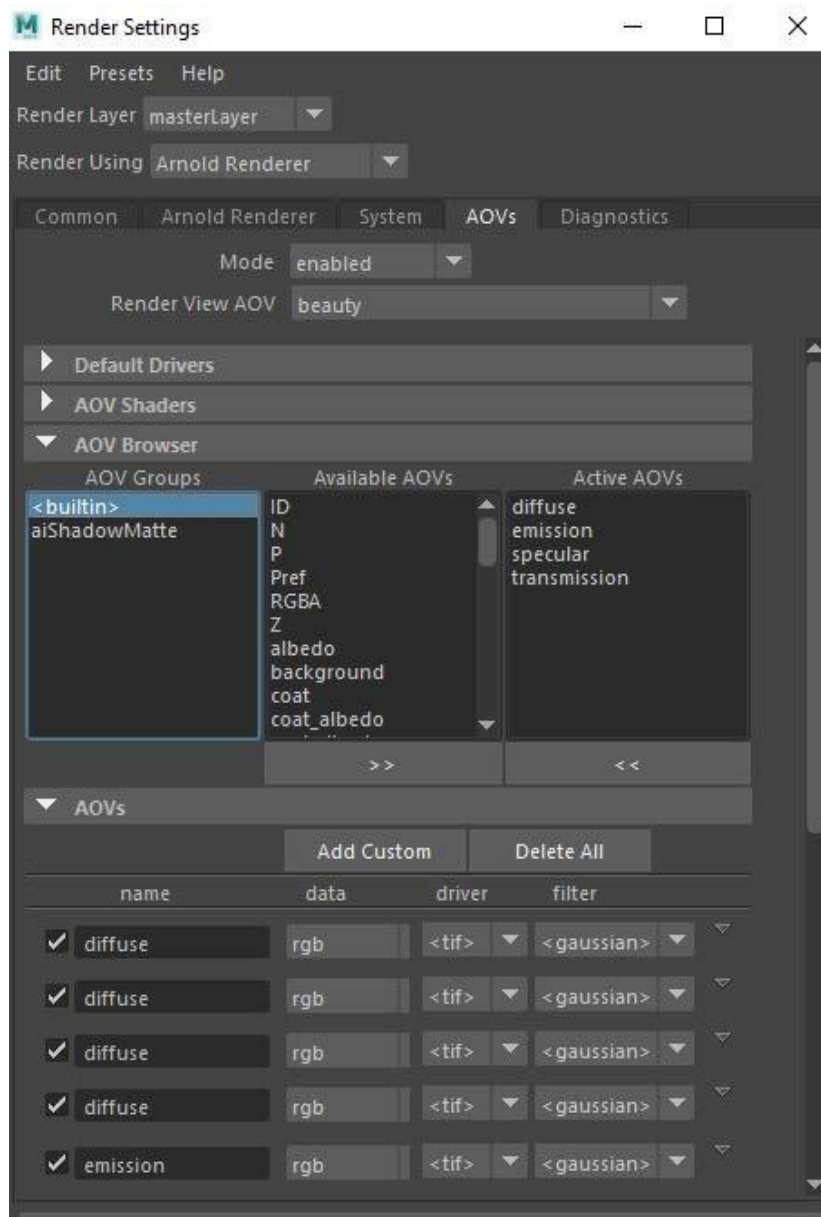


Figure 3.17: Render Settings of Car Scene

3.3.2 Wire-frame Render: For make my video production more Authentic I decide to show the mode in wireframe. For show this kind of frame I choose a Wireframe material from Arnold material preset and apply it to the object.

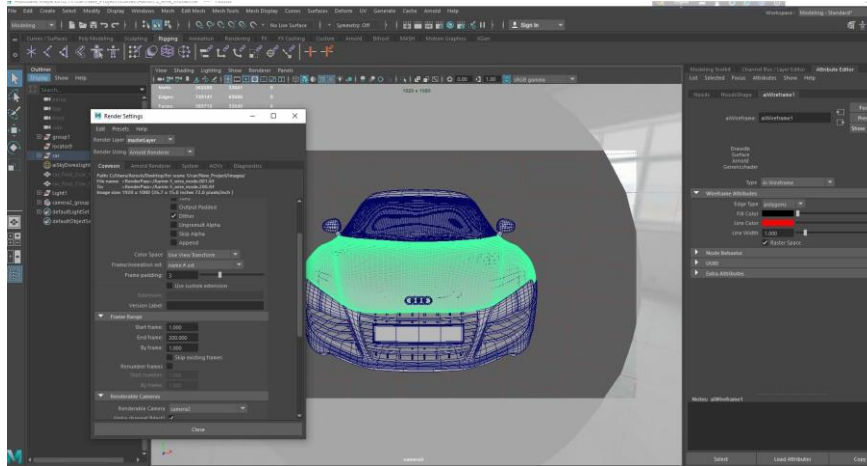


Figure 3.18: Wire-frame Render Settings

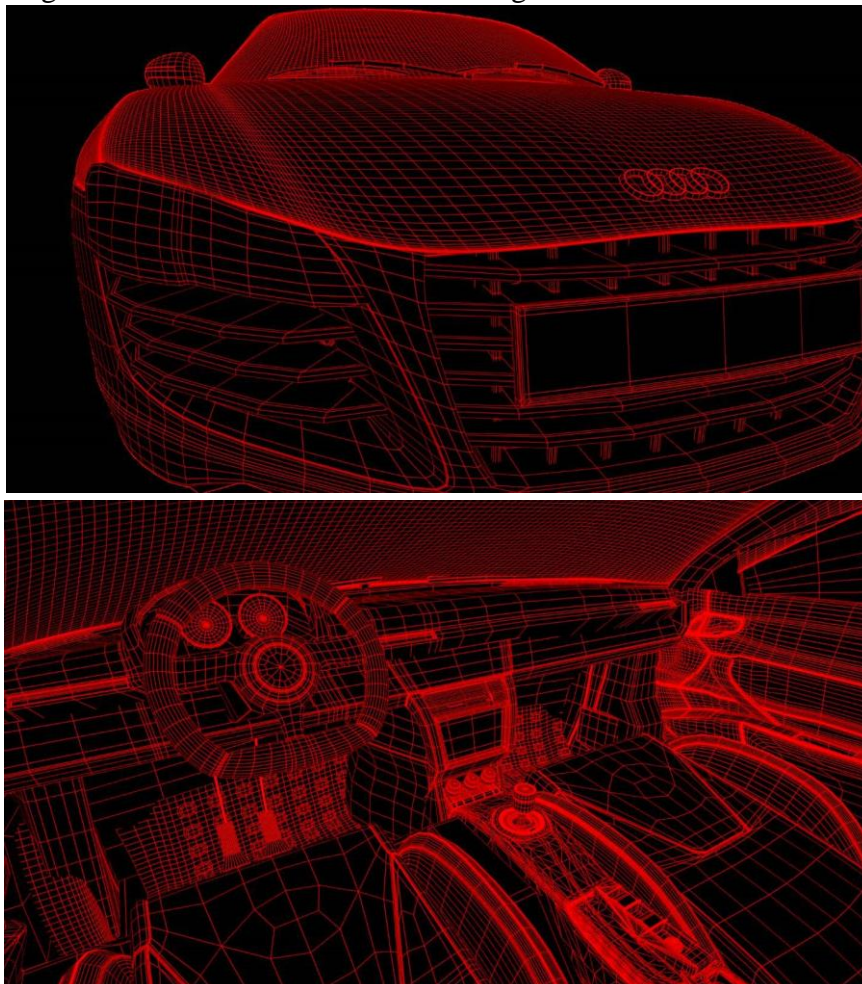


Figure 3.19 Wire-frame Render Output of Car

3.4 Augmented Reality Application Development Work-flow

In this segment, i will give details Of the work-flow process of "AR App Development". So the major work-flow discussion as followed:

3.4.1 Vuforia Development Portal: I log in to vuforia development portal and create Get Development Key of License Manager.

