Survey title of technical project scope:

Anti-Glossophobia ARVR (MR) application

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This survey is completely my own work, signed by ***RUTURAJ R. RAVAL***

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Abstract

Enhance personal, emotional, social, presentation skills as a speaker to avoid the fear of stage and speech while facing the audience and crowd with virtual reality enabled approach using Augmented Reality as a platform to overcome Glossophobia [1] (speech anxiety) with voice and gesture activated virtual audience to be able to stand up & speak with the assistance of VR headset and/or mobile device and/or computer.

Abbreviations

AR- Augmented Reality

VR- Virtual Reality

MR- Mixed Reality

AV- Augmented Virtuality

AI- Artificial Intelligence

HMD- Head Mounted Display

UI – User Interface

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1. Introduction of technical project scope

1.1 Non-technical introduction

- To overcome Glossophobia [1] (speech anxiety), to be able to have characteristic of public speaking like presentation in front of academic authorities, company managers, etc. people need to have self-confidence and practice to be able to speak in front of people so, this AR application will help the user to interact with virtual audience in front of him/her which can help user to interact with them and when user speaks some words as an error of broken speech, then virtual audience will motivate user to continue with remaining speech. This technique can be used in the intense training of a person to improve one's presentation and reduce their trauma of fearful event from past if any in a better way. The static classroom or office room can be created virtually and the audience can be held algorithmically, to react for static keywords or maybe for some gestures to motivate user in terms of boosting user's confidence, to encourage and to make a person capable enough to speak publicly.
- This kind of application will be helpful to heal human drawbacks such as, self-consciousness in front of large groups, fear of appearing nervous, concerns of others' judgement, past failures, poor or insufficient preparation, narcissism, dissatisfaction with own abilities, discomfort with own body and movement, poor breathing habits, comparison with others, etc. [2]. Psychological experience can lead to the fear of speech anxiety (Glossophobia) [1]. A number of studies explain that 75% people in the world have suffered glossophobia. The studies also revealed that, compared with men, women have higher tendency to experience glossophobia [3].

1.2 Technical introduction

The architecture for this application will conduct usage of VR and AR functionalities called MR (Mixed Reality), so the architecture design will be based on MR platform [4].

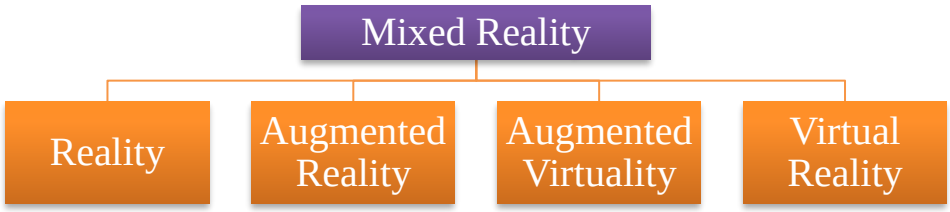


Figure 1 MR architecture

The MR is basically a combination of Reality, AR, AV and VR as shown in the above-given hierarchy. So, basically, my Anti-Glossophobia application will work in all above-mentioned environment.

1.2.1 Augmented Reality

- Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented), by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one [5]. An augmented reality system is one which complements the real world with (computer generated) virtual objects so they seem to coexist in the same space as the real world, which in both cases leads him to define the features of an augmented reality system according to the following three properties: 1. "Combining real and virtual". In the 3D real-world 3D entities must also be integrated. 2. "Real-time interactivity". This namely excludes films even if the previous condition is respected. 3. "3D repositioning". This enables virtual entities to be made to visually coincide with reality [4].
- Augmented reality (AR) is a direct or indirect live view of a physical, real-world environment whose elements are "augmented" by computer-generated perceptual information, ideally across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory. The overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is spatially registered with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, Augmented reality alters one's current perception of a real-world environment, whereas virtual reality replaces the real world environment with a simulated one. Augmented Reality is related to two largely synonymous terms: mixed reality and computer-mediated reality [6].

1.2.2 Virtual Reality

- Virtual reality (VR) refers to computer technologies that use software to generate the realistic images, sounds and other sensations that represent an immersive environment

and simulate a user's physical presence in this environment. The first wave of VR came already in 1990's when a number of industries were inspired by games. However, the user experience was still unpleasant and the hype soon passed. After 2005, the second wave of VR emerged and was more successfully employed in different fields such as engineering, medicine, mental health, design, architecture and construction, education and training, arts, entertainment, business, communication, marketing, military and travel. Now, device, component, software and user-interface development are globally moving fast forward and many world-leading players in manufacturing and e-commerce, for example, are adopting these technologies [7].

- Virtual reality (VR) is a computer-generated scenario that simulates a realistic experience. The immersive environment can be similar to the real world in order to create a lifelike experience grounded in reality or sci-fi. Augmented reality systems may also be considered a form of VR that layers virtual information over a live camera feed into a headset or through a smartphone or tablet device. Current VR technology most commonly uses virtual reality headsets or multi-projected environments, sometimes in combination with physical environments or props, to generate realistic images, sounds and other sensations that simulate a user's physical presence in a virtual or imaginary environment. A person using virtual reality equipment is able to "look around" the artificial world, move around in it, and interact with virtual features or items. The effect is commonly created by VR headsets consisting of a head-mounted display with a small screen in front of the eyes, but can also be created through specially designed rooms with multiple large screens. VR systems that include transmission of vibrations and other sensations to the user through a game controller or other devices are known as haptic systems. This tactile information is generally known as force feedback in medical, video gaming and military training applications [8].

1.2.3 Mixed Reality

- Mixed reality (MR) refers to combining real and virtual contents with the aid of digital devices. Mixed reality is seen to consist of both augmented reality (i.e., virtual 3D objects in immersive reality), and augmented virtuality (i.e., captured features of reality in immersive virtual 3D environments). All these technologies have recently peaked in terms of media attention as they are expected to disturb existing markets like PCs and smartphones did when they were introduced to the markets [7]. AR and

VR User Interfaces (UIs) have so far been used for a great number of tasks, where they at times have shown great promise for increasing a user's performance compared to traditional mouse-and-monitor UIs. However, usually the tasks that have been studied differ greatly due to the different focus of both technologies: usually, AR studies involve interaction with real-world objects that could not be performed in purely virtual environments [9].

- Mixed Reality (MR) technologies are predicted to be disruptive to human interaction. While the impact of the most internet and mobile technologies have been restricted to a limited number of human senses, cognition and affections, MR technology development is targeting to control all five basic human senses (sight, hearing, taste, smell, touch). It is assumed that the effect on the human mind and emotions will be complete through total sensory immersion. The development of immersive MR technologies that have both a broader and deeper effect on human experiences are opening new interesting research areas in marketing and sales [10].
- Mixed reality (MR), sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. Mixed reality takes place not only in the physical world or the virtual world, but is a mix of reality and virtual reality, encompassing both augmented reality and augmented virtuality via immersive technology. The first immersive mixed reality system, providing enveloping sight, sound and touch was the Virtual Fixtures platform developed at the U.S. Air Force's Armstrong Laboratories in the early 1990s. In a study published in 1992, the Virtual Fixtures project at the U.S. Air Force demonstrated for the first time that human performance could be significantly amplified by the introduction of spatially registered virtual objects overlaid on top of a person's direct view of a real physical environment [11].

1.2.4 The motive of this application

So, coming to the Anti-glossophobia application, with the help of this app, we can create a virtual environment for an user to get rid of speech anxiety with the help of MR, where user just need to wear VR glasses (Cardboard [12], Daydream [13], etc.) and need to keep Android device inside the VR device and need to run my application. Their user will be able to see beautiful, stress-busting environment, and with the help of android device camera, AR will be activated in the VR world and that helps user to see virtual view embossed with real

non-visible environment (as I will be overriding real view from camera with VR environment) but as soon as your android camera detects the static scene in front, the AR will be enabled and you will see virtual objects. And those objects are as human will provide a response to predefined static words of a user to react to motivate the user to not to feel anxious while speaking.

1.3 Targeted area

Currently, the targeted areas to perform and to run this application is covered in MR. Additionally, the other aspects to consider are an Android platform, Windows 10 PC, VR box, etc. are physical devices we need to target to be able to run this application.

1.3.1 The efficiency of using AR for targeted application

- AR [6] is a broad world; it is not limited in terms of scalability. It is a wide environment which one can opt in to use in plenty of applications. Specifically for this application, AR is important in terms of efficiency, because we need to target some view (right now one default view is there, which is classroom in the mountains) and we are targeting that VR scene as a destination to represent AR objects (means human, robots, creatures, etc.). So, if we don't target AR and if we build objects in VR world [8] without implementing AR then it will be static structure and object won't be dynamic as for the future work, we can target any surface irrespective to the surface or the view in front, then camera will target any sort of view in front to place the object on the scene in real world based on simultaneous localization and mapping to discover the location and orientation of the view in front which will be relative to the viewer and the scene. So that way objects never move away from their position. And in a future multi-user environment can be created based on AR-SLAM [14] (multi-user interaction) technology where different users are in the same environment and interacting into that MR [11] world with the help of efficient AR algorithm as an advanced application.
- Then to make AR more efficient we can provide UI controllers to operate with wireless remote or kind of device. There we can apply special moves using AI and flexible mesh-objects to animate objects as per requirement then point system can be applied based on user performance, to boost confidence. This is a good stress buster exercise, we can even organize competition between with AR among users & that's how the efficiency of AR can be extracted.

2. Implementations and system designs

2.1 System Diagram (Application flow)

The system diagram can be illustrated as described below from the user input up to the system output with the application flow.

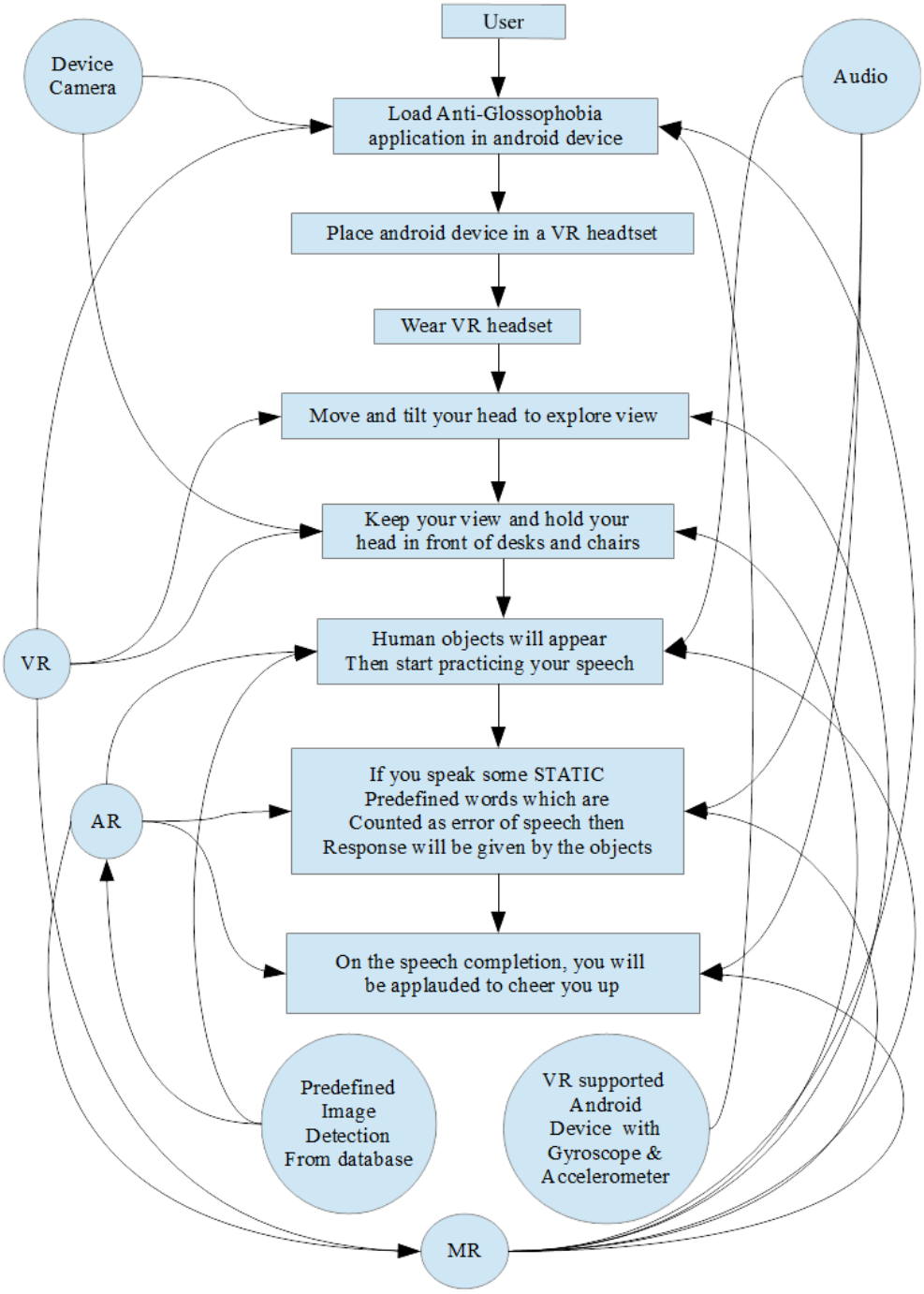


Figure 2 Application flow

2.2 System design

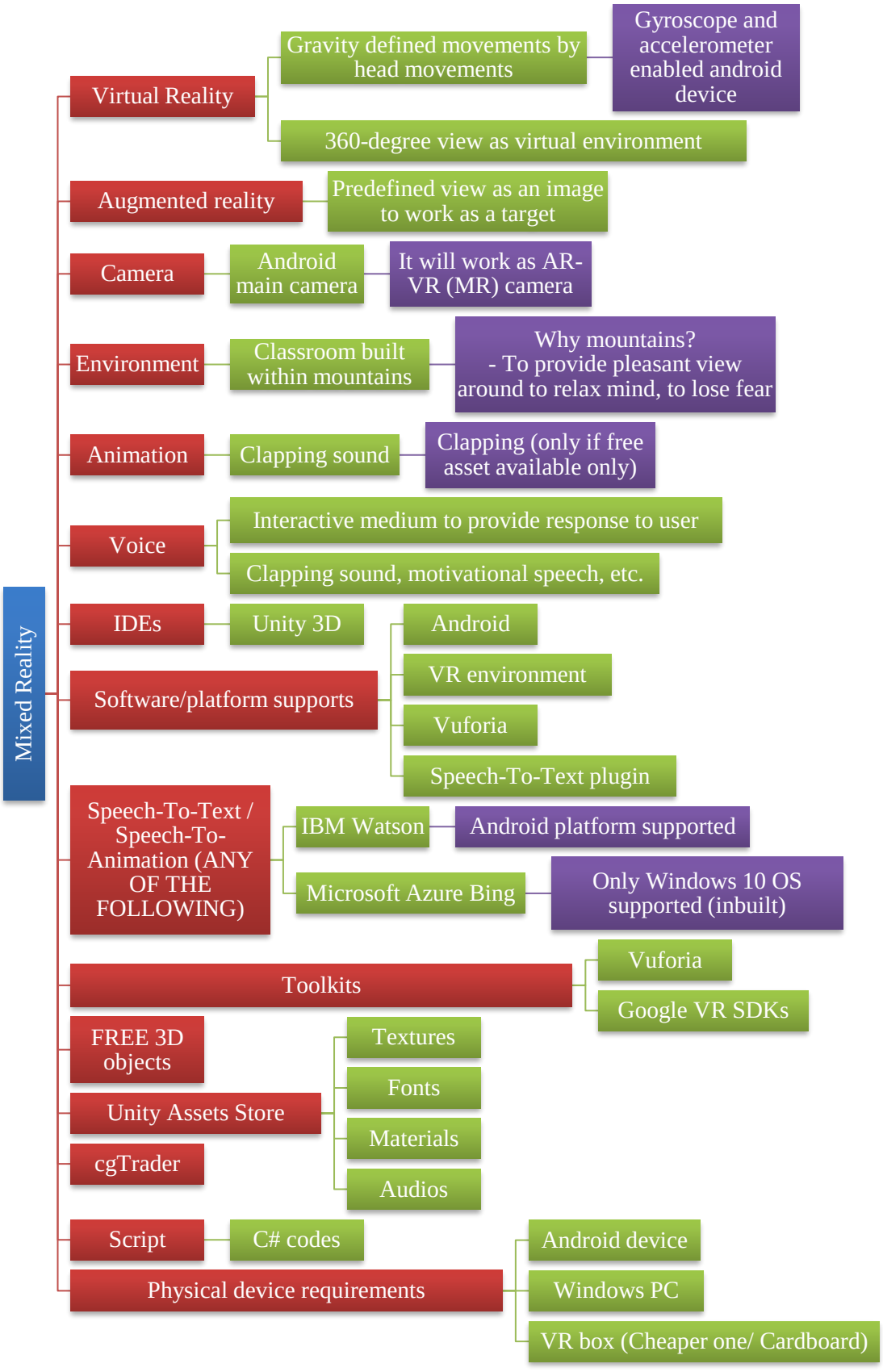


Figure 3 System Design with all components

2.3 A brief explanation of system design

- For the MR application development, the main IDE which will be used is UNITY 3D [15]. And with the help of this IDE, I will be developing my MR application. The AR toolkit which will be used is, Vuforia [16] [17]. The VR toolkit which will be used is Google VR SDKs [18]. For the speech-to-text [19] functionality there are few options like IBM Watson [20] and Microsoft Azure Bing [21], so any of this plugin will be used for Speech-to-text or Speech-to-animation functionalities.
- On another hand, for testing purpose, Unity's inbuilt emulator can be used for the testing purpose and the real android device can be used as well, for better UI and better use. Apart from that, Genymotion emulator [22] can be used too for computer-based testing. For the 3D objects and materials and textures, Unity Asset Store [23] or cgTrader [24] will be used to download FREE objects.