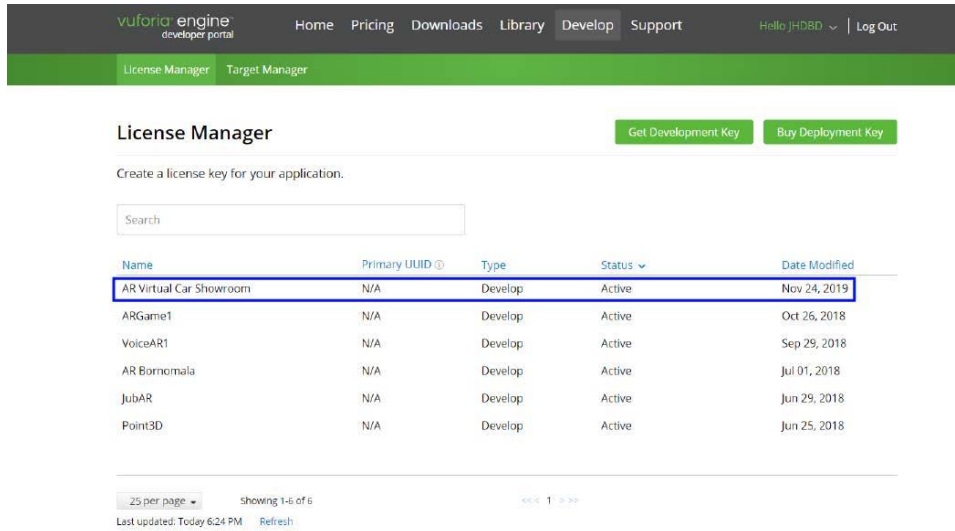


Figure 3.20: Creating Development Key of License Manager

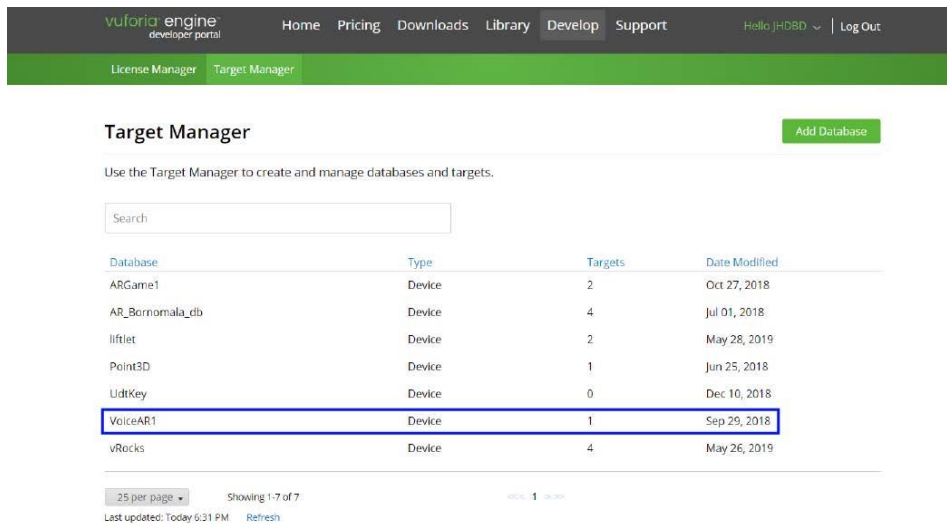


Figure 3.21: Creating Database of Target Manager.

3.4.2 Unity AR setup and workflow: I launch Unity 2019.1.3f1 version. Then from file I go to build settings and convert platform from windows to android. Now from player setting I have to change few settings and setup my company name, product name, package name then from other setting need to change and give appropriate API level. After that setup from XR Setting I need to check the vuforia augmented reality setup option for sure.

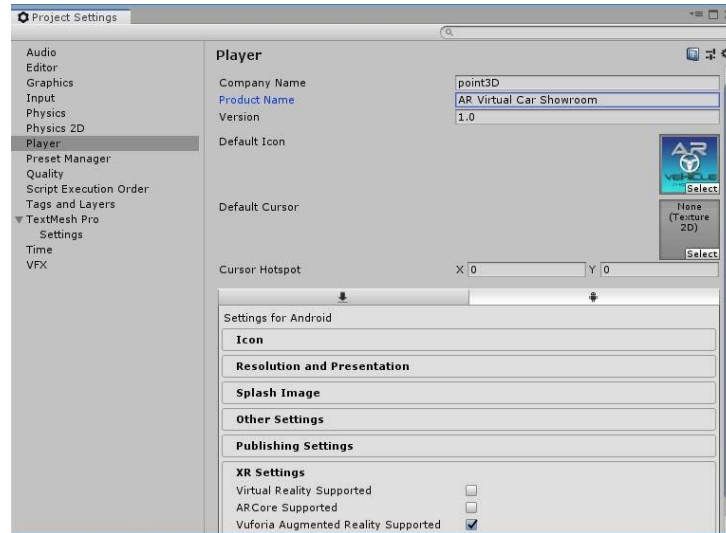


Figure 3.22: Unity Player Settings

First import Vuforia Database in Unity. Create new scene, delete Main Came and select GameObject Menu>Vuforia>AR Camera. AR camera inspector Vuforia Behaviour (Script) to click Open Vuforia Configuration, Vuforia License Manager to copy License key and paste App License key

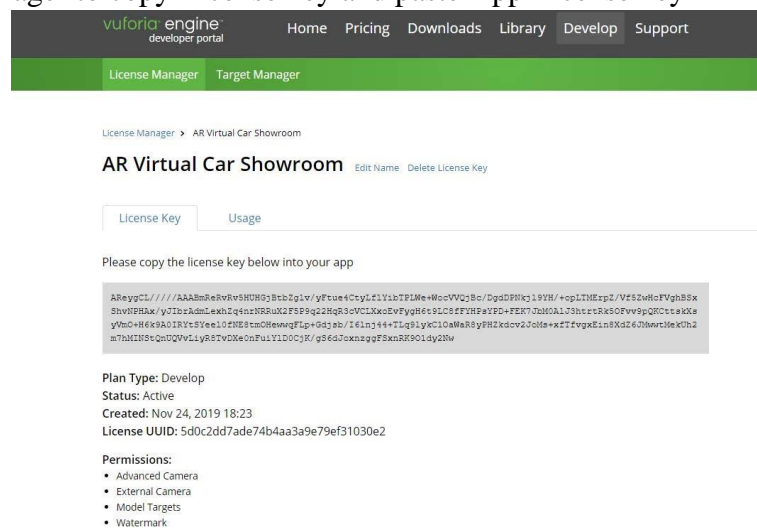


Figure 3.23: Vuforia License Key for AR license

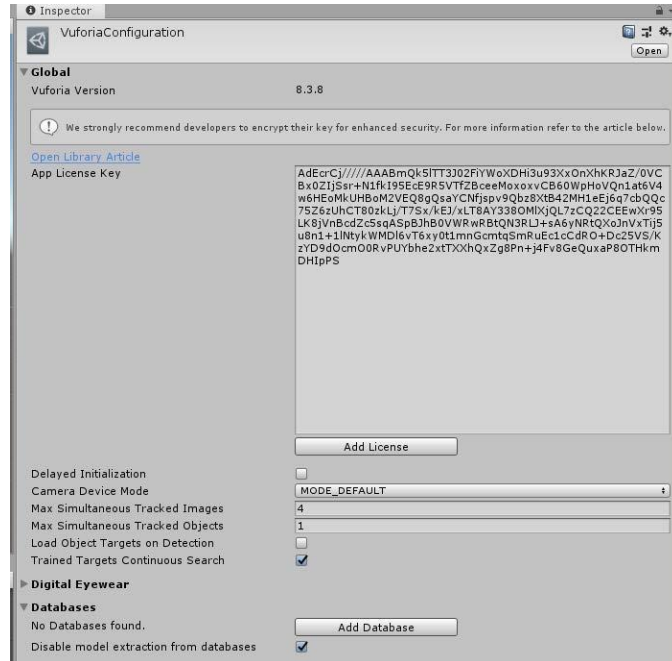


Figure 3.24: Add App License Key

Then I Created three scenes named “Intro” for intro scene, “UDT” for indoor Scene where I use user defined target and “Outdoor” with ground plane detection for Outdoor Scene.

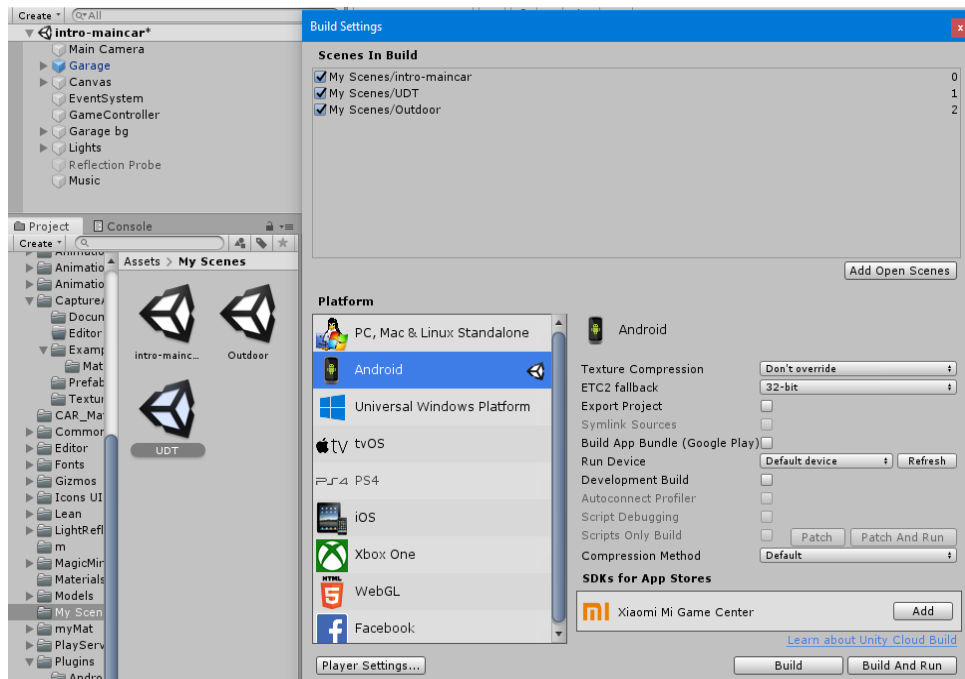


Figure 3.25: Three scenes for three parts of app

3.4.3 Scenes setup and User interface workflow: At first I created an intro scene where I have imported my 3D models the garage and cars inside of it. And then I make the cars rotating according to button press where every car is going to change dynamically.