2.4 Subsystem and interaction design description

The subsystem and interaction design between different packages of toolkits and IDEs and how they interact with each other can be described as follow. The different subsystems are shown as,

- Mobile/ PC
- Virtual Reality [8]
- Augmented Reality [6]
- IBM Watson [20] *or* Microsoft Azure Bing [21] *or* Unity3DPocketSphinx [25] (OS dependent)
- Objects
- Vuforia
- Speech
- The accuracy of speech confidence

Etc. And the relationship and how they interact is shown in next section. The final objective is to perform required task of Mixed Reality can be achieved with the help of all these subsystems, once we know the flow and their inter-connectivity and the output. Next to next section (2.6) discusses the system tools and packages in details that how the system with all the mentioned systems and their interaction will perform.

2.5 Subsystems and interaction within different systems

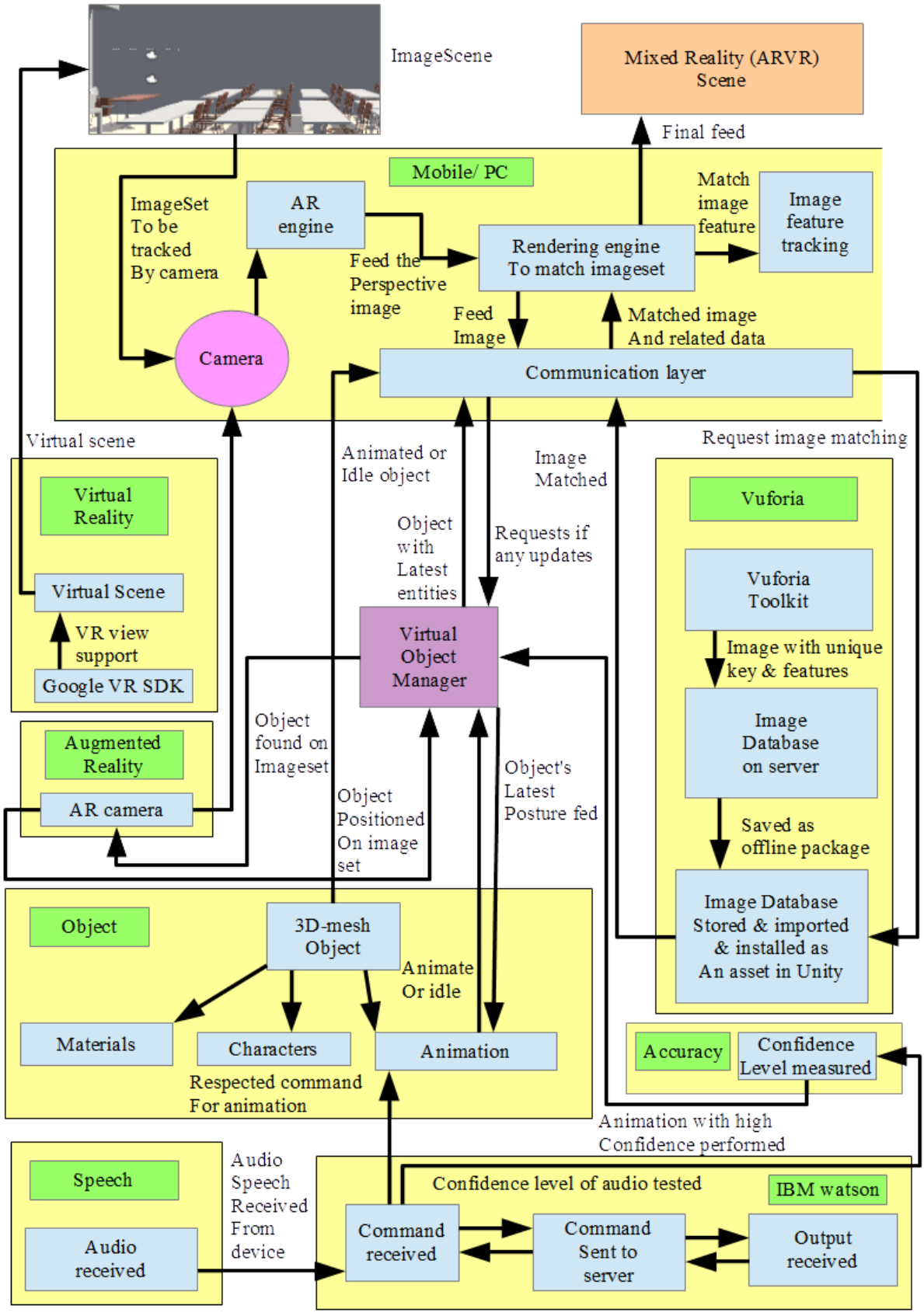


Figure 4 Subsystem architecture and interaction

2.6 Description of sub System Tools and Packages and their integration

This section will carry the details about the different subsystems mentioned in section 2.4 that how they will be used in this technical project and how they will be integrated to perform which type of an action, etc. all will be discussed as given below with the help of previous section 2.5.

2.6.1 Mobile device / PC

- The Android mobile device or PC will work as a device to an MR output of this project with their help of an inbuilt/external camera. This camera will be used as an AR camera [16] to track the image target from image set and then to load an AR engine. That AR engine [17] will feed the perspective image onto a rendering engine to match image set. That image will be fed to the communication layer, which communicates with Vuforia toolkit, to match an image with the already imported image set in the IDE called Unity [15], in which the project is being built. While the rendering the image the images features are tracked to place the object at the respective position on pre-defined image location. The communication layer communicates with the virtual object manager to track all the activities happening with the object including, position change, animation state, idle state, etc.
- For the testing purpose, the real image on a paper can be used for AR system to target it with the camera and to produce AR output, but when we consider the scenario when ARVR (MR) perspective is used, at that time, we need to consider the VR- rendered scene, to take that into an action and that scene is already stored on Vuforia portal [17], so that will be matched with current VR scene when user rotates head to target particular view, in my case a classroom with benches [23], then 3-d characters [24] will be produced.

2.6.2 Virtual Reality

- The virtual reality classroom is predefined, which works with the movement of the mobile device its scene of the classroom is taken as an image set into an account to produce the AR functionality with inbuilt camera. This VR scene and functionality is produced by the Google VR SDKs and the only condition to be able to run the VR scene is to have a gyroscope contained a mobile device for VR operations.

2.6.3 Augmented Reality

- The AR camera [16] is fed to the device camera to perform the image tracking task on predefined image set.

2.6.4 IBM Watson

- The IBM Watson [20] API is used for speech-to-animation purposes. First of all the audio is fed, which was recorded on your device and then that command is sent to the server and output is received. That output is sent to the object to perform an animation.
- Another possibility is of using Microsoft Azure Bing [21], that is discussed in next section after testing.

2.6.5 Microsoft Bing Azure

- Microsoft Azure Bing [21] API for speech-to-text or speech-to-animation API is specifically for Windows OS as it is used as an offline plugin for the development of Unity. But we can only build applications in Unity with this plugin which are windows OS dependent.

2.6.6 Unity3DPocketSphinx

- Unity3DPocketSphinx [25] is the plugin for Unity3D that given the possibility to run PocketSphinx [26] engine in Unity for Unity3D applications, which is now only supported on the Android platform.

2.6.7 Objects

- The objects are of 3D-mesh objects [23] [24] and the objects are defined by the materials and characters and their animations. The objects communicate with communication layer to update the latest status of the object in terms of the current position and it also sends data of animation to the virtual object manager which provides the animated or idle state conditions updates to the communication layer to feed the exact posture on a runtime.
- Objects are a very important entity in terms of this targeted application because that will be the virtual audience and that will help us to help the user to get over anxiety with the help of these human objects only. So the question is how to make/create these objects programmatically? And how to get from available sources? Or how to

use in a flexible way to apply animation? So, to answer all these questions follow below-mentioned solution.

- How to make/create these objects programmatically?
    - To make objects in Unity, kindly follow the tutorial [27] and then you can make very basic objects for your need but for the advanced object creations with details follow the tutorial [28] to make human models.
    - If a developer is good with designing then AutoDesk [29] and Adobe [30] can be used to create the human characters.
- How to get objects from available sources?
    - You can use Unity asset store [23] or cgTrader [24] and Vectary [31] website or any kind of such online platform which is into sales of 3d mesh object characters.
- How to use in a flexible way to apply animation?
    - To cut down the cost of development or to cut down costs of purchasing 3D objects for application development, one can always use available free object packages and can import in an unity for the basic development purpose.

Now, the discussion related to the implementation of a 3D object in my application can be led as, first I have to set the static imageset of the 3d image of different characters onto the scene, in which part of the VR world, I need those characters to be popped out when targeted. So, I will be using that particular target of a VR world [8] to target it as a destination and then AR camera [6] will detect that scene, in particular, that will enable the 3d models to place onto that scene. Then with the movement of the user, the position of the object will keep changing in terms of movement until and unless user exits that particular frame or scene.

If we talk about the technicalities, the animation will be applied to that mesh 3d object. As I have not created the object at my end, I cannot use my own animations; I have to use the existing ones and the supported ones. But there is always a scope of the project if own designed models are used so that the object flexibility can be coded such a way, as per the requirement.

I just had almost 2 months, so it is feasibly not possible to create new objects so I won't be able to complete this project, so I have used already available objects on Unity asset store [23] and cgTrader [24] website.

2.6.8 Vuforia

- Vuforia [16] is a toolkit which helps AR engine to load the image set to match the current view in VR world to be capable to load AR objects in a VR world where you need to store images on vuforia server and need to download the featured unity asset and after importing that asset in unity, the image set will perform as a target image. This all tasks are performed with respect to the communication layer of a device.

2.6.9 Speech

- Speech is an audio which is recorded by the device and then sent to IBM [20] server or for Windows platform to Microsoft offline dictionary to test and match the keyword and the same exact keyword is sent to the accuracy testing to test the level of speech confidence. If the confidence level is high, then only that will be fed to the object animation as a part of the speech-to-animation functionality of this technical project.
- For an example, if the keyword is spoken is “jump”, and if that matches with the animation keyword “jump”, the animation will be performed and that is known as a high confidence level. If the keyword is retrieved as “jimp” or “jamp” or “jemp” or “jomp” then accuracy is meant to be medium and in some cases, the animation will work, but most of the time it won’t work. And for the lowest confidence level, it can occur if the matched keyword is such as, “lamp” or “junt” or junp”, etc. and so on.

2.6.10 Accuracy of speech

- The accuracy of the speech can be measured based on the matching level of the confidence [15] measured by the respective keyword and that confidence level will help the object to perform an animation.

2.7 Description of System Tools and Packages and their integration

The different system tools and packages which are going to be used are,

- Unity
    - This is an IDE (Integrated Development Environment) [15] which will be used as a development platform to develop this project and to load different packages and to perform different functions.
    - Unity is a stand-alone IDE which can be used to produce different perspective and to entertain and to satisfy different objectives, required by the system

need, all the processes from assets to scenes to player settings to ARVR settings, to loading different packages of different platforms to adding 3-d mesh objects to adding sounds to writing C# scripts, etc.

- The Unity and all major components are shown below, that how unity development is carried out to create this Anti-Glossophobia [1] application.

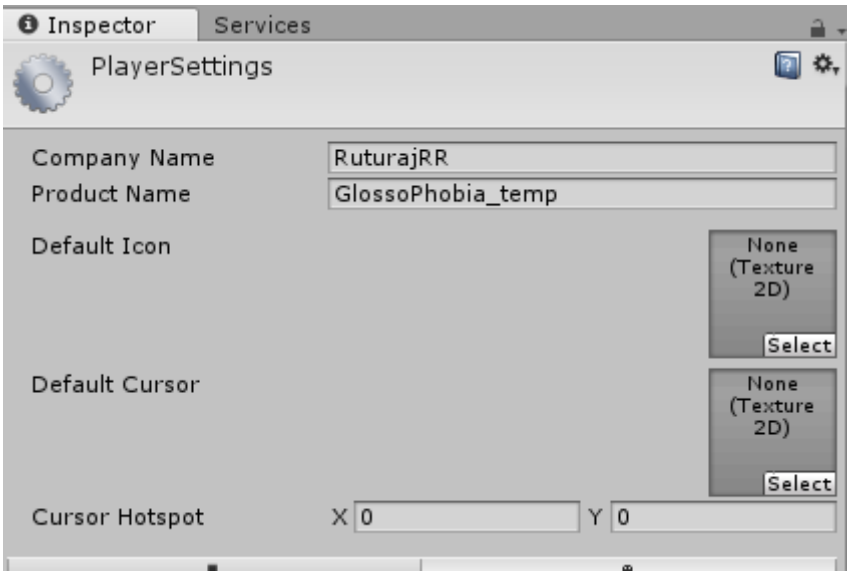


Figure 5 Project creation in unity

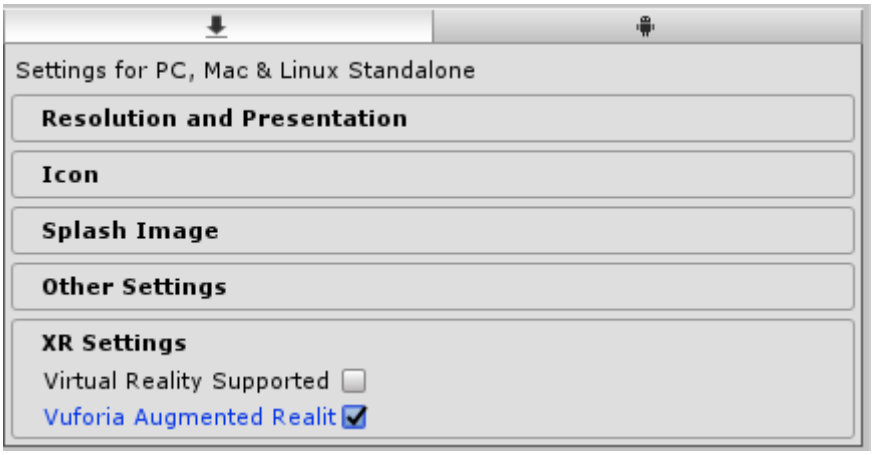


Figure 6 Check Vuforia as Vuforia AR toolkit is used

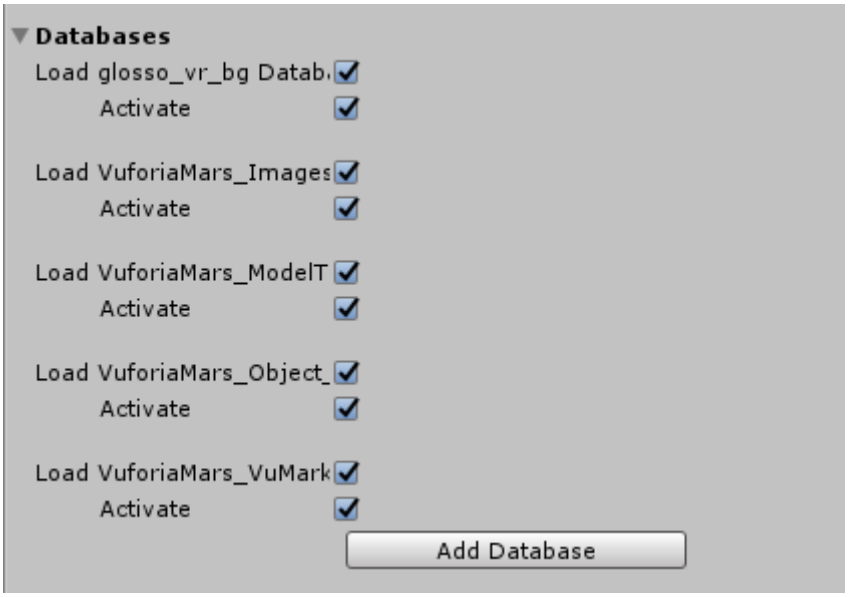


Figure 7 Vuforia enabled image asset database downloaded and stored in unity as a local database

```
public AudioSource jumpaudio;
public AudioSource rageaudio;

void Start () {

}

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

    anim = GetComponent<Animator>();
    jumpaudio = GameObject.Find("JumpSound").GetComponent<AudioSource>();
    rageaudio = GameObject.Find("RageSound").GetComponent<AudioSource>();
}

public void GolemActions(string ActionCommands)
{
    ActionCommands = ActionCommands.Trim();
    switch (ActionCommands)
    {
      case "jump":
       anim.Play("jump",-1,0f);
            //  jumpaudio.Play(11000);
            jumpaudio.Play(0);
            break;
      case "rage":
       anim.Play("rage",-1,0f);
       rageaudio.Play(0);
       break;

      default:
       anim.Play("idle",-1,0f);
       break;

    }
```