Figure 3.26: Import Car models and garage model

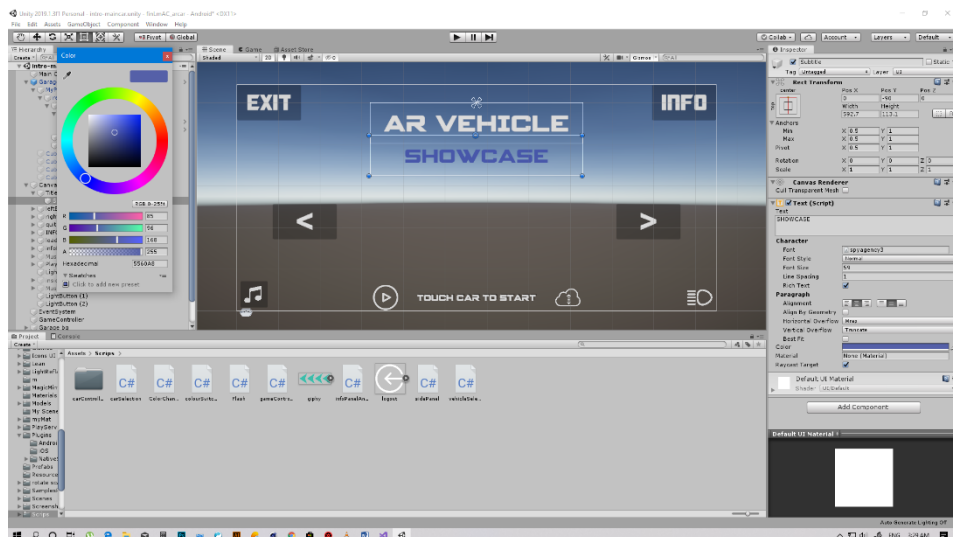


Figure 3.27: Intro scene user interface with button touch control

For the Ui I have chosen minimalistic user friendly graphics and have created the button to press or touched with unity's various functions with Boolean and triggers.

To dynamically loop through the car and for car selection I put the car list in an array and with for loop, to loop-through the cars. For right and left direction I create new void function toggleCars which will start car of given string name of that car from the list.

```

public class carSelection : MonoBehaviour
{
    //I create an empty list og GameObject
    private GameObject[] carList;
    private int currentCar = 0;
    public GameObject insidePanel;
    // Start is called before the first frame update
    void Start()
    {
        //count the child gameobjects from the cars transform
        carList = new GameObject[transform.childCount];
        //loop through the child items and fill the list in
        for (int i = 0; i < transform.childCount; ++i)
        {
            carList[i] = transform.GetChild(i).gameObject;
        }
        //deactivate all the gameobjects in the list
        foreach(GameObject gameObj in carList)
        {
            gameObj.SetActive(false);
        }
        //Set the initial GameObjects to be active
        if (carList[0])
        {
            carList[0].SetActive(true);
        }
    }

    public void toggleCars(string direction) {
        carList[currentCar].SetActive(false);
        if(direction == "Right")
        {
            currentCar++;
            if (currentCar > carList.Length -1)
            {
                currentCar = 0;
            }
        }
        else if(direction == "Left")
        {
            currentCar--;
            if(currentCar < 0)
            {
                currentCar = carList.Length - 1;
            }
        }
        //set the current car to be active from the list
        carList[currentCar].SetActive(true);
        gameController.currentSelectedCar = carList[currentCar].name;
    }

    public void showPanel()
    {
        insidePanel.SetActive(true);
    }
}

```

Figure 3.28: Car selection dynamically changing from Right or Left Directions

For the Car rotation I have created rotation script and attached to car list parent object to rotate all the car inside it and also for ui panel animation I created an animator and make animations accordingly for example open info or close info panel animation and call them with anim.play function attached to button for triggering animation as button pressed.

```

using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class rotateScript : MonoBehaviour {

    private float speed = 25f;

    // Update is called once per frame
    void Update () {
        transform.Rotate (0, speed * Time.deltaTime, 0);
    }

    Animator anim;
    // Start is called before the first frame update
    void Start()
    {
        anim = GetComponent<Animator> ();
    }

    public void playSlide()
    {
        anim.Play("infoAnim");
    }

    public void closeSlide()
    {
        anim.Play("infoAnimReverse");
    }
}

```

Figure 3.29: Car Rotation and UI panel animation controller

Now user need to enter indoor or outdoor scenes for their AR experience of the vehicles. For that I have created an inside panel where I put two buttons as indoor or outdoor where I attached my game controller script with change level functions. My added Unity 'scenemanager' will load the scene within give scene name as string value. Also to quit the app I have use default 'Application.Quit' function.

```
28
29     public void quit()
30     {
31         Application.Quit();
32     }
33
34     public void changeLevel(string scene)
35     {
36         SceneManager.LoadScene(scene);
37     }
38
39     public void toggleFlash()
40     {
41         if (onOff)
42         {
43             CameraDevice.Instance.SetFlashTorchMode(false);
44             onOff = false;
45         }
46         else
47         {
48             CameraDevice.Instance.SetFlashTorchMode(true);
49             onOff = true;
50         }
51     }
52 }
53
```

Figure 3.30: Change level or scenes and quit out of application



Figure 3.31: Indoor or Outdoor scene option for user

For the 'Indoor' scene I have chosen Vuforia UDT(User Defined Target). This targets are Image Targets that are created at runtime from camera frames selected by the user. User-Defined Targets allow us to pick an image at runtime. Thus, we can experiences AR “any time, anywhere” by selecting an image – like a photograph, book cover or poster – from our immediate environment without having to carry around pre-defined targets.

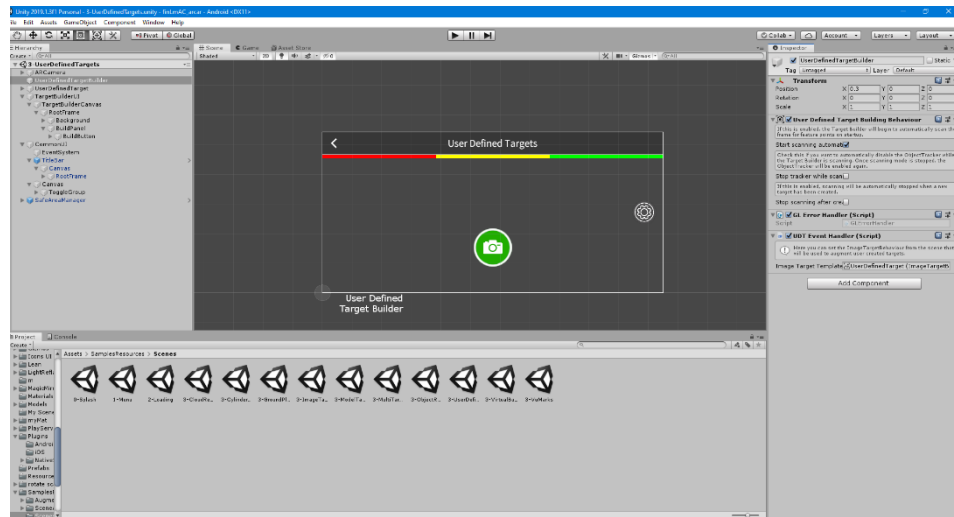


Figure 3.32: Vuforia User Defined Target

This is vuforia augmented reality default user defined target sample what I have used as my indoor scene reference for tracking through any object or cover pages.

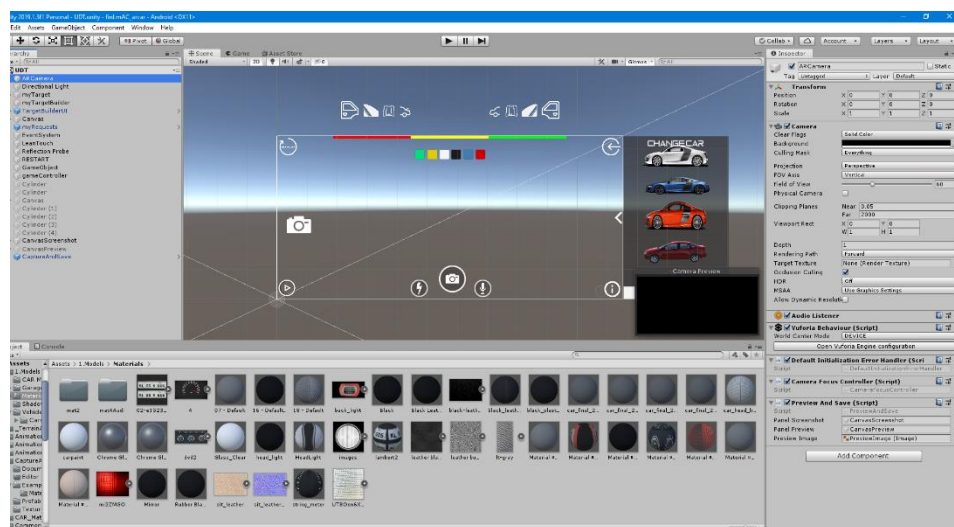


Figure 3.33: UDT & UI setup for indoor scene

To use ar functionality within my 3D model and augment in real world I choose vuforia AR Camera from gameobject >Vuforia>AR Camera also this technique I used in next scene. In AR Camera hierarchy I can find vuforia configuration inside it I enable Google ARCore Support also extended tracking mood for better tracking result.

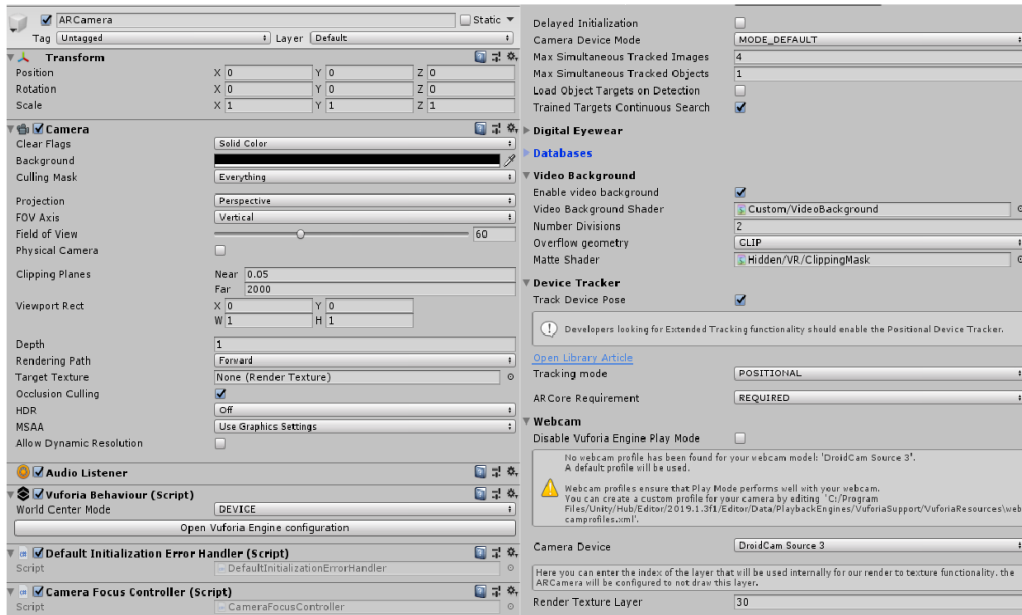


Figure 3.34: AR Camera and Vuforia Configuration Setup

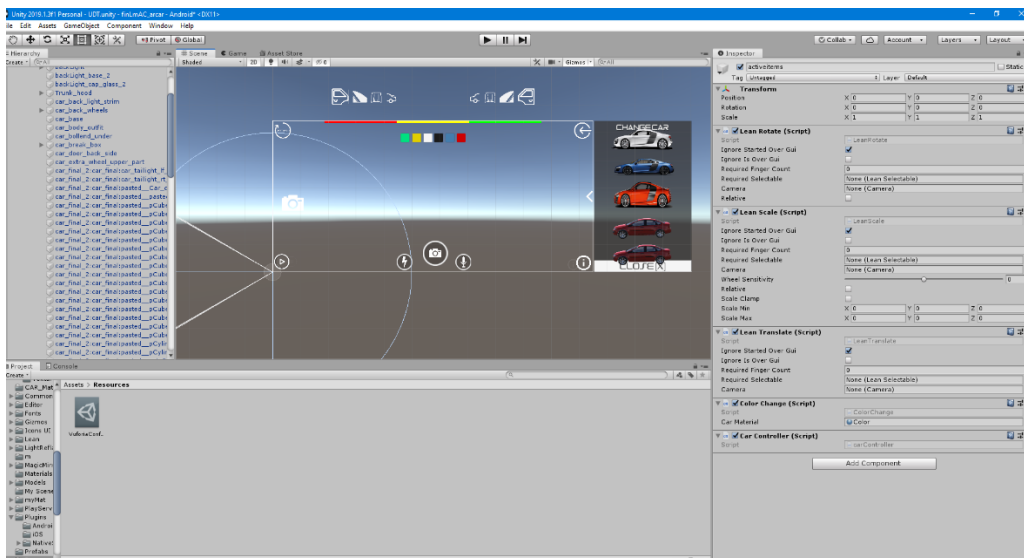


Figure 3.35: UI and full setup of Indoor Scene

After importing 3D models setting up AR Camera i need to focus on functionality and user interface. I choose minimalistic on screen ui button for instant action trigger while performing Augmentation.

My target was to create AR experience more convenient with using voice command to perform various vehicles animations or color change functions. For that I needed a cloud based AI service what will understand voice command and pass through the commands as a sting value to unity. If command matches certain animation or functions going to triggered and perform. I have chosen a free online AI service named “Wit AI” and created my AI bot then trained it. Although I have trained the bot but it will learn through the time and get better in understanding.

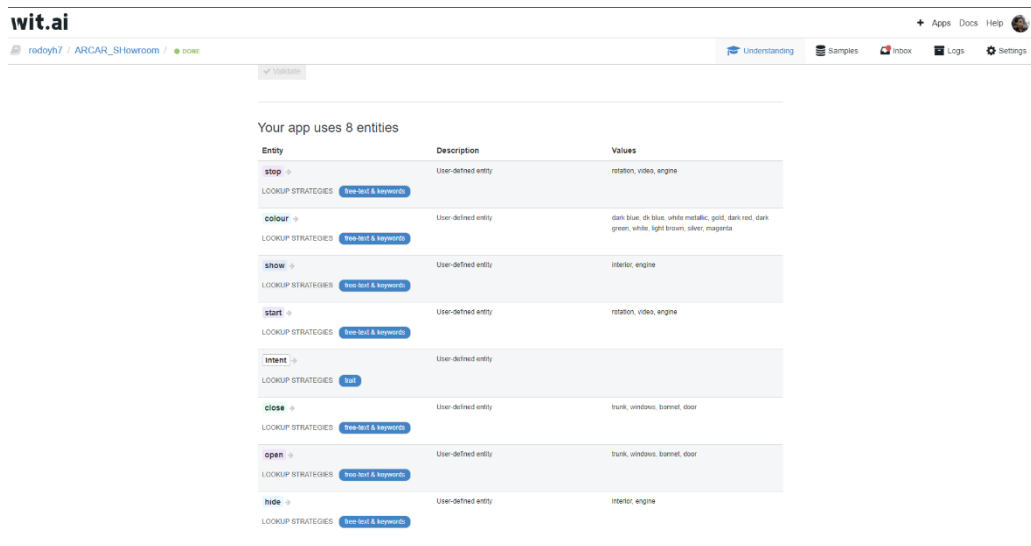


Figure 3.36: Creating AI Bot in Wit AI

```

public partial class Wit3D : MonoBehaviour {
    // Class Variables

    // Audio variables
    public AudioClip commandClip;
    int samplerate;

    // API access parameters
    string url = "https://api.wit.ai/speech?v=20191118";
    string token = "6RXTG62LRRBDU4M4YMS2F2IJXTJWXSPF";

    //Custom 1
    // GameObject to use as a default spawn point
    private bool isRecording = false;
    private bool pressedButton = false;
    public Text myResultBox;
    //public VideoPlayer vidScreen;
    //public GameObject vidCanvas;

    // Use this for initialization
    void Start () {

        // If you are a Windows user and receiving a Tlserror
        // See: https://github.com/afauch/wit3d/issues/2
        // Uncomment the line below to bypass SSL
        // System.Net.ServicePointManager.ServerCertificateVa

        // set samplerate to 16000 for wit.ai
        samplerate = 16000;
        //void StartRecording() {
    }

    void Update () {
        if (pressedButton == true) {
            pressedButton = false;
            if (isRecording) {
                myResultBox.text = "Listening for command";
                commandClip = Microphone.Start (null, false, 5, samplerate);
            }

            //Custom 5
            if (!isRecording) {
                myResultBox.text = null;
                myResultBox.text = "Saving Voice Request";
                // Save the audio file
                Microphone.End (null);
                if (SavWav.Save ("sample", commandClip)) {
                    myResultBox.text = "Sending audio to AI...";
                } else {
                    myResultBox.text = "FAILED";
                }

                // At this point, we can delete the existing audio clip
                commandClip = null;

                //Start a coroutine called "WaitforRequest" with that WWW vari
                StartCoroutine(SendRequestToWitAi());
            }
        }

        public IEnumerator SendRequestToWitAi(){
            //Custom 6
            string file = Application.persistentDataPath + "/sample.wav";
            string API_KEY = token;
        }
    }
}

```

Figure 3.37: Accessing AI bot from unity through recording button

To access wit ai bot I used there github forum instructions and assets as needed.