Figure 8 Some basic codes for Speech-to-animation

```
private void OnRecognize(SpeechRecognitionEvent result)
{
  m_ResultOutput.SendData(new SpeechToTextData(result));

  if (result != null && result.results.Length > 0)
  {
    if (m_Transcript != null)
      m_Transcript.text = "";

    foreach (var res in result.results)
    {
      foreach (var alt in res.alternatives)
      {
        string text = alt.transcript;

        if (m_Transcript != null)
          m_Transcript.text += string.Format("{0} ({1}, {2:0.00})\n",
              text, res.final ? "Final" : "Interim", alt.confidence);
                if(res.final == true)
                {
                 GolemControllerObj.GolemActions(text);

                }

      }
    }
  }
}
#endregion
```

Figure 9 Some change in default codes of speech recognition engine

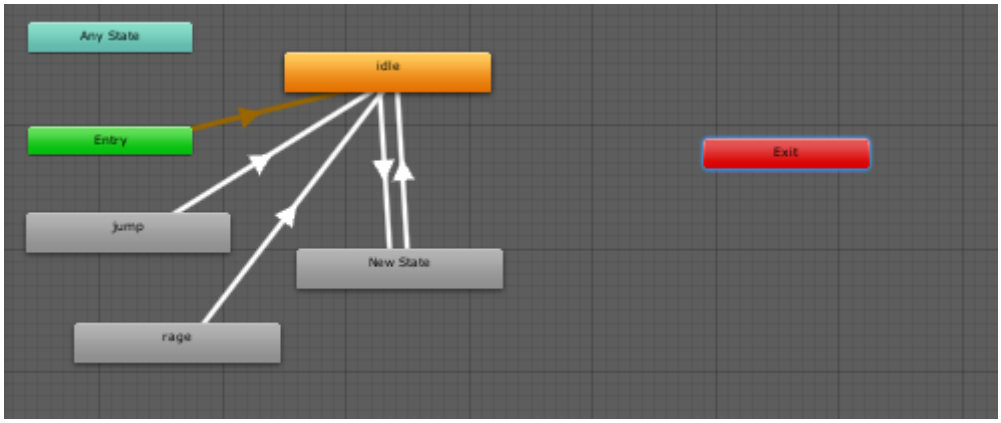


Figure 10 Animation behaviour

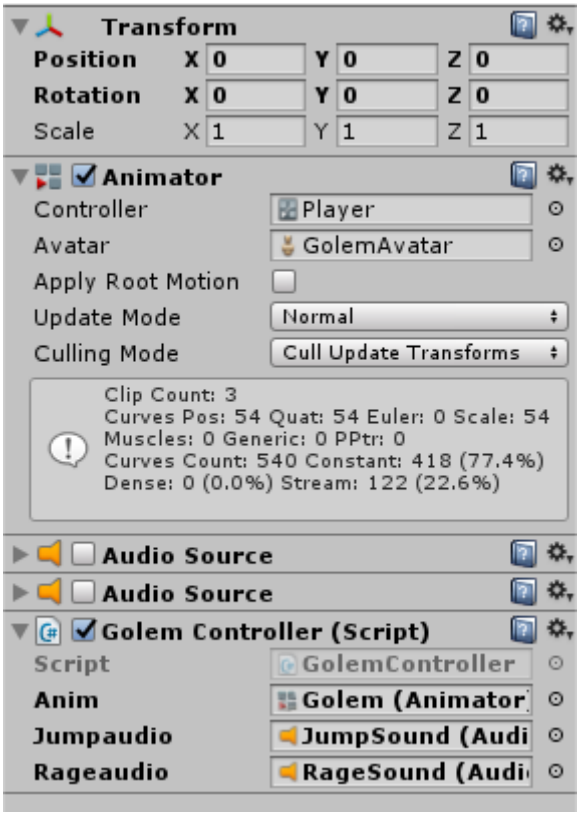


Figure 11 Applying sound effect and script to the object to perform such a way

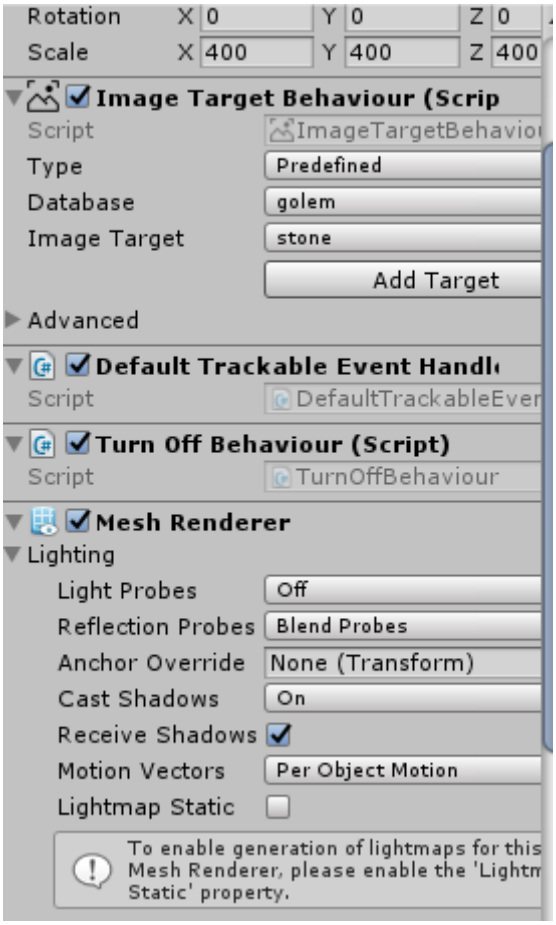


Figure 12 Choose the image database to target the static scene to place the object on that scene

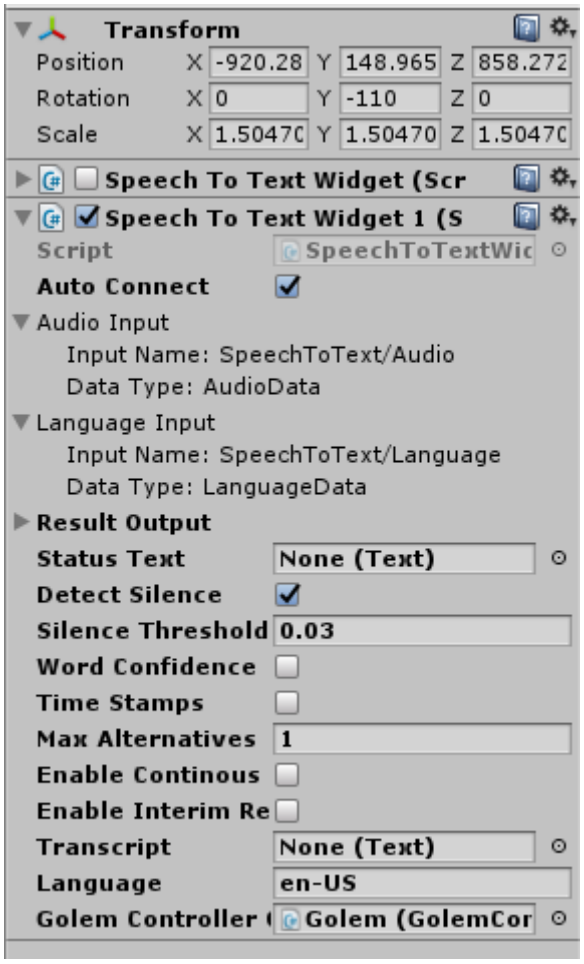


Figure 13 Speech to Text widget (default script) changes applied

Figure 14 3D model placed on a static scene

Figure 15 Screenshot of a running example

Figure 16 VR classroom

Figure 17 Multiple models in VR world on some static image scene

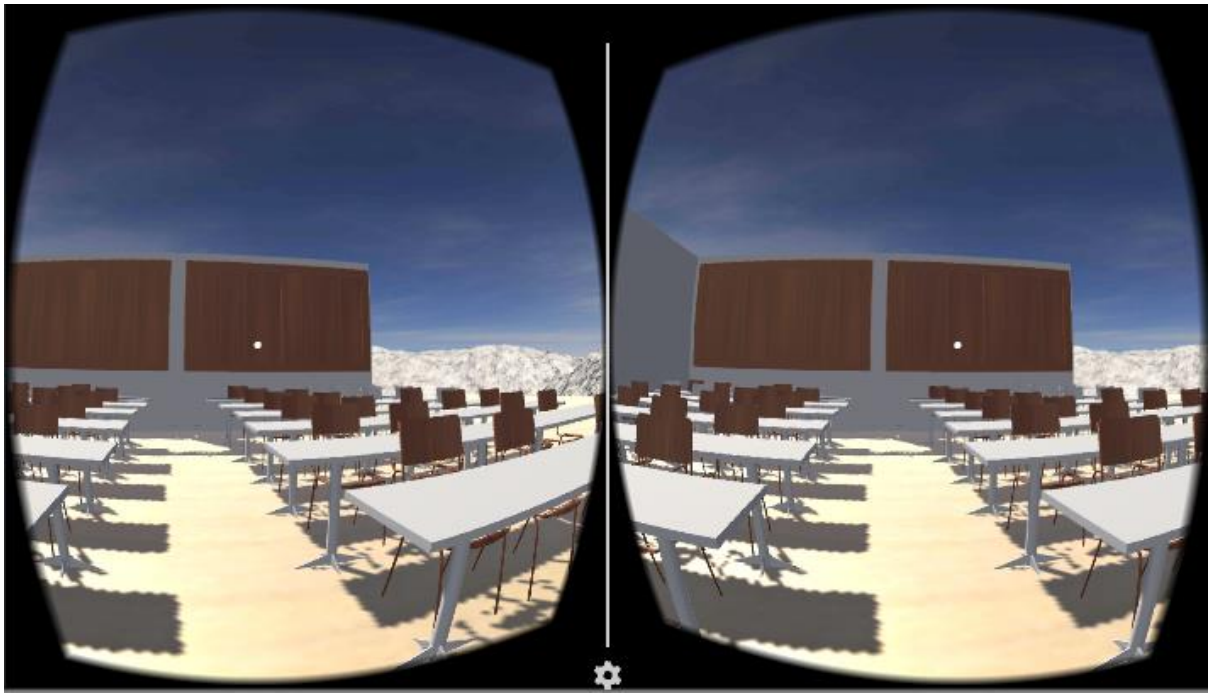


Figure 18 VR classroom view

Figure 19 AR view for head mounted device

- Google VR SDKs [18]
    - This is used to load VR functionality onto the device to explore 360° VR world. This package helps in loading the VR enabled view on the device to enjoy the 3d view of the developed environment from unity.
- Vuforia [16]
    - This is a toolkit used as an AR engine to store images on the server which will be imported as an asset in unity to work as an image target in VR world.
    - Kindly have a look at how to use Vuforia portal for AR [17] [15] purpose as shown below in a chain of images.

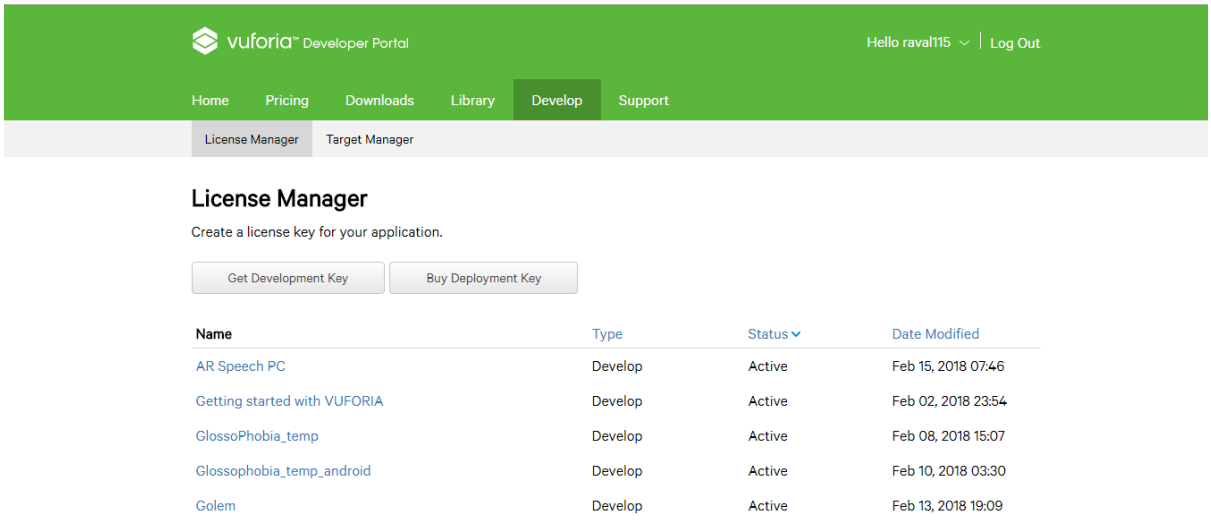


Figure 20 Create license key for your project

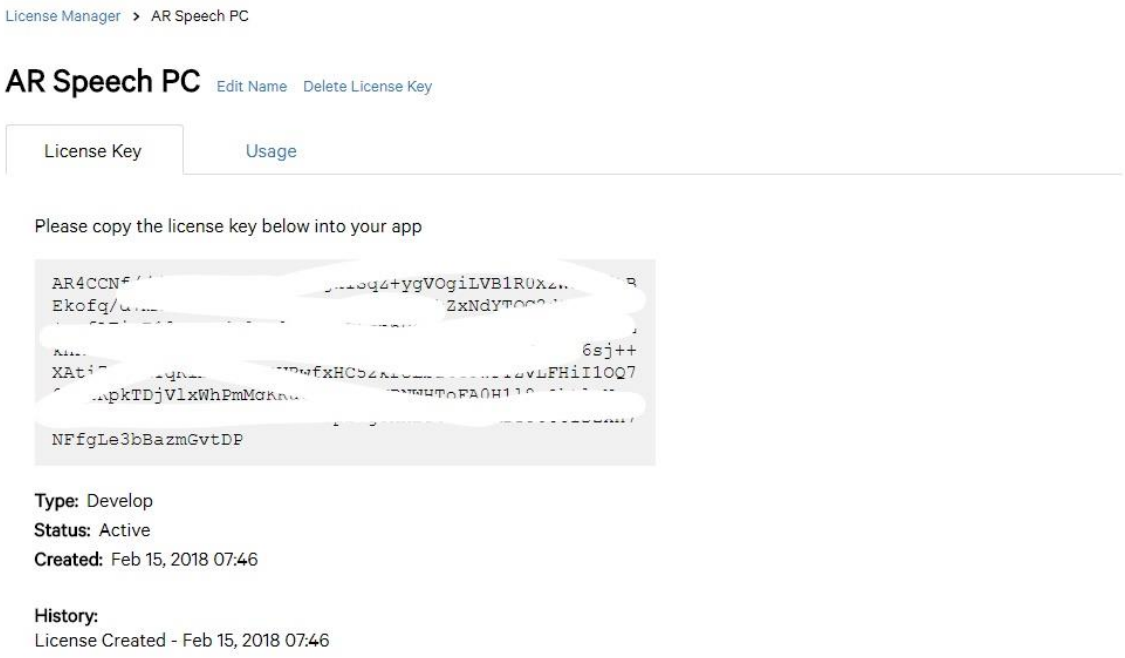


Figure 21 Copy this license key in Unity and place it in Player settings

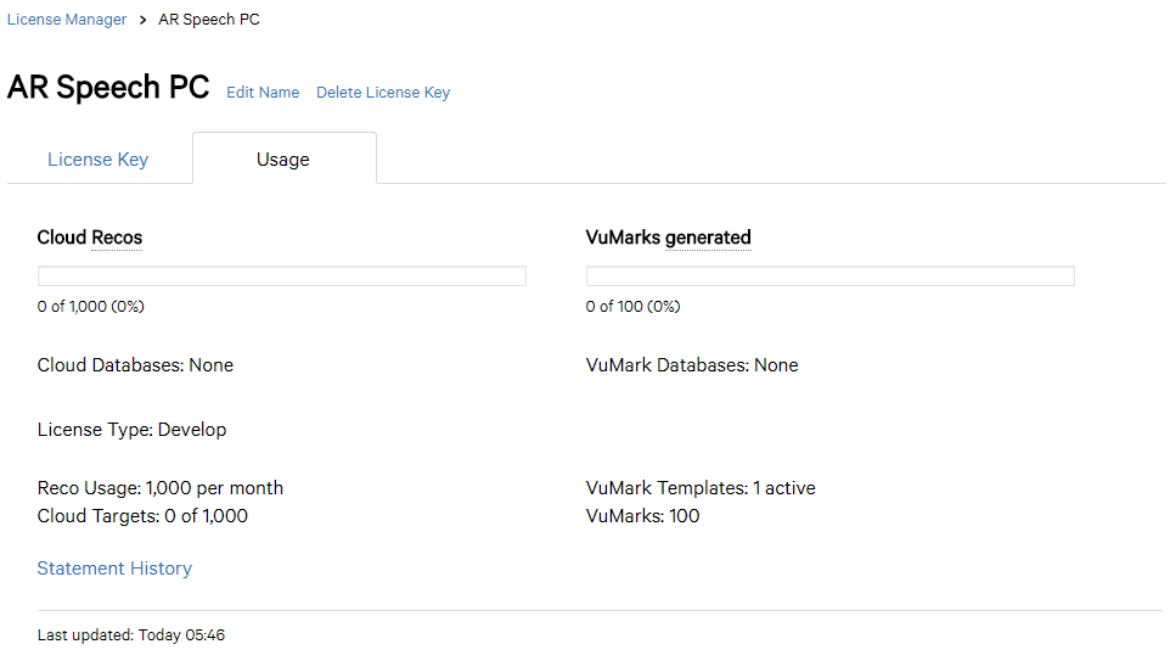


Figure 22 VuMark generated key I have used so, 1 active user is shown as I am the one who is using this key right now