To send voice request and to make recording button working I used my bot url and token inside string url, string token value. I used isRecording bool to make record button response on pressed or touched also created an audioclip variable to hold and keep the recorded voice in store for next processing. As Unity online request system 'WWW' function work and wit ai github forum suggests I modify the assets, codes for my application's need.

```

124 }
125
126 public IEnumerator SendRequestToWitAi()
127 {
128     //Custom 6
129     string file = Application.persistentDataPath + "/sample.wav";
130     string API_KEY = token;
131
132     FileStream filestream = new FileStream(file, FileMode.Open, FileAccess.Read);
133     BinaryReader filereader = new BinaryReader(filestream);
134     byte[] postData = filereader.ReadBytes((int?)filestream.Length);
135     filereader.Close();
136
137     //Custom 7
138     Dictionary<string, string> headers = new Dictionary<string, string>();
139     headers["Content-Type"] = "audio/wav";
140     headers["Authorization"] = "Bearer " + API_KEY;
141
142     float timeSent = Time.time;
143     WWW www = new WWW(url, postData, headers);
144     yield return www;
145
146     while (!www.isDone) {
147         myResultBox.text = "Thinking and deciding ...";
148         yield return null;
149     }
150     float duration = Time.time - timeSent;
151
152     if (www.error != null && www.error.Length > 0) {
153         UnityEngine.Debug.Log("Error: " + www.error + " (" + duration + " secs)");
154         yield break;
155     }
156     UnityEngine.Debug.Log("Success (" + duration + " secs)");
157     UnityEngine.Debug.Log("Result: " + www.text);
158     Handle(www.text);
159 }

```

Figure 3.38: Process of sending voice request to cloud based wit AI bot

```

4 using UnityEngine.EventSystems;
5
6 public class ColorChange : MonoBehaviour
7 {
8     public Material carMaterial;
9     // Start is called before the first frame update
10    void Start()
11    {
12    }
13
14
15    // Update is called once per frame
16    void Update()
17    {
18    }
19
20    public void ChangeColor()
21    {
22        string Buttonname = EventSystem.current.currentSelectedGameObject.name;
23        if (Buttonname == "Green")
24        {
25            carMaterial.color = new Color(0 / 255f, 233 / 255f, 133 / 255f);
26        }
27        else if (Buttonname == "Yellow")
28        {
29            carMaterial.color = new Color(233/255f, 216/255f, 0/255f);
30        }
31        else if (Buttonname == "White")
32        {
33            carMaterial.color = new Color(255/255f, 255/255f, 255/255f);
34        }
35        else if (Buttonname == "Black")
36        {
37            carMaterial.color = new Color(29/255f, 29/255f, 29/255f);
38        }
39        else if (Buttonname == "Blue")

```

Figure 3.39: Changing Car Color

To change car color I access the materials of the car and according to button pressed with specific name of buttons change material to given rgb color value through the char changer script.

I have added rotate, scale and move option for the cars in augmented reality experience with help of Lean Touch asset. I go to unity asset store then found lean touch as free asset download and imported it into my project. Now I select modify lean rotate, scale, move scripts and attached as far user requirements.

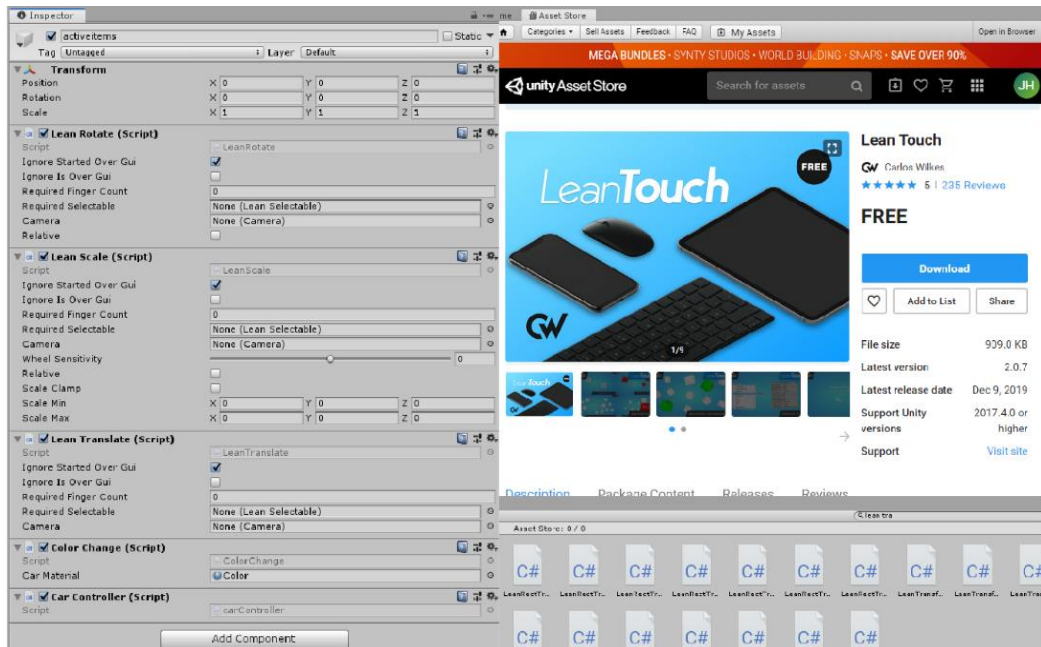


Figure 3.40: Import Lean touch from asset store for translate control

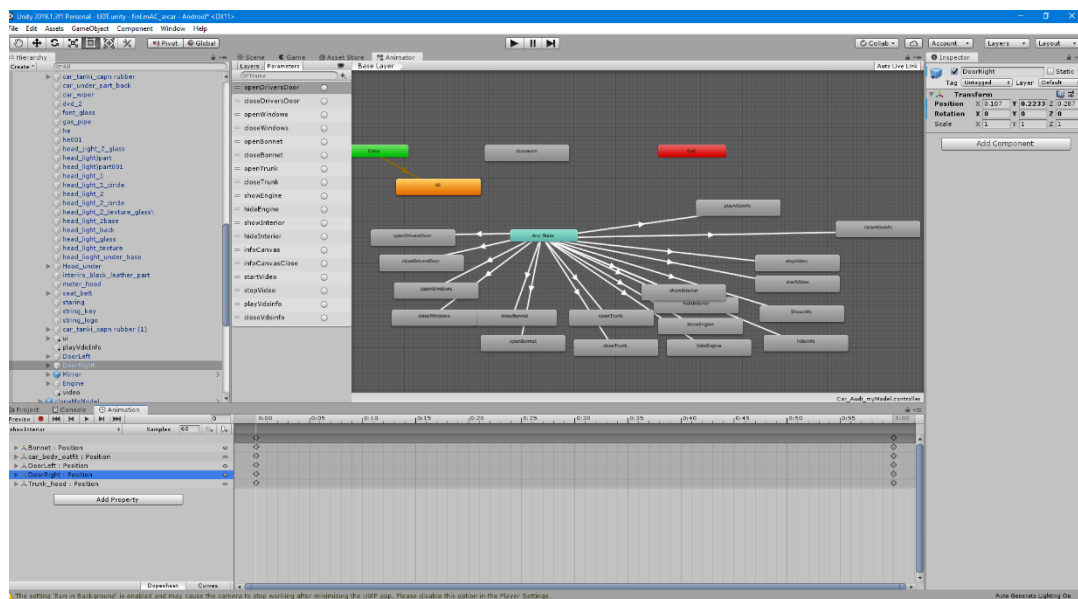


Figure 3.41: Animations of car parts

I have manually created, individual car parts and ui animations with identical specific triggers.

After completing the indoor udt AR scene I focus on Outdoor scene where, user can place their chosen 3d model in any surface or plain floor within proper lighting. Most of the feature remain in outdoor scene as indoor scene so I duplicate my indoor scene and modify it. For outdoor scene I am using vuforia ground plane detection technology that's why I don't need any udt functionality so deleted it.