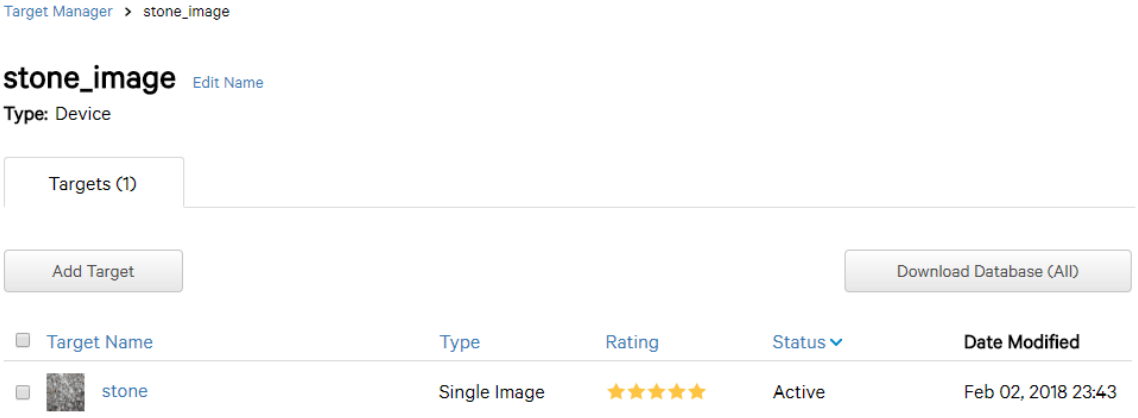


Figure 23 Store image in the database

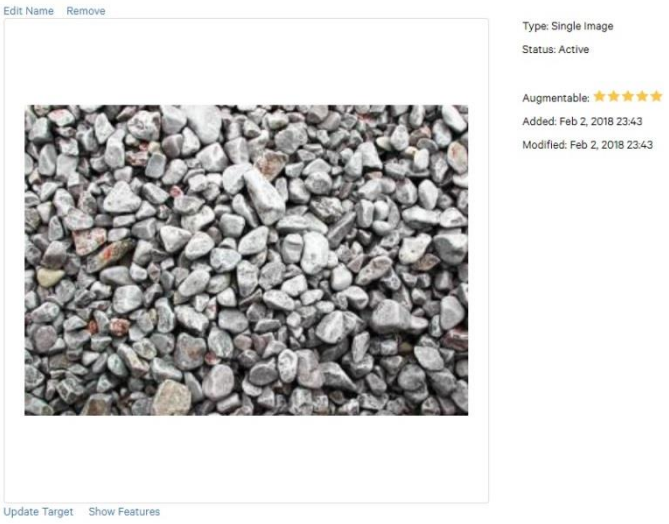


Figure 24 Image stored on Vuforia portal and that will be downloaded as an asset later to add as an imageset in unity

Figure 25 Shown visible features on which the object can be placed (in yellow marks)

- IBM Watson [20]
    - IBM Watson's speech-to-text API is used in the project as speech-to-animation to get the reaction on the spoken keyword.
- VR box [13] [12]
    - VR box is useful to test VR application for 3d scene experience.
- Mobile device
    - A mobile device which has gyroscope functionality is required to test the project and to record the audio at run-time.

- PC
    - PC is required to develop the project and in some case to test the VR world if the mobile device is not supported by a gyroscope.
- Script C# [15]
    - C# coding is the core part of the project which will connect all the different packages from VR SDKs to IBM Watson API to AR vuforia engine to integrate all tools and to perform the desired task.
- 3d Objects [23] [24]
    - Different 3d objects are used such as animated characters, 3d classroom, 360° 3d environment, etc.
- Image assets [17]
    - This is required to load and to target the image to perform AR tasks.

Etc.

So, this is how all the system tools and packages will be imported and will be integrated with their subsystem functions and interaction from the previous section to make this project a reality.

2.8 How my application is different than already existing applications?

This project is a representation of the ARVR market, where in recent times too many advancements have been made in this area but there are still limitations and drawbacks, and this particular, MR area is not yet explored that much, which should have been explored already. So, rather targeting the MR or ARVR implementations just for entertainment purpose or gaming, etc. purposes, the vast usage of MR must be applied to all different fields, so this application is one such of an example, which helps the user to cure medical deficiencies like speech anxiety. So, this way too many different areas can be targeted to cure human drawbacks.

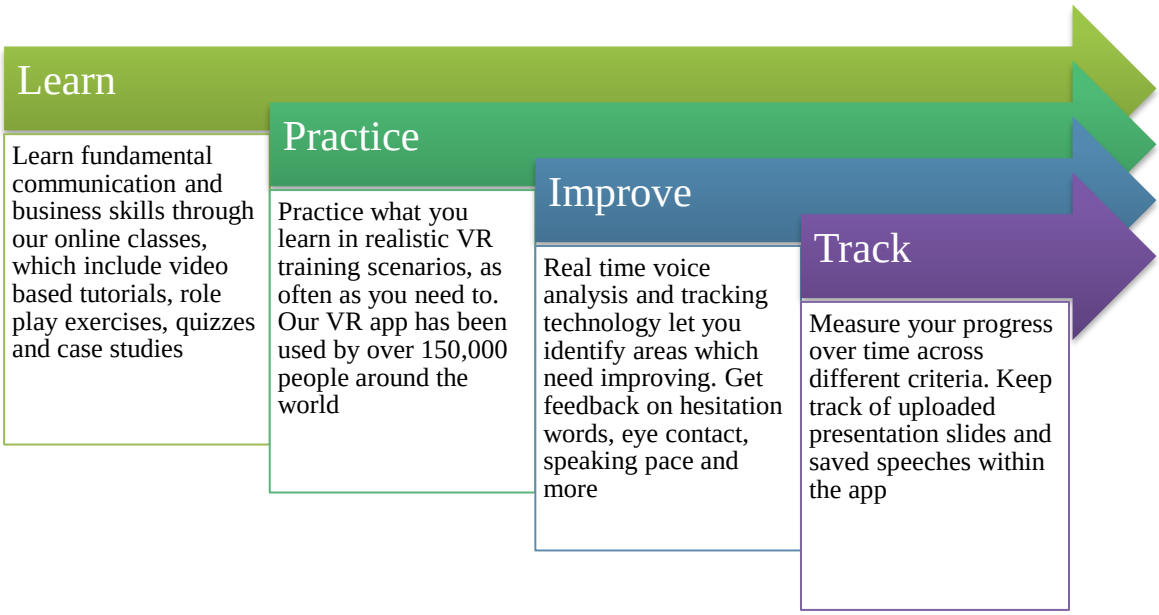
Therefore, in the next section of related work, I have mentioned few related applications and how they differ with this application.

3. Related work

- There are few related works in this field of curing glossophobia in terms of applications such as VirtualSpeech [32] [33], Virtual Human Technologies [34], Samsung #BeFearless [35], Ancientc [36], Virtual Orator [37], etc.
- The other plugins which can be used for speech-to-text/speech-to-animation technology are KeenResearch-ASR plugin [38] and Unity3DPocketSphinx plugin [25].
- Additionally, few more therapies are there which can be used in future with MR technology to enhance MR technology more advanced. There are such research works which can use as a reference like Speech and Language therapy [39], VR speech therapy [40], Virtual patient to train communicational and interpersonal skills [41], etc.

3.1 VirtualSpeech

- What are they offering? [32] [33]
    - Essential public speaking to perfect the speaking, communicational skills, with a combination of tutorial videos and virtual reality experience
    - Job interview preparation to learn interview techniques to practice answering company specific questions in the realistic virtual reality environment
    - Business networking to learn networking and communicational skills such as effective listening, conversation openings and how to exit a conversation, etc.
    - Practicing presence to reduce anxiety and to improve everyday life with online classes combined with immersive environments
    - Sales training and strategy to learn sales skills, strategies and techniques to sell online and in person with tutorial videos and virtual reality
    - Learn English for business to improve speaking, learning and writing skills for the workplace with immersive VR scenarios and tutorial classes
    - Training the tutor with strategies and techniques for delivering high-quality workplace training that leads to better learner outcomes (coming soon)
    - Leadership communication to learn how to convey the ideas in ways that drive effective decision making, teamwork and action through online classes and virtual reality (coming soon)
- This application focuses on 4 main points as shown below.



- How can this application be related to Anti-Glossophobia application?
  - First of all, all the aspects which are mentioned can be taken as an example to improve and to provide different areas in my application after the inspiration. The only major difference is that my application is an ARVR (MR) application and this mentioned one is just based on VR. So, all the areas which are explored in VirtualSpeech can be explored in my application with MR functionalities, to make it work dynamically in a real environment, except in virtual environment.

3.2 Virtual human technologies

- What are they offering? [34]
  - Virtual Confederates product line designed specifically for the research community helps address many of the difficulties in using confederates. Virtual Confederates can also leverage the power and flexibility of virtual reality to make possible studies that could not realistically be done before.
  - vTSST
    - The Trier Social Stress Test (TSST) is a classic and standard experimental setup for the induction of stress.

- Virtual Asch
  - Virtual Asch application uses Virtual Confederates, ensuring sincere answers and eliminating the need for multiple human confederates.
- When avatars are no longer just pixels, they rise up to be virtual humans. They believe virtual humans have a higher calling. Their applications enable virtual humans to fulfill their ambitions of helping people. They also conduct and collaborate avatar based research that helps us better understand people and virtual humans.

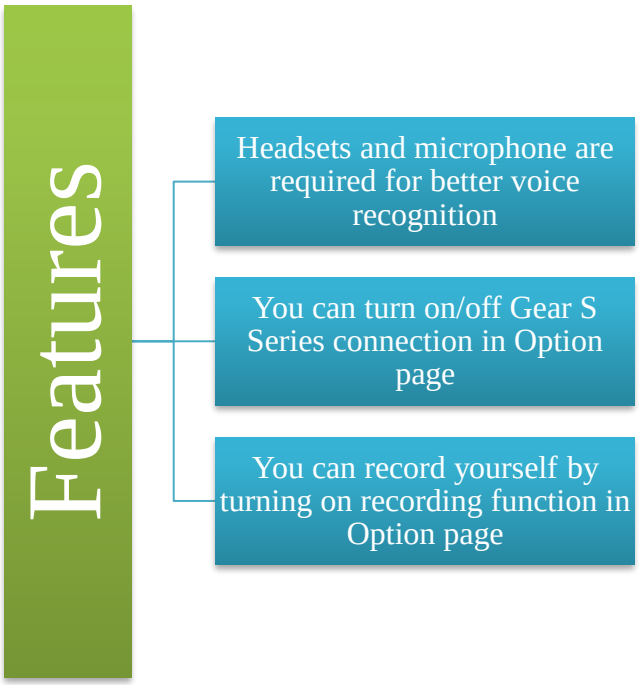
- How can this application be related to Anti-Glossophobia application?
  - The inspiration can be taken from this application in terms of enhancing virtual human objects and their behaviour, animations, accuracy, scalability in terms of usage, etc.
  - What else can we be beneficial if inspired by the virtual human technologies?

- Virtual Confederates deliver the same performance every time. They do not get tired or have bad days. There are not even any subtle differences that could introduce a hidden confound. This provides a new level of consistency between exposures and participants.
- Even actors cannot provide the level of emotional control and consistency of Virtual Confederates. Perfect the emotional delivery during production and then let your worries go.
- Move the experiment virtually out of the lab into the situation you really want to explore. Virtual environments and situations can be almost anything.
- Reproducing an experiment, whether running extra participants in the same lab or reproducing in another lab or culture, is at best difficult. Personnel come and go, but Virtual Confederates are always there for you.
- No more scheduling nightmares. Virtual Confederates are always available when you need them.
- Need 10 confederates, 100? Virtual Confederates scale very well.
- Studying impact does the appearance of people on some factor? Virtual Confederates are the perfect chameleon. You can change race, shape, or even make virtual confederates look like the participant.
- Virtual Confederates incur an upfront cost, but then can be used as often as you require and adapted for use in follow-up studies. Actors are expensive, particularly if you require more than a single confederate or the experimental design necessitates many hours. Virtual Confederates costs scale very well.
- By going virtual, dangerous situations are physically mitigated. Virtual Confederates are willing to get into any situation that your Ethics committee might approve.

3.3 Samsung #BeFearless

- What are they offering? [35]
    - This VR app is designed by Samsung to help you overcome your fear of public speaking. In Business Life, you'll learn to speak comfortably in five scenarios that are most relevant to work life: job interview, business lunch,

team meeting, management presentation, and job fair. The app responds to your voice volume, speaking pace, eye contact, and heart rate. Be fearless and overcome your fear of public speaking When paired with the Gear S series, your heart rate can also be measured, providing even more information to gauge your progress.

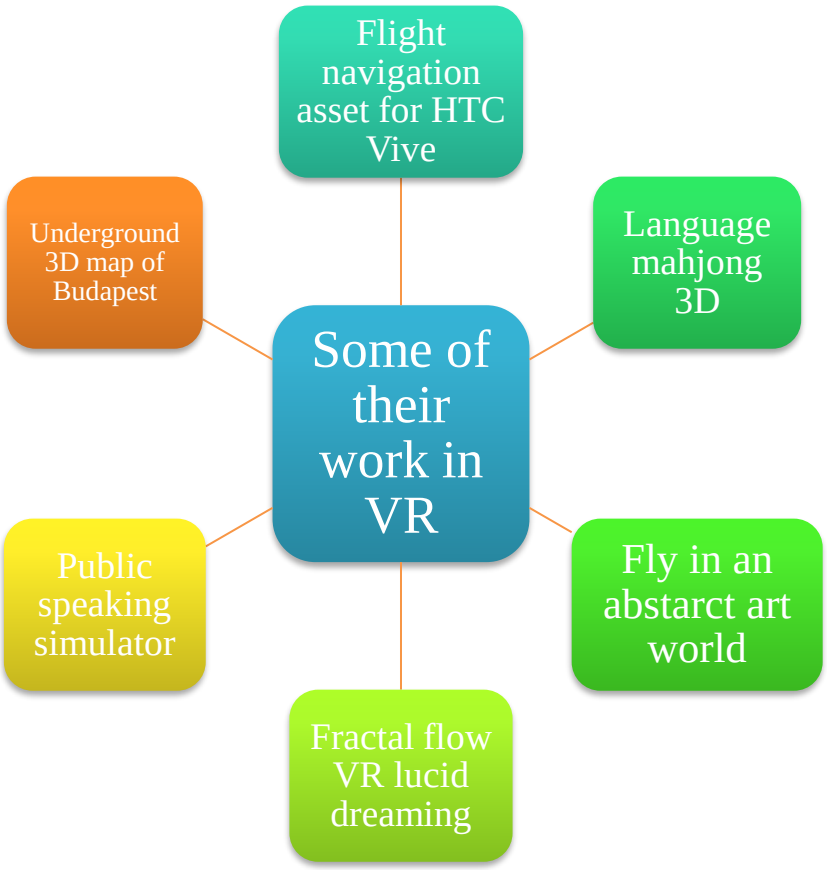


- How can this application be related to Anti-Glossophobia application?
    - This application just targets the VR environment, what about the real world scenario? Then my application's concept can be used by merging the AR into VR in the five scenarios they have mentioned in job field as well as in different fields as well.

3.4 AncientC

- What are they offering? [36]
    - They believe that learning can be a delightful experience. In itself, there is nothing boring or exhausting in learning. Only our obsolete learning systems - frontal schooling - made it feel like that.
    - It is 2018. This concept is changing now. Learning can be the most exciting and delightful thing you've ever experienced.
    - To support the endeavours they are happy to help people in their Unity 3D projects, whether it is learning app or AR/VR. Their experience with

SteamVR and HTC Vive enables people to create interactive VR environments.



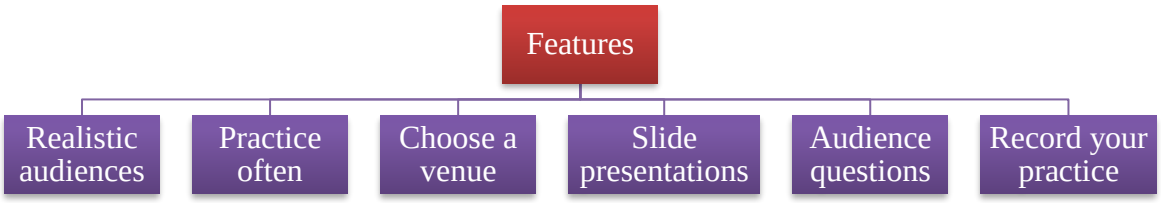
-
- What is there specially offered in terms of speech practice?
    - It simulates an office setting where twenty people are staring at you. This way you can get comfortable with this situation without taking the time of others. You can change the size of your audience to eight or just three or you can turn on friendly/unfriendly voices. This first version of this environment is free, however, you can contribute by voting inside the app. You start the app, turn your back to the audience and activate the voting switch. This way we will know how to further expand this application for you.

- How can this application be related to Anti-Glossophobia application?
    - Again this application is to practice speaking in the virtual world. So, my point is to target real scenario with the help of virtual and augmented objects to provide MR experience to the users.

3.5 Virtual Orator

- What are they offering? [37]

- Virtual Orator is a revolutionary new technology for training public speaking skills. Maximize your training benefits, by practicing in the same situation for which you are training: speaking in front of people. Virtual Orator is a virtual reality simulator that creates the sensation of being in front of an audience.
- Practice where, when and as often as you need. No more forcing your family, friends, or coworkers to endure five rounds of practice presentations. Our virtual audiences will take their place. Adjust the venue, audience size and behaviour to fit your training needs; from starting out with a fear of perfecting that important presentation, Virtual Orator provides the right speaking experience for every need.
- Practice in a variety of venues. Pick a space similar to where you will present, so you can 'own' the stage when you step in front of the audience. Or, Pick a venue and audience to challenge yourself.
- Every time you start Virtual Orator, we invite a randomized audience. You choose the size of the crowd and their general behaviour, from friendly to distracting and disinterested. Our software creates realistic situations, and our proprietary AI makes the virtual humans behave accordingly.



- How can this application be related to Anti-Glossophobia application?
    - As discussed earlier, this kind of work can be to encourage to use the most important features in my application to enhance the user experience in terms of the virtual audience and then my concept of the real scene and augmented reality. This kind of portfolio can be used in my application to offer a different kind of audiences for the users to speak in front of the users to get trained in every possible way whether it is hard or easy!
    - Some of the inspiration can be taken as,
        - Your presentation experience is real. Our technologies transform avatars into Virtual Humans to simulate real speaking situations. You select the kind of audiences: kind/unkind interested/uninterested, etc., and Virtual Orator creates the audience to match.
        - Practice as often as you need. Audiences attend your talk each time as if it was the first time. Randomized audiences and behaviour. Don't get bored, speak about the randomized impromptu topic.
        - Practice in a venue that is similar to where you will be giving a speech. Challenge yourself in a larger venue with more people.
        - Practice your slide-based presentation by importing them. Slides are projected in all venues that support it. A laptop displays the slides in front of you.
        - Trainers can record questions and interjections to be included in the virtual scenario. These can then be triggered at appropriate moments and will be spoken by a member of the virtual audience.
        - Virtual Orator includes an integrated ability to record the environment, a webcam, or both. Ideal for reviewing how you did or sharing with an off-site trainer.

3.6 Speech and language therapy

- What are they discussing? [39]
    - VR headset during speech-language therapy is for everyone
        - VR is universal for all ages
    - This therapy is used for expressive, receptive, pragmatic, figurative language, fluency as well as articulation skills, etc.
    - Wonderful motivating incentive

Top 10 reasons to use VR in classrooms

- Travel to and explore places all over the world without leaving the classroom
- Experience different careers first-hand
- Time travel to key events and places from the past
- Allow students to share their world with others by creating their own VR content
- Explore how the VR can be integrated into every subject area and curriculum
- Develop empathy for communities in crisis by stepping into their shoes
- Explore the depths of the ocean and the vastness of space
- Explore within the human body
- Discover how VR can be used in other industries like medicines, engineering, entertainment and real estate
- Promote curiosity and wonder

- How can this research be related to Anti-Glossophobia application?
    - This kind of research is helpful to understand the need for my application and how it can be implemented in such a way that Anti-Glossophobia application contributes to resolving the issue of speech anxiety as 75% of people in the world are suffering from it so what if this kind of work is carried out since the childhood like, providing VR experience in learning the subjects with AR functionalities which I have proposed, then Glossophobia problem can be reduced from 75% to at least 40% in next 10 years, that is my expectation.

3.7 Virtual patient to train communicational and interpersonal skills

- What are they discussing? [41]
    - The purpose of this study was to explore one novice clinical educator's experiences with training essential communication and interpersonal skills using a virtual patient. Over 3 weeks, the clinical educator (CE) delivered a series of half-day clinical placements to students using an educator-controlled virtual patient, depicting an older adult male with mild dementia. Students completed one 15-minute session interacting with the virtual patient in the virtual learning environment (VLE), followed by a group debrief/discussion session. Prior to, during and after delivering the clinical placements, the CE engaged in semi-structured interviews, where she was prompted to reflect on her pedagogic approach and practice. Thematic analysis revealed six themes underpinning the CE's unique narrative: pedagogical control, validation of pedagogical practice, safety in the virtual learning environment, learning pedagogical practices, self-reflection, and adult education. The CE described how being immersed in the VLE allowed her to confidently deliver training. The findings have implications for the future training of CEs who will provide clinical education using VLEs in clinic settings.
- How can this research be related to Anti-Glossophobia application?
    - This research can help to teach students how can they operate the patients in the virtual world to train students and to enhance student's communicational and interpersonal skills to train how can they interact with patients and how can they communicate to solve their problems.
    - So what I offer with my application, why to use just virtual scenario, we can use real scenario and can build augmented objects in virtual scene to train

students in any environment, that is how Anti-Glossophobia application can be helpful.

3.8 What is the outcome and what is my opinion and thinking?

As given the all of the related work, the one thing is common and that is, VR implementations in different ways to solve the speech anxiety problems. Therefore, my approach is kind of advanced one in terms of implementation plan, as all the features from related work can be applied and still there is a scope of AR functionality and additionally speech recognition engine is incorporated, that will be helpful in solving Glossophobia problem, so there is a lot of scope in terms of expanding the idea of ARVR (MR) not only working with virtual world but also working with real scene of real sight, that will be the different case for users to explore new possibilities with my proposed system.

3.8.1 How AR will be implemented for the targeted application and what is the importance of AR and what kind of difference will this proposal raise?

- If there are already good application existing in VR area to solve speech anxiety problem, then why there was a need to build this kind of application? There are pretty good features in other applications then what is the contribution in this application?
    - So, to answer all the questions, I have proposed AR incorporation in VR to make my application in MR area wherein a virtual world, real-world objects are targeted to display the audience in MR and that is how VR environment will be used in AR environment as a surrounding but objects, humans which are going to be displayed will be an augmented version, so that user can use this application to display human audience or any sort of audience in real scenario so it is not bounded in virtual environment. Now, this version of application only works with one static scene (real environment) but in future, the engine can be trained to display any dynamic target as an environment.
    - So, to create these kinds of implementations in terms of AR, in future, machine learning or deep learning aspects can be explored to target dynamic (any non-static environment in terms of classroom, office, etc. kind of possibilities) environment that provides more possibilities to train users to make them comfortable enough in any such environment they are comfortable in, to help to cure Glossophobia problem.

- Importance of AR can be described as, apart from VR functionality, AR can enhance any VR environment by collaborating with real scene, to make the application and the user experience more relatable and more real and that is more important as training users in real environment with virtuality can be helpful in solving glossophobia issues than just virtual world, as any efforts you put to create great computer graphics to create realistic VR environment, still there will be a lack of real world to explore. Therefore, AR can fulfil that need.
- In terms of difference of this application with others, the explanations can be given as all the related and existing applications or ideas are just working in virtual world to enhance user experience, and what about developing the scenario where users can explore real environment with virtuality called MR, then this application is going to make difference in the current market of AR, VR, MR somehow that is why I am raising this proposal.

4. Limitations of Unity

Unity [42] is by far one of the best software, but as it is told, each and every great thing comes with some cons. The same way there are few limitations of main IDE, which is Unity 3D which is the core of this application, as this application is used to create the prototype of the project. Unity supports building on 27 different platforms. The platforms are listed in the following: iOS, Android, Tizen, Windows, Universal Windows Platform, Mac, Linux, WebGL, PlayStation 4, PlayStation Vita, Xbox One, Wii U, 3DS, Oculus Rift, Google Cardboard, Steam VR, PlayStation VR, Gear VR, Windows Mixed Reality, Daydream, Android TV, Samsung Smart TV, tvOS, Nintendo Switch, Fire OS, Facebook Gameroom, Apple ARKit, Google ARCore, and Vuforia. Below mentioned are few limitations of this system.

- Poor source control integration and large team tools
- Slow, programmer centric UI tools
- Really rudimentary particle editing
- You can't nest prefabs
- Next to impossible to get an iOS game under the over the air limit
- Null reference exceptions crash platforms that don't allow JIT compiled code
- The stark reality that it's a 32-bit floating point precision limits its physics to a 10 km cubed space, so no big epic space battles.
- It's game objects that do not self-pool, so you need to drag out the pool manager, pool-able component scripts for anything with object turnover rates. Even though it has an ageing stuttery garbage collection system.
- The fact that the API still does not do multi-threading, even though it uses a modular component-based scripting system and internally runs a multi-threaded jobs core.
- The vectors, transforms and quaternions that do not have a batch based SIMD powered or multi-threaded API
- The lack of instancing even though it's been a common feature of DirectX and OpenGL since 2009
- The lack of Mantle, DirectX 12 and Vulkan support
- The UI that was great to use as a programmer but so poor performance
- The baked Navmesh system that was never designed to work with procedural content

5. Marketing strategies and possible future work

To market this app, what could be the features of the application to make this idea, this application develop more advanced in terms of selling and to make it reach to end-users? The simple answers can be given as follows,

- The more advanced version can have options like classroom, office, presentation room, podium stage, webinar speech, etc. to select from available options.
- Most the AR functionalities such as sight, hearing and touch can be provided in MR environment and in some cases taste and smell can be applied too.
- The gesture, the voice-based system can be applied thoroughly. The AI [43] platform can be implemented as well with the speech-recognition services to make voice-enabled features more enhanced.
- For the primary school kids, MR training can be applied as a compulsory subject that can help students from a young age to overcome glossophobia.
- Like telephonic calls to remove anxiety and stress, MR can be helpful.
- Doctors can use these techniques to heal their patients.
- To enhance concentration power, MR can be useful for target based applications.
- MR in this term can be enhanced apart from glossophobia to cure any kind of phobia.
- MR can change the way we see the world today with the help of technologies available.
- The VR glasses or static AR inputs can be improved to upgrade user experience.
- This application can be used as a course and to gain marks (obviously, with an advanced version with plenty of features) as a part of presentation skills in schools, colleges, universities, etc.

6. Market investigation

MR system can be applied to different fields such as [44],

- Education
- Medical imaging visualization: 3D modelling of medical imaging
- Training
- Therapy
- Planning
    - 3D printer
    - Endoscopic surgery
- Assisting
- Nephrectomy
- Neuroscience enhancement
- Telementoring
- Telemedicine
- Telesurgery
- Augmented biofeedback in pelvic-floor muscle re-education
- Healthcare in ARVR market worth $5.1 Billion by 2025 as shown in below given charts [44] [45]

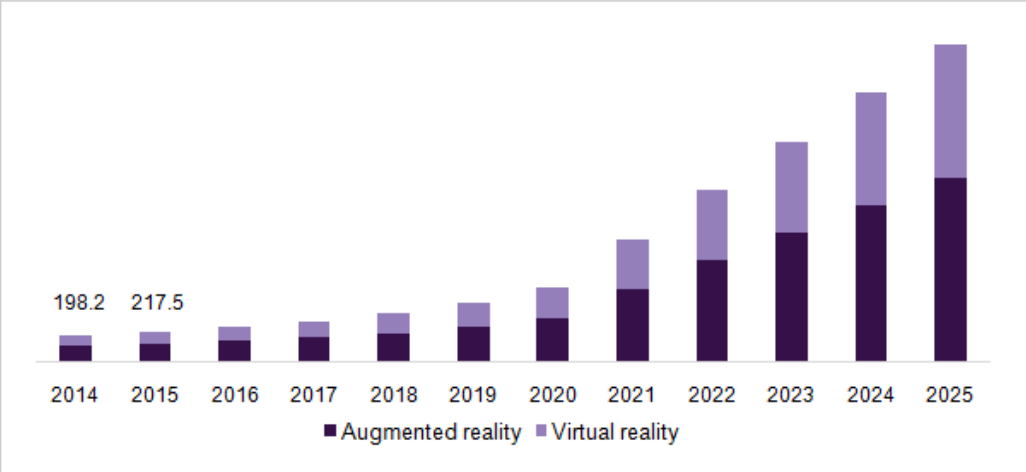


Figure 26 North America AR & VR in healthcare market, by technology, 2014-2025 (in USD Million)

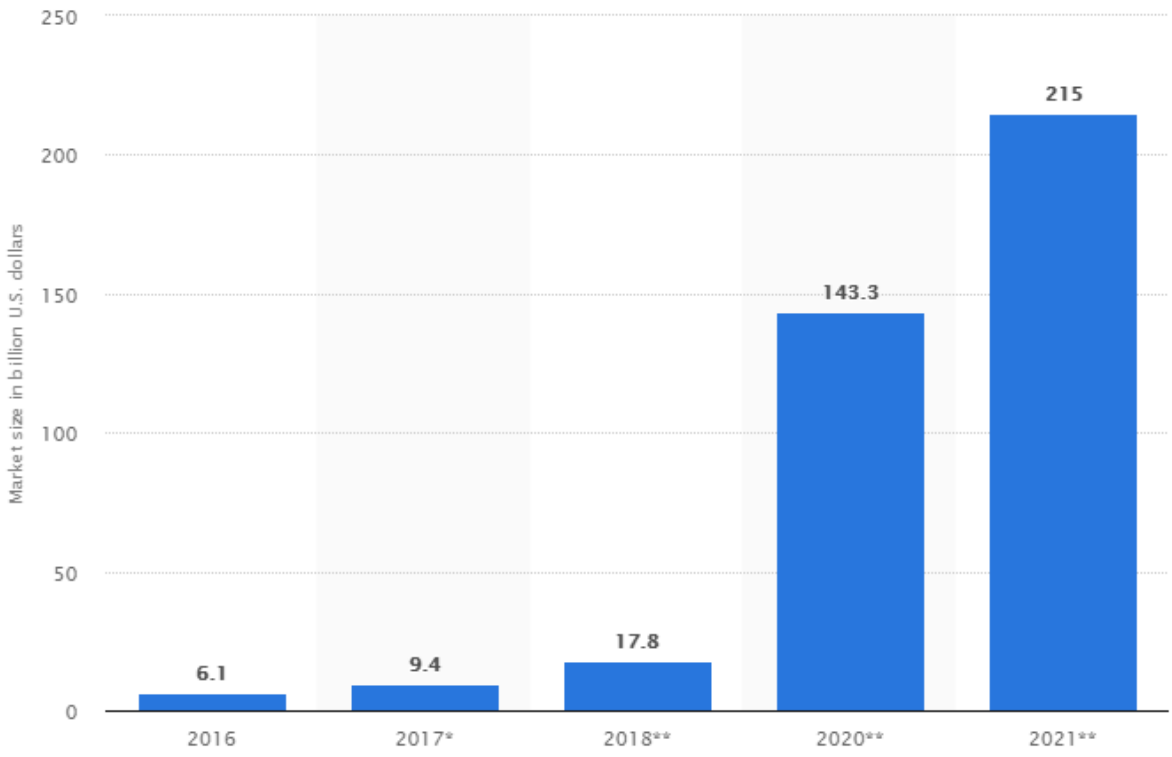


Figure 27 Forecast ARVR market size worldwide from 2016 to 2021 (in Billion USD)