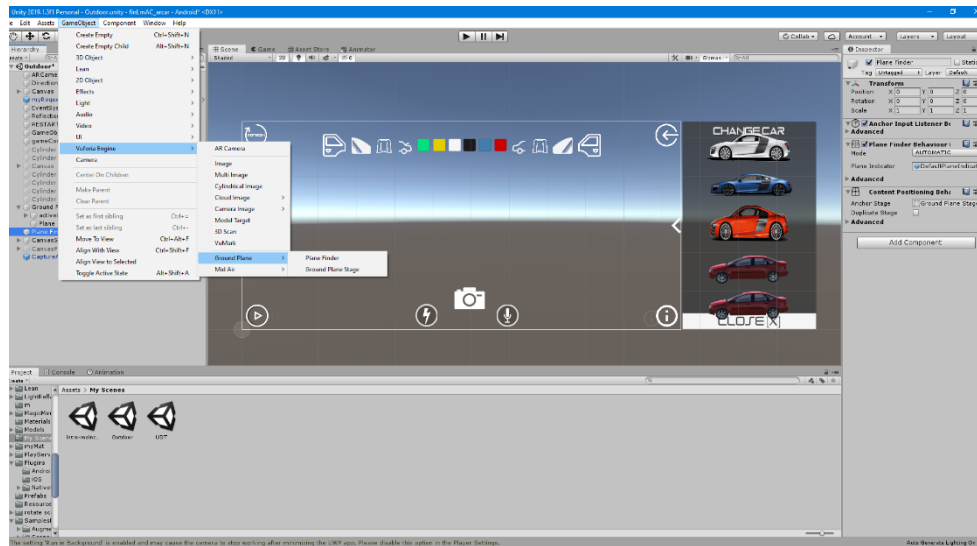


Figure 3.42: Ground Plane detection setup in outdoor scene

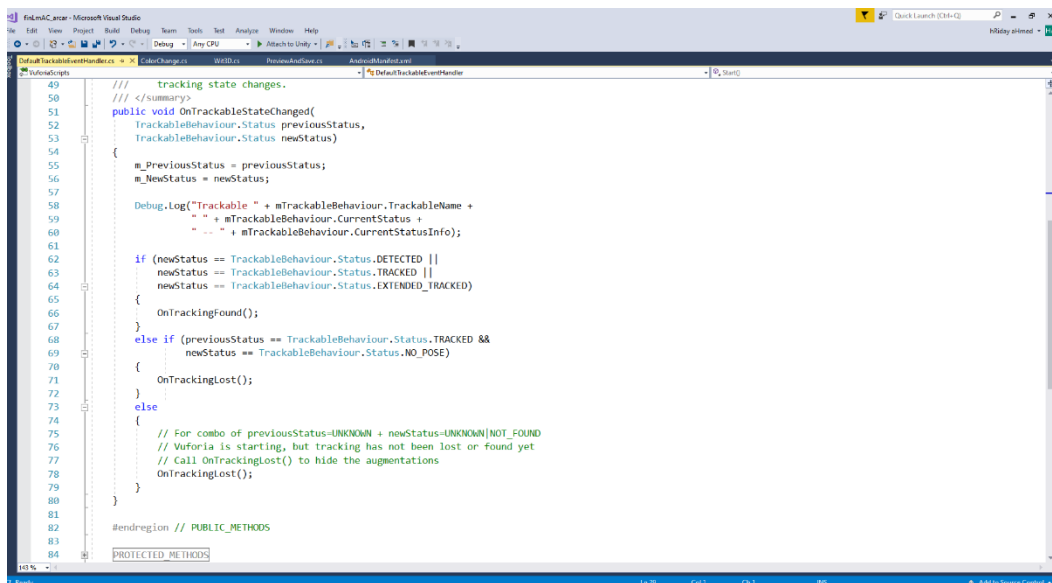


Figure 3.43: Vuforia default tracking event handler

As like indoor scene I must attach vuforia default Trackable event handler script with ground plane detection for tracking point detection and placing the ground plane in surface, what also use plane finder.

CHAPTER 4

Software's & Plugins

4.1 Introduction

Once i identified what to do for my project and i had the essential data for swing to the production phase, i made the list of needed software as below, and made sure i have them installed in my workstation.

- Unity – 2017.2.5f1 & 2018.3.3f1
- Adobe Illustrator
- Autodesk Maya 2019
- Vuforia
- Adobe After Effects CS6
- Microsoft Visual Studio 2017

4.2 Unity

Unity Technologies developed a cross-platform game engine called UNITY. It was first out in 2005 and has already threw several updated versions with superior tools to develop communicating games, software and application. The most helpful part of Unity is, it can be used in numerous operating systems, and the deployed software from unity can opt for almost any widespread operating system. Thereby, one can develop software in unity for both Windows, MAC and android, Linux, iOS; everything. The game engine has fundamentally two parts to work with. One is the frontend which includes making the scene with necessary elements and the other is the backend, where the scripting/programming is done. The user only experiences the results showed in frontend. Unity game engine allows scripting in two languages. The C# and JavaScript.

I have selected this game engine for my project because of its user friendly user experience and user workflow. I designed the scenes and user interface in this engine and C# programming language to make them interactive.

4.3 Adobe Illustrator

Adobe Illustrator is a vector graphics editor developed powered by Adobe Inc. Initially designed for the Apple. Development of Adobe Illustrator began approximately 1985. Along with Creative Cloud, Illustrator CC was released. The latest version is Illustrator CC 2019. It was released in October 2018. It is the 23rd generation in the product line. Adobe Illustrator was reviewed as the best vector graphics editing program by PC Magazine in 2018.

4.4 Autodesk Maya

Autodesk Maya is a 3d designing, modeling, animation and VFX software with the abilities of animating CG objects. This software was released in February 1998. Since then, this software is being widely used for animation. Because of having a user friendly interface, Maya has become one of the beloved 3d modeling and animating tools to the industry experts. After the initial release, the software is being advanced with newer and smarter prospects and the latest versions include realistic shader and dynamic simulation tools to get even physically and visually perfect models and animations. We have chosen this software for all the 3d design and modeling parts of our project.

4.5 Vuforia

Vuforia is a plugin which provides cross-platform Augmented Reality support for Android, iOS, and UWP devices, through a single API. It allowing developers to write their apps once and run them using the best available core technology. It starts with Unity 2017.2, Unity Developers have been able to create Vuforia-enabled apps using a simple authoring workflow and open scripting directly in the Unity Editor. The Vuforia plugins included performance optimizations. It included tight ongoing synchronization of features and fixes. It is a native Unity workflow that enables developers to focus on creating the best AR experiences.

With Unity 2019.3, we introduce with Vuforia 8. Its helps developers to attach digital content to even more types of objects and environments using Model Targets, Ground Plane. While ensuring the best possible experiences on the broadest range of devices and operating systems.

Image Targets

Image Targets are a particular kind of marker utilized in the Marker-based following. They are pictures you physically enroll with the application and go about as triggers that show virtual substance. For Image Targets, utilize pictures containing particular shapes with

complex blueprints. This makes it simpler for picture acknowledgment and following calculations to remember them.

Markerless following

Applications utilizing Marker less following are all the more general area based or position-based Augmented or Mixed Reality. This type of following depends on advancements, for example, GPS, accelerometer, spinner and more unpredictable picture handling calculations, to put virtual items or data in the earth. The VR equipment and programming at that point regards these articles as though they are tied down or associated with particular true areas or items

4.6 Adobe After Effects

Adobe After Effects is another mighty product of Adobe Systems. This is fundamentally used for post- production in non-linear editing panels. This software has a status in the film, television and game industry for its prospects of motion graphic animation, visual effects production, 2d animation, video and audio editing. This is the one stop solution for nearly any kind of compositing works in the industry now. The software was first released in 1993 and since then it has been progressed with several newer versions. Though there are other node based powerful compositing tools in the industry now, Adobe after effects is still the first choice for artists like me who like to work with layers and timelines. In our project, we used Adobe after effects for the intro video of the project.

4.7 Microsoft Visual Studio 2017

An Integrated Development Environment (IDE) was developed by Microsoft and named as Microsoft visual studio ^[10]. This software is used to develop computer programs, websites, applications, mobile apps and lots other items. This IDE can produce both native code and managed codes. Also the integrated debugger makes it capable of source level debugging and machine-level debugging.

As Unity game engine needs an IDE to script for the product, it includes some external IDE with it. Microsoft Visual Studio is preferred by the Unity officials for its latest versions and that influenced me to use this for my project's backend.

4.8 Adobe Photoshop

Photoshop was created in 1987 by the American siblings Thomas and John Knoll, who sold the dispersion permit to Adobe Systems Incorporated in 1988. It can alter and create raster pictures in numerous layers and backings covers, alpha compositing and a few shading models including RGB, CMYK, CIELAB, spot shading, and duotone. Notwithstanding raster illustrations, it has restricted capacities to alter or render content, vector designs (particularly through cut-out way), 3D designs and video.