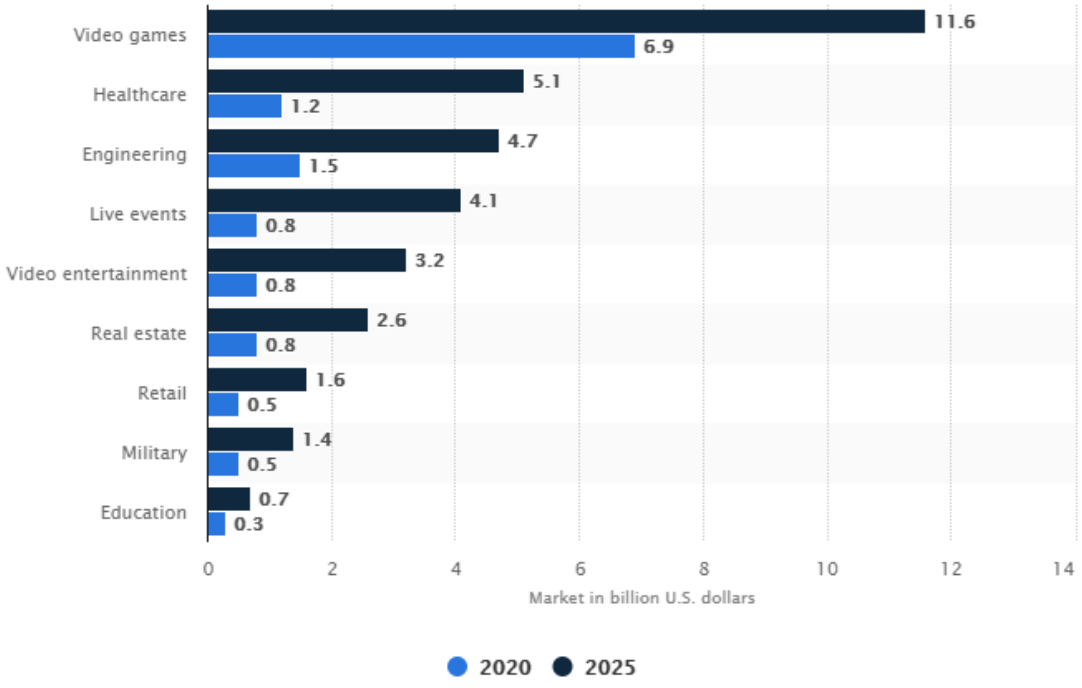


Figure 28 Forecast size of the augmented and virtual reality (VR/AR) market worldwide in 2020 and 2025, by segment (in billion U.S. dollars)

6.1 Marketing investigation to commercialize this application

6.1.1 Statistics

The statistics has shown that the adaptation of VR and HMD have increased from 5 million units to 68 million units in 2016 to 2020. The global sales will be amounted to 12 times according to the forecast. This data provides the convincible higher chances of more production and sales from financial holdings, procurement and distributions as growing weight in the industry from the perspective of business. North America was the major contributor to the market during 2015, where the rise in sales of all VR consoles and HMDs. By 2025, China is anticipated to become the largest region for video games equipped with VR technology followed by US since the technology has been in place for a considerable amount of time. The cost of labours, market shares and usages and populations and growth rate are the factors that we will consider China as the future marketplace to launch along with North America. The value chains in North America and China, have become increasingly interlinked as a result of rising concern over the market since those two regimes are capital intensive and have more productive capacity in consumptions, the consumers have captured huge market shares. The increase in earnings, reflecting the impact of the prices on the profit margin for our proposed entrepreneurship because Virtual reality remained stable growth between these two countries suggests that we will be more likely to consider our main audiences and market performance according to regional analysis. Kindly refer Figure 26 and 27 for better understanding of how ARVR market is predicted to grow in coming years. [44]

“VR will be big, AR will be bigger and take longer.” What sounded revolutionary when we first said it 2 years ago has become accepted wisdom. But now the market has actually launched, we’ve got 12 months of real-world performance and major tech players’ strategies emerging. And that’s changed our views on VR/AR growth. A lot. Our new Augmented/Virtual Reality Report 2017 base case is that Mobile AR could become the primary driver of a $108 billion VR/AR market by 2021 (underperform $94 billion, outperform $122 billion) with AR taking the lion’s share of $83 billion and VR $25 billion. Let’s start with less than happy times. Facebook (Oculus Rift) and HTC (Vive) had growing pains at launch, whether slower than expected shipping or order cancellations. Oculus launched without Touch controllers, which eventually cost $199 instead of being bundled (i.e. non-PC full system costs hit $798 – same as HTC Vive). Samsung’s Galaxy Note 7 saw part of its mobile VR ambitions literally go up in smoke, as the new Gear VR was designed to be compatible with that flagship device. Magic Leap also received a boatload of

speculation about the tech it used to raise $1.4 billion. Thankfully Nintendo/The Pokémon Company/Niantic had a breakout success that even they didn't anticipate. Pokémon Go delivered $600 million mobile AR revenue in its first three months alone, making more money through the year than the entire VR games software market in 2016. While this came from a very specific set of circumstances, there have been direct knock-on effects for major tech companies' mobile AR strategies. As well as Sony's solid launch of Playstation VR, the quiet achiever last year was Google. It launched its Daydream View mobile VR headset/controller and the first Tango mobile AR phone. What helped even more was Snap's genius launch of Spectacles, which made wearing goofy future glasses cool again (no more Glassholes) even though it isn't really AR. [46]

6.1.1.1 Augmented Reality by name

In response to Pokémon Go, Apple's Tim Cook said that Apple is "high on AR in the long run…continue to invest a lot in this…AR can be huge." Google's Sundar Pichai, Facebook's Mark Zuckerberg and Microsoft's Satya Nadella also hailed Pokémon Go as a major early win for AR. But there are 5 big challenges AR needs to conquer for mass consumers: (1) hero device (i.e. an Apple-quality device, whether made by Apple or someone else), (2) all-day battery life (3) mobile connectivity, (4) app ecosystem, and (5) telco cross-subsidization. While most attention is paid to what that hero device will look like and when it will get here, two of the other challenges are particularly hard to solve. Until a major breakthrough in battery technology, a lightweight pair of AR smartglasses doing heavy duty AR is hard to power all day without a battery pack or hot-swappable batteries (which are fine for enterprise customers, but a harder sell for consumers). This is a non-trivial problem. Plus it's a major risk for the developer ecosystem to invest heavily in building apps for new platforms until the installed base reaches scale. It's the perennial chicken and egg problem that all new tech platforms face. So where does this leave titans like Apple, Google, Facebook and Microsoft, and all the high-growth AR smartglasses startups? [46]

6.1.1.2 Augmented Reality by nature

Mobile AR could conquer the five major challenges for AR to go mass consumer in the short term. Mark Zuckerberg thinks so, "the phone is probably going to be the mainstream consumer platform [where] a lot of these AR features become mainstream, rather than a glasses form factor that people will wear on their face." Smartphones solve four of the major challenges for mass consumer AR already: all-day battery life, mobile connectivity, app ecosystem and telco cross-subsidization. Plus you're probably reading this on a hero device

(iPhone, Samsung or other great Android phone) – it just doesn't have the sensors and software to be a full AR phone. Yet. Pokémon Go is a thin lens into the potential of mobile AR (even if industry insiders don't like to call it that). The first step to true mobile AR was taken when Google launched its Tango AR phone with Lenovo. While that doesn't look like the hero device mobile AR needs to take off yet, it points in the direction of the tech that Apple, Samsung and others could use to revitalize innovation and growth in the slowing smartphone market. And this is where mobile AR's secret weapon comes into play – replacement cycles. [46]

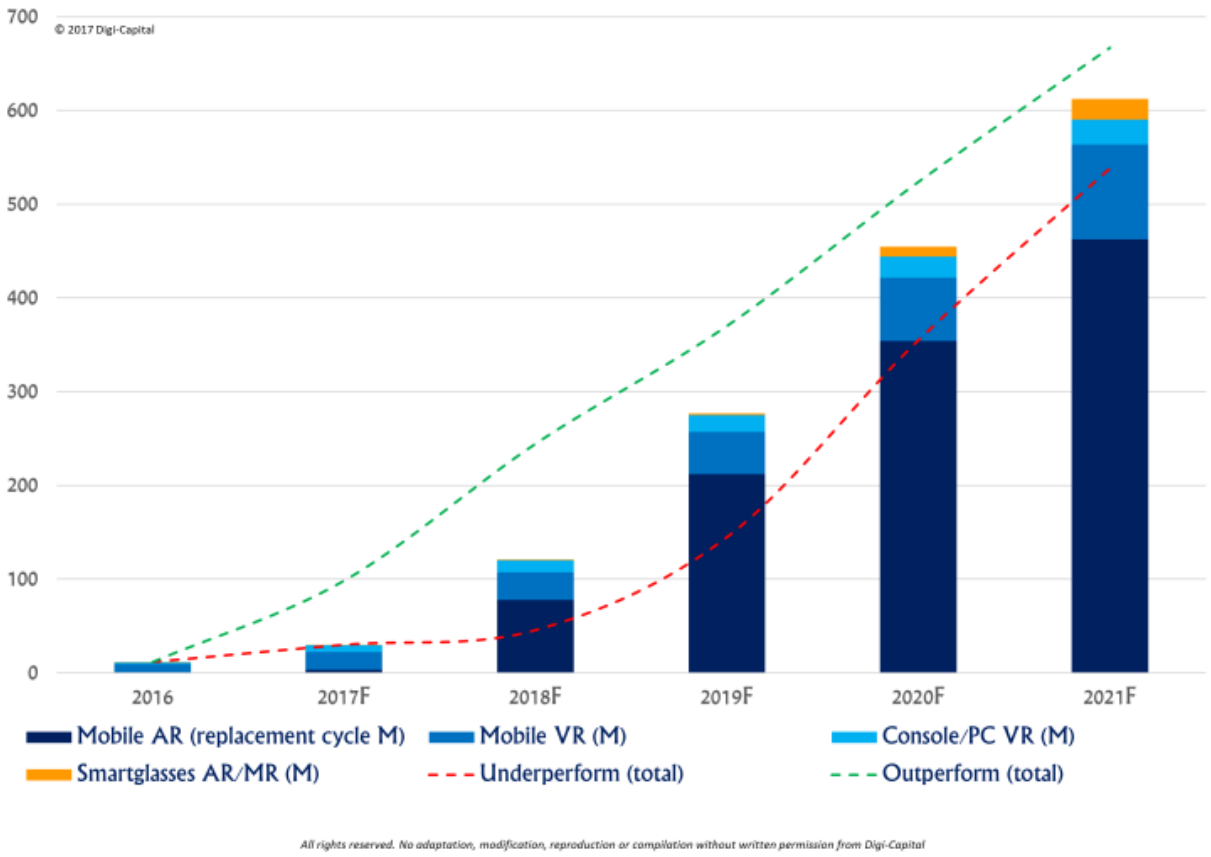


Figure 29 ARVR installed base

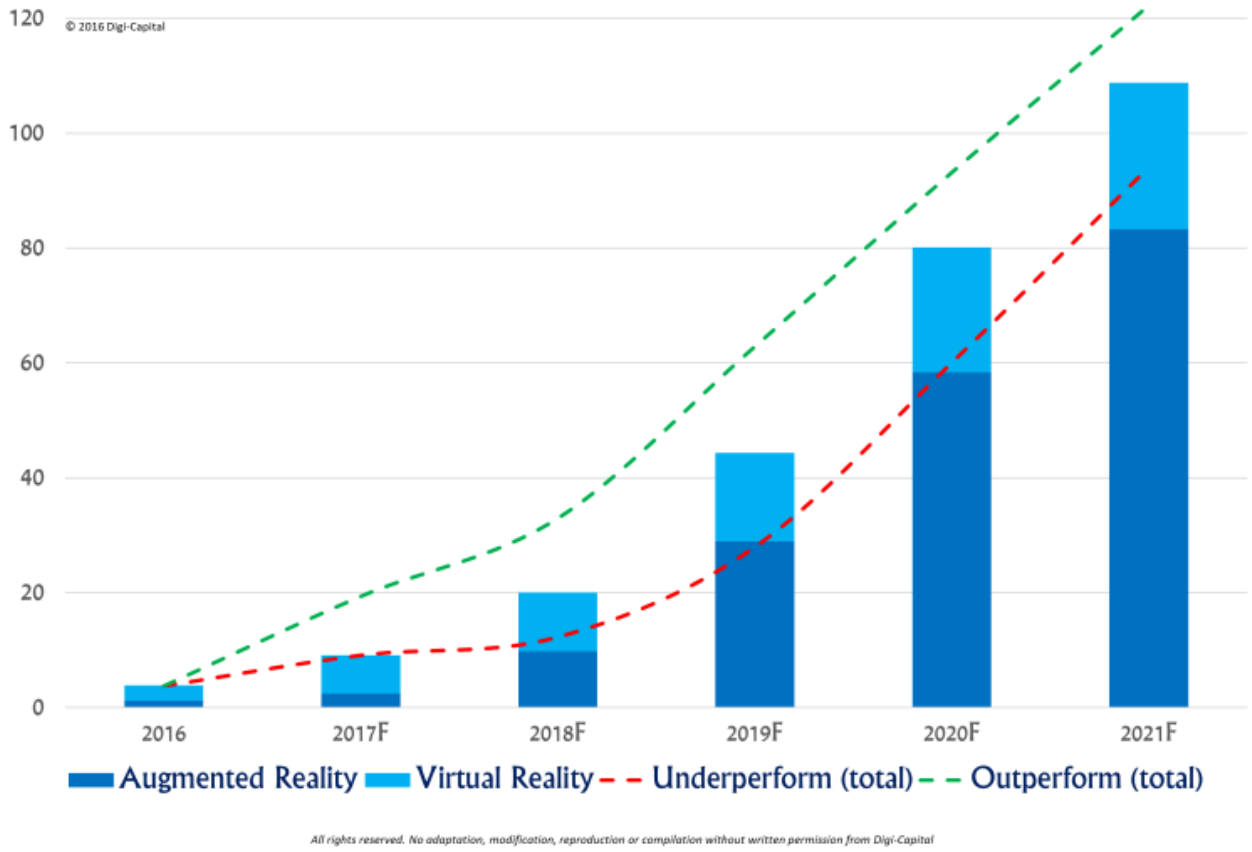


Figure 30 ARVR revenue

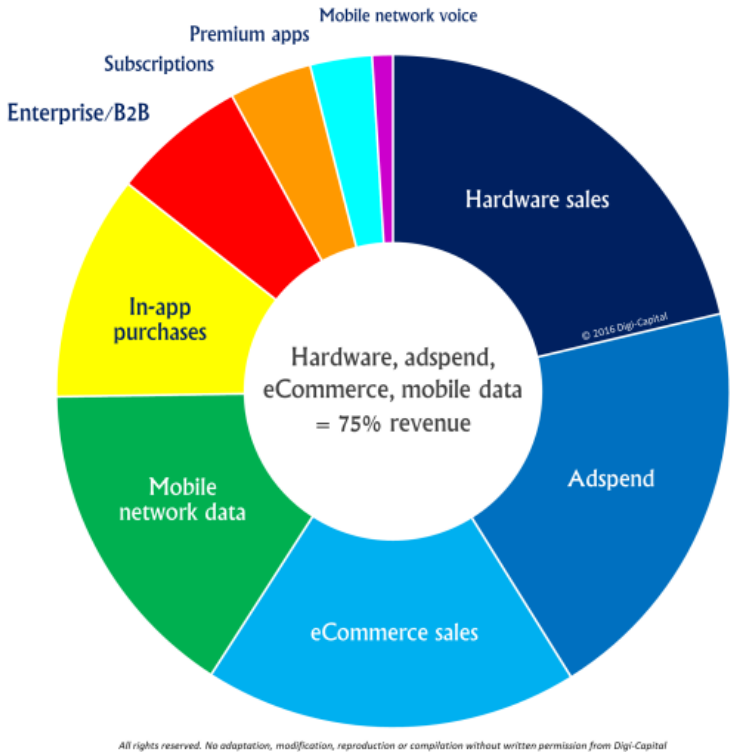


Figure 31 ARVR long-term business models

6.1.2 Competition and start-up status

There is enough of a competition in the market, but as suggested, if I want to commercialize this application, there is important thing which I need to consider and need to focus to be unique is, a competition in already existing market of AR and VR, I should be able to provide more in terms of features and enhanced user experience than already existing among competitors.

Since ARVR market is getting more complex, divergent and uncertain, the core investigation to learn the competition is to learn via the available resources and that is how I can think of a start-up of this kind of an application but there are few challenges like, competing with tech-giants like, Samsung, Google, Facebook, etc. and investment issues, etc.

So to face these challenges, the product must be scalable enough and a good amount of investment is needed to invest money to commercialize this application.

6.1.2.1 Autodesk and Unity

The design and 3D-modeling software developer best known for AutoCAD has been no stranger to investing in cutting-edge technology such as 3D-printing. Autodesk's core business in 3D design engines makes it a sleeper pick for both VR and AR technologies. Last fall, the company partnered with Microsoft to help improve the tech giant's AR headset Hololens for industrial and mechanical design of 3D objects. And more recently the company has added support for the HTC Vive and Oculus Rift headsets to its game engine Stingray. (The move was originally supposed to bring Autodesk's game engine a step closer to competing with Epic's Unreal engine or Unity, both of which are making big strides into VR and are available on the Vive, Rift, and upcoming PlaystationVR.) Interestingly, Unity and Autodesk announced a recent partnership to increase interoperability. [47]

6.1.2.2 Amazon

One of the last major tech companies to announce an AR/VR initiative, Amazon is joining the race and assembling a VR team for its Amazon Video division. Additionally, the company is said to be working on "smart glasses" that would interact with the Alexa environment. The details on the smart glasses are scant, but company has sought a patent for smart glasses. Amazon has also released its video game engine called Lumberyard, which is computing infrastructure that supports VR applications in addition to major gaming platforms. Amazon also has deep roots in the gaming community with its acquisition of Twitch, a video platform for gamers, which it bought in 2014. The

company is rumored to be integrating more augmented reality tech into its brick-and-mortar effort so patrons could picture how items would look in their homes. Like popular mobile apps from Ikea, the first major AR/VR efforts for Amazon are likely to enable more frictionless commerce. [47]

6.1.2.3 Facebook

Facebook's bold acquisition of Oculus for $2B back in 2014 is looking ever more prescient. One of the few major headsets available in the consumer market (along with the HTC Vive), the Oculus Rift began shipping its consumer-level version in late March 2016. Using the Rift requires a high-performance gaming PC, but Oculus also offers a cheaper option through a partnership with Samsung. Oculus offers a headset holder for the Gear VR headset, which is powered by Samsung Galaxy smartphones, and currently has the largest footprint of all VR headsets. Some have speculated that the overall vision for Facebook and Oculus is to potentially create a metaverse (virtual world between billions of people that could replace everyday interaction), an idea in which Mark Zuckerberg is reportedly a firm believer. In addition to gaming and entertainment, this would fit in well with Facebook's mission to "make the world more open and connected." Facebook's AR/VR vision became clearer at the recent Oculus Connect developer conference, when the company unveiled the Oculus Go, a standalone headset with a $199 price tag. Scheduled to release in 2018, the move is an aim to offer the high fidelity of the up-market Rift, except without requiring an expensive gaming PC. This should further expand Facebook's social VR footprint. Facebook also released the Camera Effects Platform, an AR studio for developers to use with the Facebook app, in a manner similar to a Snapchat filter. But the company is also said to have more than 1000 employees, or 5% of its staff working on the Oculus and broader virtual reality effort. The company has also been aggressively pursuing intellectual property around facial and emotion recognition, as well as iterations on its headset designs. [47]

6.1.2.4 Apple

Rumors suggest Apple has been investigating virtual and augmented reality applications for more than a decade. At WWDC in June 2017, Apple went public with its first major effort and unveiled ARKit tools for iOS developers, as well as opening up a machine learning library called CoreML. In just a few short months, ARKit developers have released promising augmented reality apps that will reach any Apple customer with an iPhone 6S or above. Today, that figure amounts to 381M iPhones and devices, but ARKit's footprint is projected to boom up to 850M units by 2020. Already, early AR apps have taken off: the

smash hit AR mobile app Pokemon Go was reported to be the most downloaded app in the first week in App Store history. Apple is also said to have 1,000 engineers working on augmented reality in Israel. Announced later in September 2017, the latest iPhone X comes with facial recognition security, using a "TrueDepth" front-facing infrared camera that's said to be derived from its PrimeSense acquisition. While it's primarily for mapping faces now, future TrueDepth cameras could 3D-map environments in front of users for more hi-fi augmented reality. Baking AR into Apple's flagship product may seem a newfound frenzy in 2017, but the move comes as little surprise given Apple's M&A history and the tenor of its speech around AR. Since mid-2016, CEO Tim Cook has indicated that serious investment is being made behind the scenes, stating in an interview: "AR can be really great. We have been and continue to invest a lot in this. We are high on AR for the long run. We think there's great things for customers and a great commercial opportunity. So we're investing." Furthermore, Apple made a series of acquisitions beginning in 2014 that indicated a serious commitment to computer vision. AR acquisitions include the purchases of FlyBy Media and metaio, but the company also acquired Emotient, RealFace, and Faceshift for facial recognition and machine vision. By all metrics, the aquisitions prove AR/VR and computer vision are priorities, and it will be interesting to watch if the company expands into dedicated headsets. [47]

6.1.2.5 Google

In the wake of the pioneering (but ultimately unloved) AR headset Google Glass, Google moved into the mobile space with its VR project Cardboard. By the numbers, Cardboard was an early success. Built atop Google's Android operating system, the Cardboard app has been downloaded more than 50 million times and Cardboard's partnership with the New York Times, in which it shipped low-tech Cardboard phone holders with the Sunday edition, put it in the hands of over a million readers. 2017 has been a year of platform expansion, which started with the release of Google's mobile VR content platform called Daydream, intended for use with the Pixel phone and fabric VR head mount. Additionally, the company opened an AR development platform called ARCore, which serve as the Android analog to Apple's ARKit. In addition to its mobile VR initiative, Google is reportedly also working on a standalone headset that would not require a tether to a PC or game console. Google's venture arm is also a backer in the exceptionally well-funded stealth AR startup Magic Leap. [47]

6.1.2.6 HTC

Along with the Rift, the HTC Vive is among the top standalone headsets in today's consumer VR headset market. Powered by a high-performance PC, the headset is targeted at gamers and employs laser sensors on the outside of the headset that enable users to traverse a 15′ x 15′ space (a much larger area than other VR systems), which allows users to engage in more room-scale sort gameplay, whereas other headsets require sitting or standing in one place. HTC, along with Oculus, recently brought down its headset list price to $599. HTC recently sold its $1.1B smartphone business to Google, but curiously will retain the VR headset division, which some say indicates Google's willingness to develop its own hardware independently. HTC says its strategic partnership with Valve, the gaming house behind the Steam platform and Half-Life, gives it an edge in delivering content. A 2016 survey found that developers prefer working atop its Vive platform over Oculus. Additionally, HTC is an active investor in the AR/VR space. Its ViveX venture accelerator is tied for 2nd as the most active investor in AR/VR. [47]

6.1.2.7 Intel

After a string of cancellations and false starts, Intel's AR/VR strategy is left largely a question mark. At its 2016 developer forum, Intel unveiled ambitious plans for Project Alloy, an untethered VR headset that can track hand gestures without any external hardware. Ultimately, the plan proved too ambitious. In recent months, Intel cancelled the entire Project Alloy, closing the unit completely. Further, the company also shuttered its Recon augmented reality brand, which makes a Google Glass-like attachment for sports and safety goggles. (Intel acquired Recon Instruments for $175M in Q2'15) Originally, Intel and Windows had announced a partnership between the Windows Holographic operating system and the Project Alloy hardware. Oddly, the platform move might have been the project's undoing. UploadVR said "Intel seemed to be locked out of the market for VR headsets by Microsoft" and with AR, the plausible market may have been too small and nascent. While Intel's efforts going forward may not be as first imagined, the company said in a statement that it will continue to build on its AR/VR assets: "We will continue to invest in the development of technologies to power next-generation AR/VR experiences. This includes: Movidius for visual processing, Intel® RealSense™ depth sensing and six degrees of freedom (6DoF) solutions, and other enabling technologies including Intel® WiGig, Thunderbolt™, and Intel® Optane™" [47]

6.1.2.8 Microsoft

The standalone AR headset Hololens runs Windows 10 and became available for developers for a hefty $3000 back in March 2016. However, the headset isn't commercially available and has primarily been used by experimental developers applying the technology to enterprise use cases (running the Windows Mixed Reality software). Microsoft is making a large effort to become a software player in AR/VR. In October 2017, Microsoft made a key acquisiton of Altspace VR, a social VR platform that shut down due to financial troubles. The move is aimed at shoring up Microsoft's software offerings. The company also will open up Windows Mixed Reality fully later in October, and has a partnership with gaming platform Steam. The company has also pursued a range of AR patents, such as a holographic keyboardand glasses that help tell you what to eat. On the hardware front, Microsoft unveiled "mixed-reality headsets" (translated as VR headsets with gesture control) made in partnership with PC partners like Samsung, Dell, Acer, Lenovo, Asus, and HP. Most notably, Samsung announced a dedicated headset, called the HMD Odyssey, that will be available for $499 this fall running Windows software. Microsoft's XBox console is already popular with gamers, and the company is trying to make its Windows AR/VR ecosystem central for hardware makers. So far, the high-profile partnerships make it clear Microsoft is planting a flag in AR/VR, as well as aiming for ubiquitity as a software player. While the reviews on its Hololens and partnership headsets are mixed, it also wouldn't be surprising if it released a PlaystationVR-like headset competitor built for XBox gaming. [47]

6.1.2.9 Samsung

Samsung partnered with Oculus shortly after the Facebook acquisition in a deal that granted them early access to Oculus's software platform. With any Samsung Galaxy S7 able to power the GearVR headset (Samsung gave away the headset with Galaxy preorders), Samsung's GearVR has the largest footprint of any headset with over 5M units sold, and roughly 57% of the VR market share for 2017.Now, Samsung is opening up its platform and partnerships. The company's latest announcement of a standalone headset, called the HMD Odyssey, will be available for $499 this fall. Curiously, the software will be running Windows Mixed Reality, the AR/VR tailored version of Windows 10. While the move might seem at odds with the longtime Oculus partnership, the company vows it's "committed to working across platforms." [47]

6.1.2.10 Snapchat

Snap has indicated a deep desire to be more than a photo messaging app, and since IPO has been developing several AR initiatives. Originally, the company pioneered camera "lenses" that use computer vision to snap onto users' faces, a primitive sort of augmented reality. Then, in late 2016, Snap released a hardware initiative called Spectacles, which are sunglasses with a dual camera attachment. While not entirely AR or VR, the move indicates a desire to weave perception hardware with its consumer platform. Snap has also patented aggressively in augmented reality, with patent drawings that could incorporate future version of Spectacles, which are currently in the works. Additionally, the mobile app now has "World Lens Filters," which are lenses that allow users to record video messages with augmented reality characters. So far, these projects are experimental and the company faces intense competition from Facebook (and Instagram) in its mobile AR effort. But on analyst calls the company has been vocal the AR initiatives, and its patent portfolio suggests it's betting heavily on being a player here. [47]

6.1.2.11 Sony

Sony's October 2016 release of the PlayStationVR, a high-end gaming VR headset that competes with the Vive and Rift, has been a surprise success, selling more than 1M units in less than a year. PlaystationVR is listed at a far lower price than its rivals ($399) and runs atop the relatively inexpensive $299 PS4 console, though it requires the purchase of additional cameras and controllers. The PlayStation 4 already has a huge gaming footprint and is the best-selling of the major video game consoles. Some theorize that when the PSVR launched, it had a surprisingly robust lineup of VR experiences ready to go, giving it an advantage over other players. In 2015, the company also released a Google Glass-like headset called SmartEyeglass, which was panned by several technology critics. [47]

6.1.2.12 Xiaomi

Though Xiaomi still hasn't announced a full VR rollout, the company has already made moves into the mobile VR space with its Mi VR Play, similar to Google's Cardboard. The low-end mobile headset clearly targets entry-level users who aren't willing to pay $1500+ for high-end gaming PCs. More recently, the company has been rumoured to be collaborating with Oculus on a $200 self-contained headset, with a special software version for the Chinese market. With several VR-capable smartphones, along with former Xiaomi executive Hugo Barra now running Facebook's VR division, Xiaomi could become a serious player in the overseas VR market. [47]

6.1.3 Application portability and support

The application is targeted now for android and windows platforms only but for the future possibilities, it has to be on ios, and other VR-HMD supported devices to scale the application among end-users.

One more thing that is required is to enhance and develop the AI functionalities to provide dynamic speech recognition and performance capabilities. Then with AR terminologies, some advancements are required in terms of targeting dynamic scenes to merge virtual environments with the real environment.

6.1.4 Expense management

As per the current scenario, purchasing the good HMD with gesture and voice-controlled features is required and that is the only cost a user has to bear. On our side, the cost of the production is, if we are using some paid services to create human mesh objects and when we purchase, the AR engine space on some dev portal, that cost needs to be bear by us.

6.1.4.1 ARVR app development sketch

The ARVR, app development sketch can be estimated as shown below.

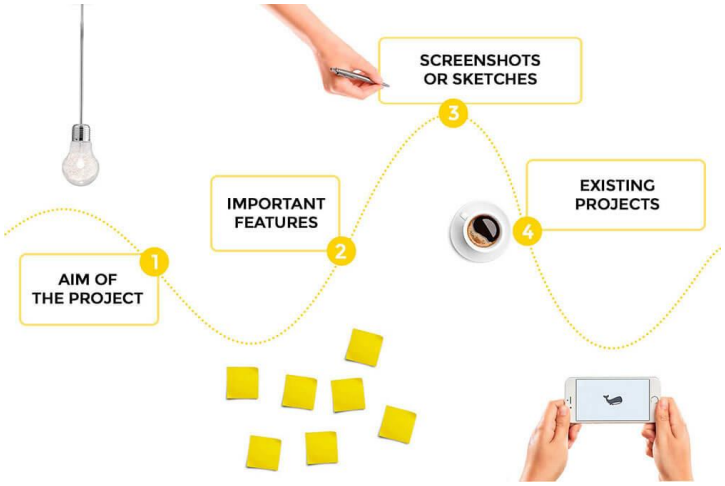


Figure 32 ARVR project sketch to estimate budget

“Project documentation must be a clear guide for the developers about the customer expectations. “ that I firmly believe and on basis of this statement only I have developed this Anti-Glossophobia application. The standard rates are Project documentation for VR app development: $700-$3,400, 3-10 days. [48] The below-given image shows the different timeline for different kinds of applications in ARVR, and then I will show how much efforts are needed for my application.

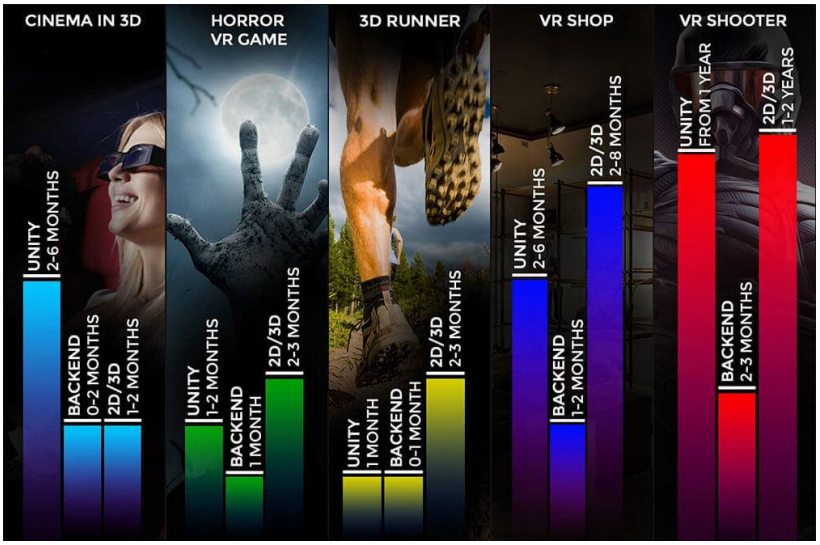


Figure 33 Area wise cost management

The below-shown prices are for different areas and how much does it cost in a different region in the world.