Photoshop tools

After stacking Photoshop, a sidebar with an assortment of devices with numerous pictures altering capacities appears to one side of the screen. These devices normally fall under the classes of illustration; painting; estimating and route; determination; compositing; and retouching.

4.8 Apple Xcode

Xcode for MacOS is an IDE integrated development environment to develop softwares for macos, iOS, iPados, tvOS, watchOS run in device like Macbook, iPhone, iPad, iPod, apple Tv, apple Watch. First released in 2003, the latest stable release is version 11.3 and is available via the Mac App Store free of charge for macOS Catalina users. Xcode supports source code for the programming languages C, C++, Objective-C, Objective-C++, Java, AppleScript, Python, Ruby, ResEdit (Rez), and Swift, with a variety of programming models, including but not limited to Cocoa, Carbon, and Java.

This IDE contains everything we need to build superb softwares and to bring our apps to even more devices. It take benefit of SwiftUI, an all-new user interface framework with a declarative Swift syntax. Jump conveying iPad app to Mac with just a click. And with support for Swift packages, Xcode 11 lets us share code between all of apps or use packages created by the whole community.

CHAPTER 5

Final Output & Evaluation

5.1 Introduction

In this chapter, i will discuss the building process and evaluation result and the introductory video. It will help us to find out the lacking and bugs.

5.2 Building the .apk file for Android:

Through the process detailed earlier, our application is ready with all functionalities. But, the main problem is, still i need to play and run this inside Unity game engine. So, it's not yet ready for the audience. In order to build it to .apk file, i need to do a "Build Settings".

In the "Build Settings" option, there are player setting options too. i can change the name of the App, the company name, the versions, the chosen devices, the logo of the Application, cut scenes and all other necessary formalities there. Inside the build settings, must arrange my scenes according to order, keeping the Scene Management script in mind.

This is to be noted that, without building the scenes in serial, the application won't be deployed properly as useable. apk file.

5.3 Building the .ipa file for iOS:

To build my project for iOS devices as like iPhone, iPad or iPod, at first I need an Apple MacOS running machine called mac. And also need to export my project files from unity>asset>export asset and save to share through other devices. From that mac open unity then import my project assets. After importing and error fixing go to file build setting switch from android to iOS platform then setup player setting as before like apk build. But here for better AR experience I have to choose Apple Arkit instead of choosing google Arcore. Now clicking build and run setting will bring up the whole project inside apple's Xcode development kit for ios and the project automatically saved as xcode project. Inside xcode I changed few setting for ios devices support as like Minimum iOS version support and add development key to successfully build run in iphone or ipad as apple required development id to launch applications under development.

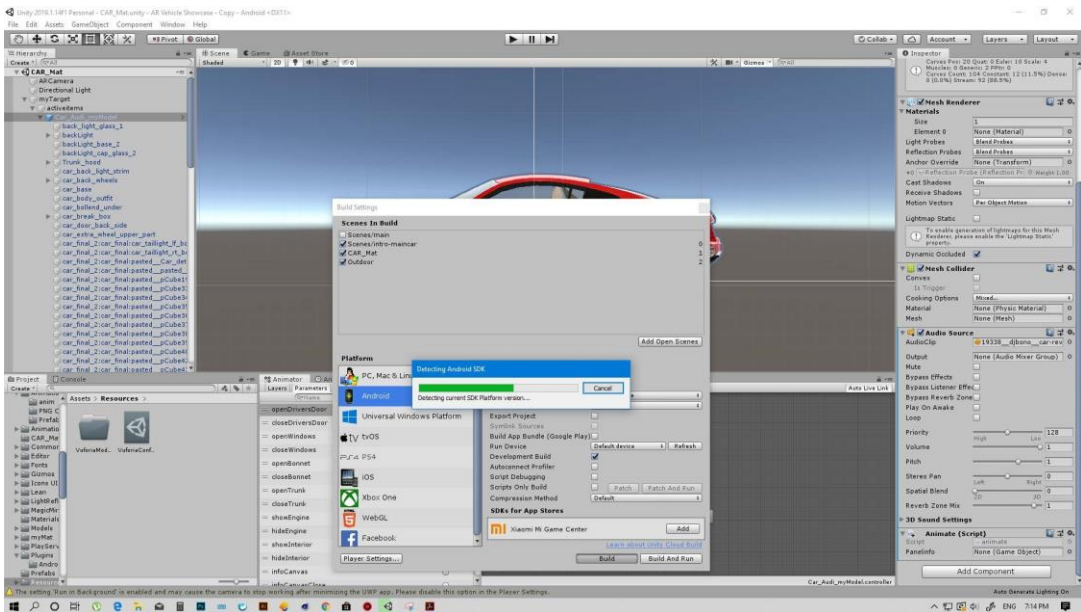


Figure 5.1: Build “AR Virtual Car Showroom”

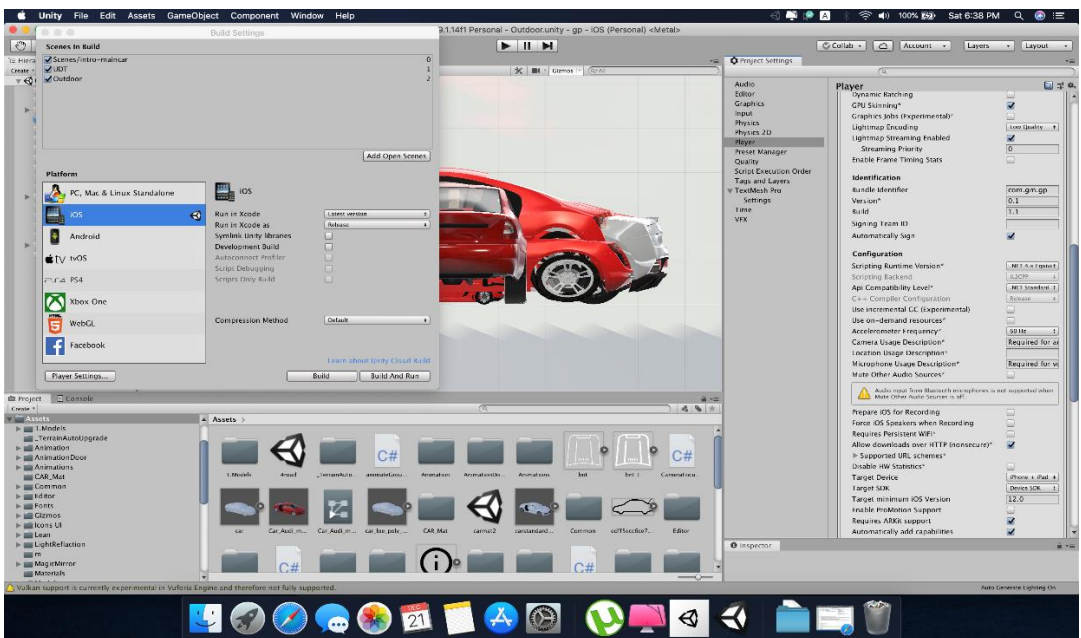


Figure 5.2: Build “AR Virtual Car Showroom”

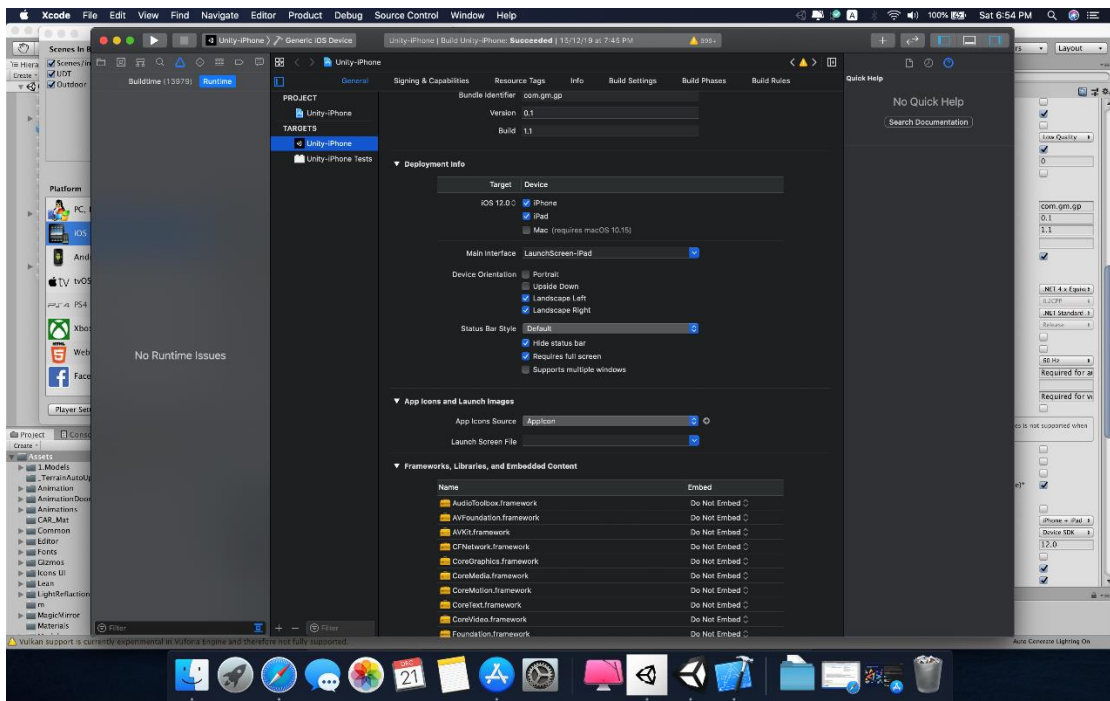


Figure 5.3: Xcode Setup iPA settings for iOS

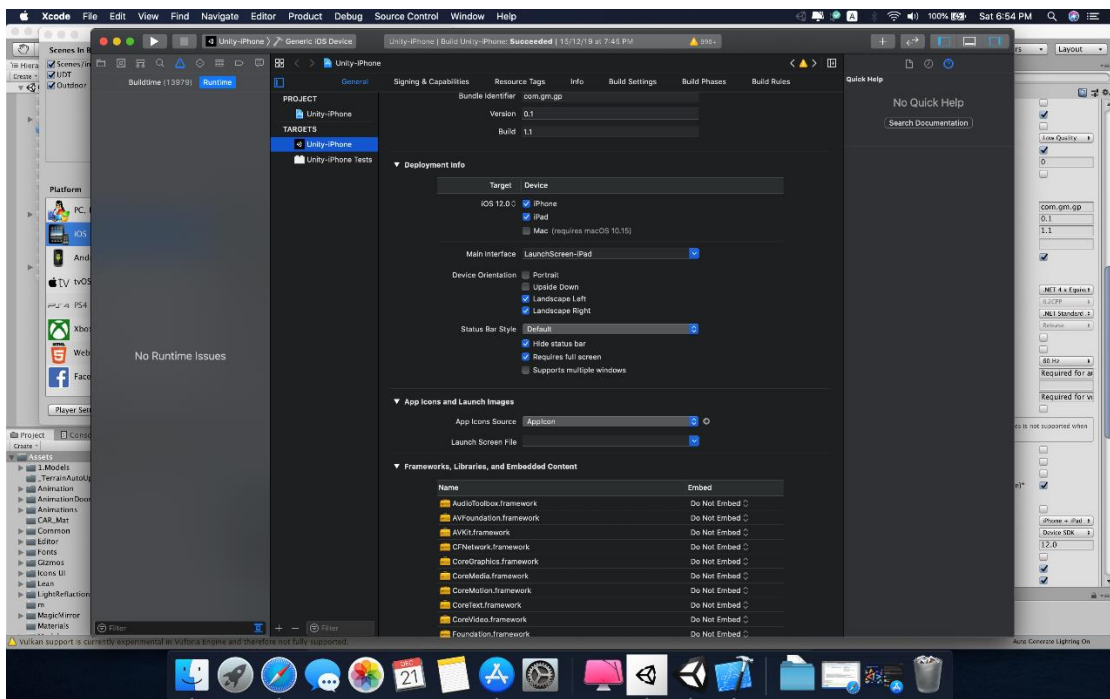


Figure 5.4: iOS iPA Runtime Debugging in Xcode

If the work file was needed to be modified in other workstations, I found it useful to have the project settings folder always with the exported package. In order to use the same work files on another computer, we need to open a new project and import the custom package in that

new project. The “Project settings” folder should be replaced by the previously saved project settings folder. Thus all tiny details will be reloaded. Otherwise, it’s very common to have errors, which are almost impossible to solve without creating that part from scratch.

5.4 Compositing the Intro:

The Introductory video is a short video clip that is just made with the intention of introducing car details. This video will also be used to promote this application. This short blood worming video is both a promotional and inspirational, indeed.

In the making of this video, the design used in the apps are used with visual effects added and composited with Adobe After effects.

5.5 Lacking, Bugs and Challenges:

The “AR Virtual Car Showroom” application have some lacking and bugs. This application play by Smartphone or Tablet. So, mobile devices need to have Arcore or Arkit support to run ground plane detection as I used in outdoor scene. Although without these feature every other reasonable smartphone can run my application only ground plane detection or ourdoor scene will not augment 3d model. But the indoor scene is going to work fine. To develop this application need powerful workstation and to add driving feature drivable car need extra automotive physical engine that cost a lot.

Other problems are not working “AR Virtual Car Showroom” application low android version, low ROM and RAM smartphones. So, this application will need minimum android version of android 7.1 or higher and for iOS need minimum iOS version of iOS 11 or latest android version, high ROM and RAM smartphones perfectly for run effectively.

“AR Virtual Car Showroom” app would provide a very lifelike conception of the luxury automotive vehicles, carrying the automotive showroom on a plate to the customer.

The virtual experience would look like the real-life scenario users would be able to rotate, move, scale, see inside and even split it into parts. By entering inside, possible car owners would see if the car they intended to buy would be suitable to drive. Clients would use iOS or Android device and hold it in front of a space with proper lighting they want to see a vehicle in. By picking a location, customers will be able to place a car and look inside.

CHAPTER 6

Discussion

6.1 Introduction

In this chapter, I have presented a comparative discussion about my project and other ways of presenting AR & VR. Regardless of time and technology, how the result is being useful and is freely discussed in this chapter.

6.2 Discussion:

Instructors realize that the educational method must to be all regarding creativeness and interaction. While academics don't principally have to be bound to apprentice all students into science, their goal is to induce them officious about a topic. That's where AR & VR could come in handy. The possible outcome of joining smartphones, with Augmented and Virtual Reality for business-trade, education is huge, yet it still has to be wholly learned. AR in numerous ways, could allowance customer's extra digital information about any product, and make complex information easier to show and understand. The time given to complete this project was restricted to 8 months. However, it is a challenge because there are continuing academic subjects need to be carried out together with this project. Consequently, multitasking is very essential because this project must be completed without disturbing academic performance. In addition, time managing is also a key factor to ensure this project hits the barrier throughout the process and able to be completed on time. In numerous cases, academic data isn't enough to get the correct skills in skills. Students not be simple listeners and passive observers. Students of technical colleges principally would like to observe and active expertise in their areas. Through interaction, unlike Augmented Reality features could help perform a virtual practice – with augmented showcase, digital modeling, and simulations, and acquire some capability in the end. It is not a secret that driven and involved students will understand a subject better and learn faster.

CHAPTER 7

Conclusion

In this era, social life has been extensively affected by the electronic devices around them, and the rate is still rising. Some specialists also believe that this social media-based society is truly breaking the bondage between humans and humanity is under a threat too. But there must be ways to use every tool in a positive way because the tools are not controlling us, rather we are accountable as the users. So, if we can clarify our way of thinking, way of using the chances science has offered to us, we certainly can make a better future.

This structure also can be made to control more smart devices. For example, it may be designed to assist as a showcasing solution for the automotive companies in Augmented Reality application. As the Augmented Reality and Virtual Reality technology are rising, automated sales and trade system control is another emerging technology, both of this idea can be merged to produce smart apps and games. These apps can controls various sectors of business and education.

This project was just a beginning. More attractions, services and inspirations will help this endeavor to reach its utmost success of creating a modern society. Where modern trade will not only be depend on newspaper and tv commercial depended, but modern trade business will symbolize modern technique to reach customer and boost sales, above all modern ways of looking at life.

What have I gained from this Project:

This project has qualified me to operate new environments. Both environments are cutting edge and used in with my patients' level, so it was nice to get a taste of what i could enter into when I graduate. It would be good if more modules used newer technologies as it generates new challenges and allows the output to look better. I am honestly proud of what I have accomplished. The "Augmented Reality (AR)" was something completely new to me. I have done a short course about "AR" and its requirements expandable enough so that, I could challenge myself and produce a really useful application with the combination of Augmented and 3D modeling animation.

CHAPTER 8

Future Possibilities

8.1 Introduction

In this chapter, I tried to discuss the enormous possibilities after this project. This “AR Virtual Car Showroom” is a momentous in the electronic mediums of Showcasing products. But, this is unquestionably just a beginning. This kind of project has a lot more to be extended. There are possibilities of adding newer features and making this application more useful to a larger number of users. Keen people can get inspired by this step and draw their paths on this journey in many different ways.

8.2 Opportunities with this project in near future:

- In these apps, I tried to make an app for car brands customers only. In the near future, I would love to add more like driving capabilities, drivable car, showroom based system etc.
- This app can also be used to showcase others companies product.
- I will make these apps for different grade customers in the future.
- This is the beginning, I will work for various audience with different contents in future.
- I can implement this application as prototype for other future product showcase.
- The automobile industry has more exciting possibilities for presenting cars in numerous ways!

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