- Simplest game for VR/AR - $5 000 - $8 000;
- Online shop in virtual or augmented reality - $15 000 - $25 000;
- Horror game - $20 000 - $80 000;
- 3Ds Max in VR - $50 000 - $200 000;
- MMORPG - from $100 000

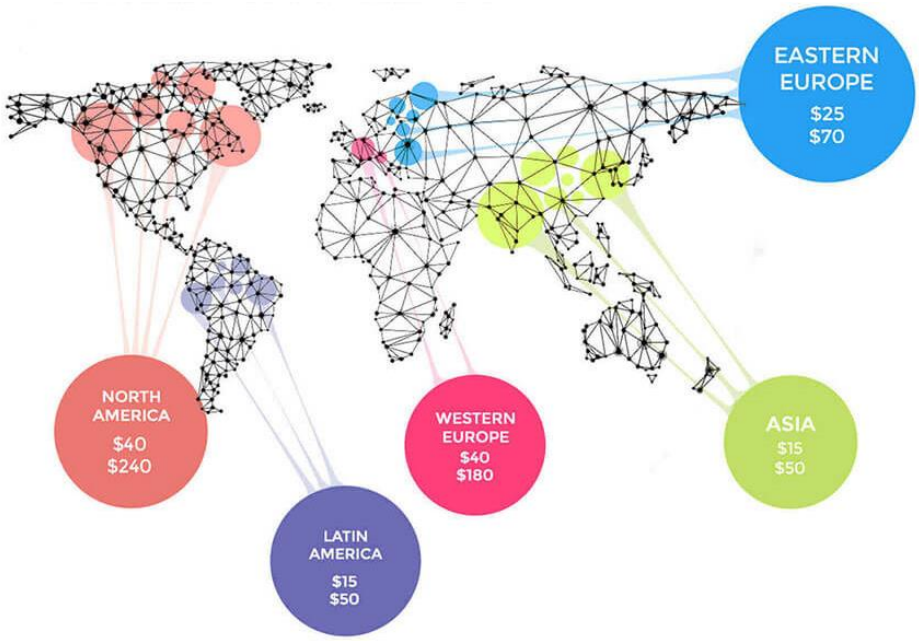
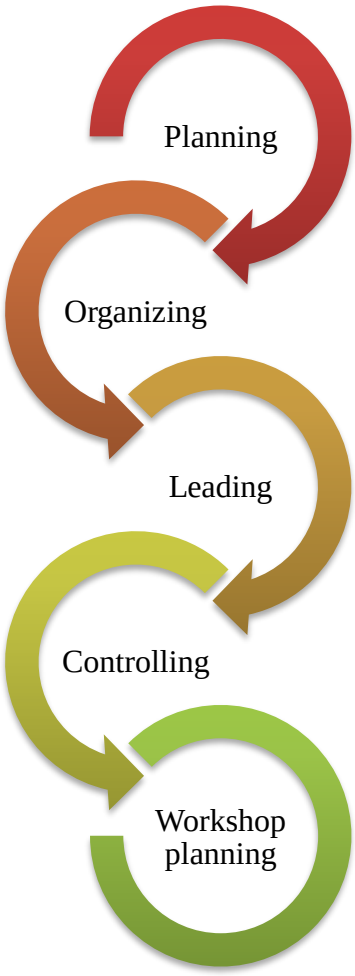


Figure 34 VR app development rates worldwide

Then which kind of life cycle is performed, matters a lot in ARVR app development. Below shown is the example, how each task is carried out.

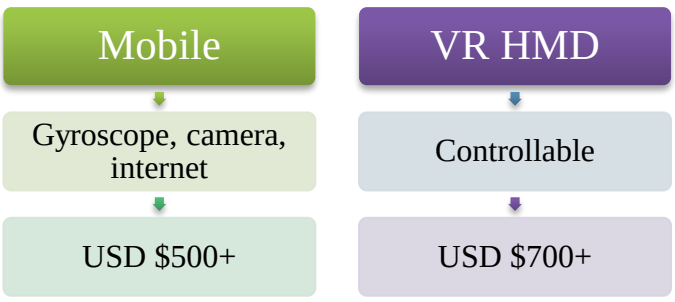


6.1.4.2 The expense management for Anti-Glossophobia application

For my application there are different aspects that need to be taken care of, like

So, after planning all these aspects, I need to decide the budget for each individual entity. And to do so, segmentation of individual aspect is needed to estimate the budget.

- User level



- Developer level

USD $2000+ Computer for application development

- Good graphics card, high RAM

USD $500+ Mobile device

- For testing purpose, gyroscope, camera internet enaabled

USD $99/m - $499 AR toolkit: Vuforia

- First 1000 users are free then it varies between custom package and static package

Free cloud IBM Watson

- Speech-to-text

Free offline Microsoft Azure Bing

- Speech-to-text

USD $700+ VR HMD

- For testing purpose: controllable

USD $0 - $2000 3D objects

- Characters, animations: varies the range

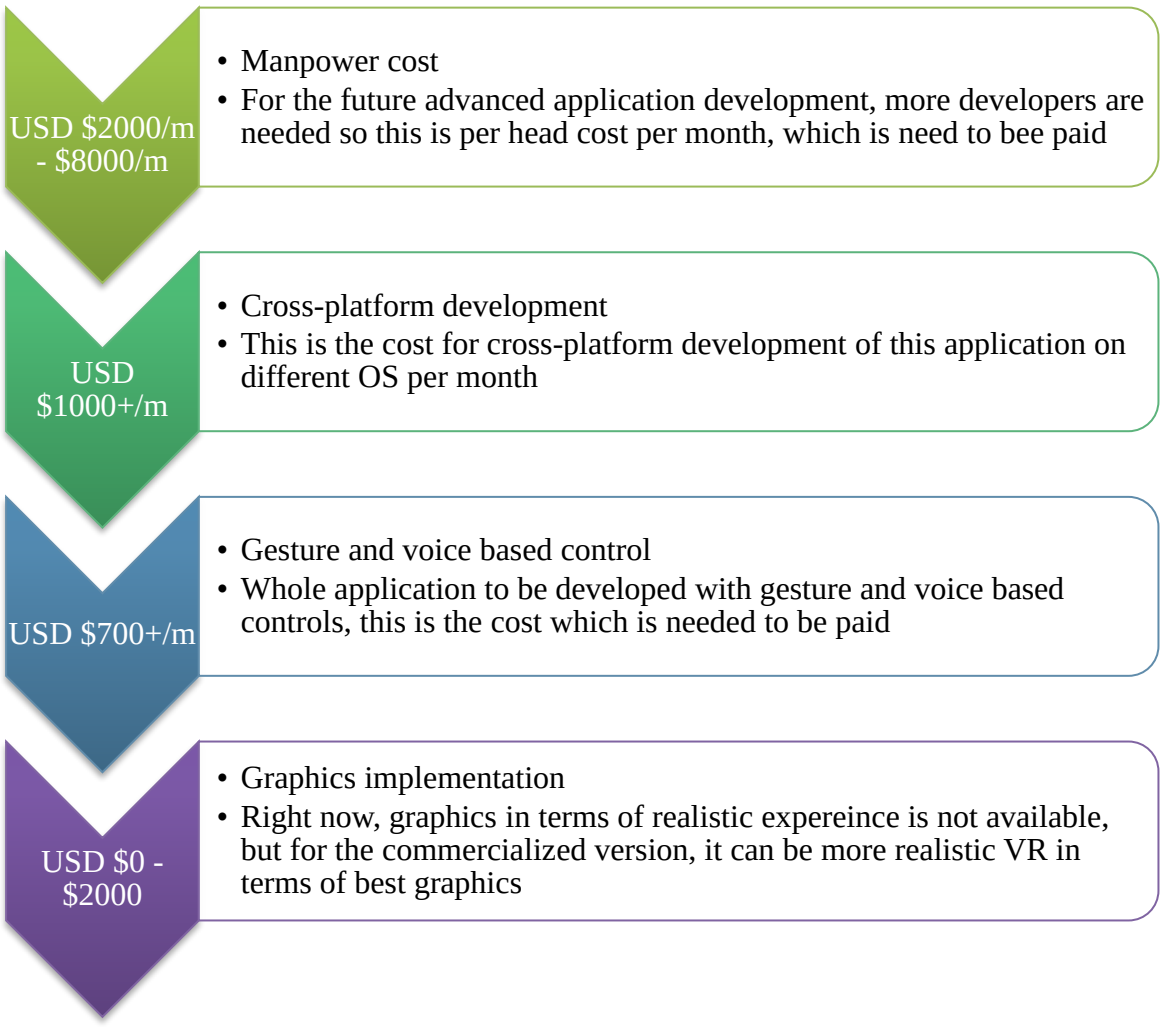
USD $0 - $2000 VR scenes

- To deploy VR 360 degree environment

USD $0 - $2000 VR venue

- To display AR audience, virtual venue is required, e.g. 3D classroom

- Future development costs, with advanced features
    - All the features from previously mentioned points and the new advancement costs follows as shown below.



    -

And at the end, not to forget, to compete with the tech giants as mentioned in section 6.1.2, billions of money needs to be invested to manufacture the product and to distribute it to the end users.

7. Conclusion

From this survey report, the conclusion can be made on the basis of the approaches that can be implemented in future work apart from currently existing application and additionally it can be applied to the multiple OSs as well.

ARVR and mobile market are the emerging technologies around the globe, so application like this has a good market if the application is helpful to the users and can be used to cure serious anxiety related problems then it will be cheery on the cake for this application to run in a global market to compete with big technical giants like, facebook, google, Amazon, Sony, Samsung, htc, apple, etc.

This report mainly focused on existing techniques and their inspiration to involve in this application with the help of outperforming the limitations I have right now with this application. The optimization techniques to enhance the user experience is discussed.

The leveraging goal of this application is unique in its way as it is based on MR which is not only VR but also the combination with AR. The report consists of the system architecture and the possible implementation plan for commercialization purpose in future.

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Appendix

Implementation codes, manual of installation and self-development, user guide

Vuforia

1. *Create an account on developer.vuforia.com and get a development key by creating a new project.*

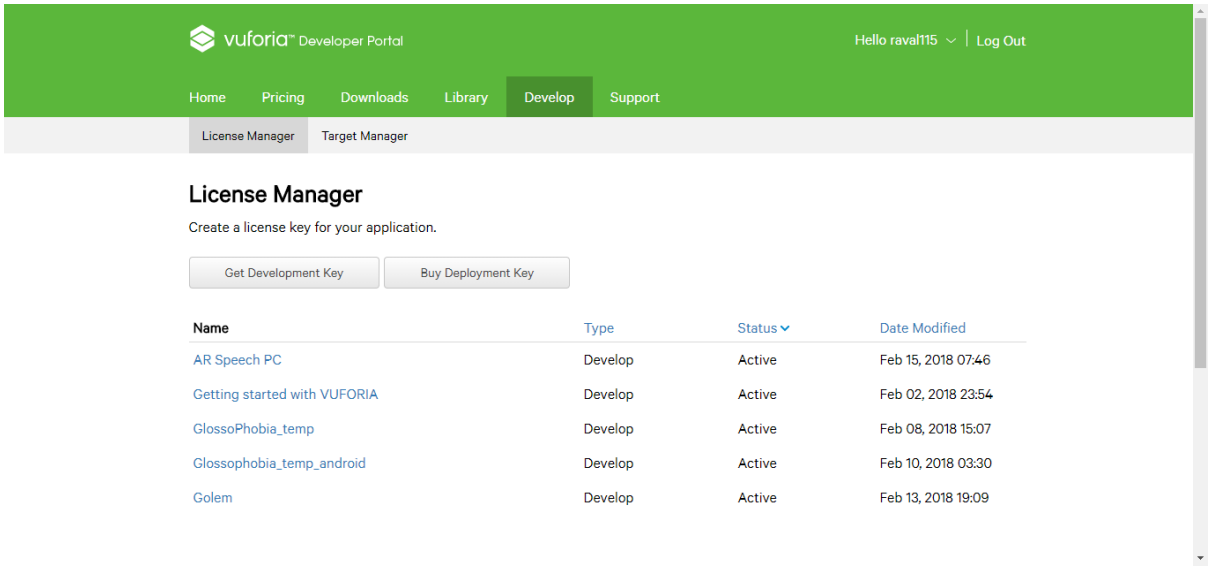

Figure 35 Get development key

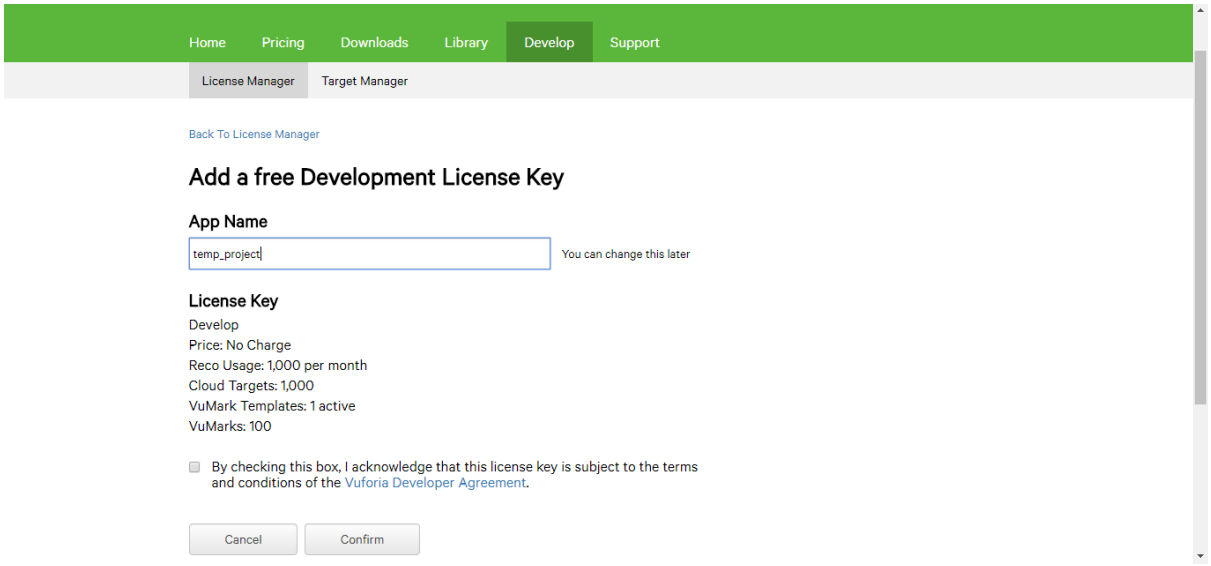

Figure 36 Add a new project

2. *Then get a license key for the future use in Unity IDE.*

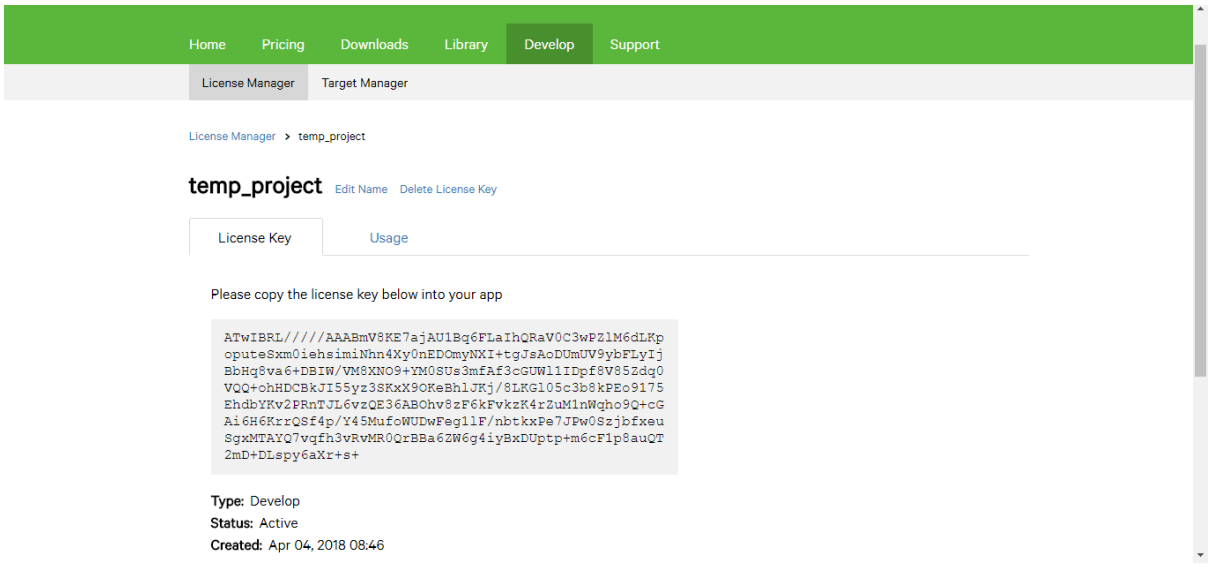

Figure 37 Copy project license key for later use

3. *Go to target manager to add a static target for your object, which will be targeted by the AR camera (device camera). Select 'Device', do not select 'Cloud' or 'VuMark'.*

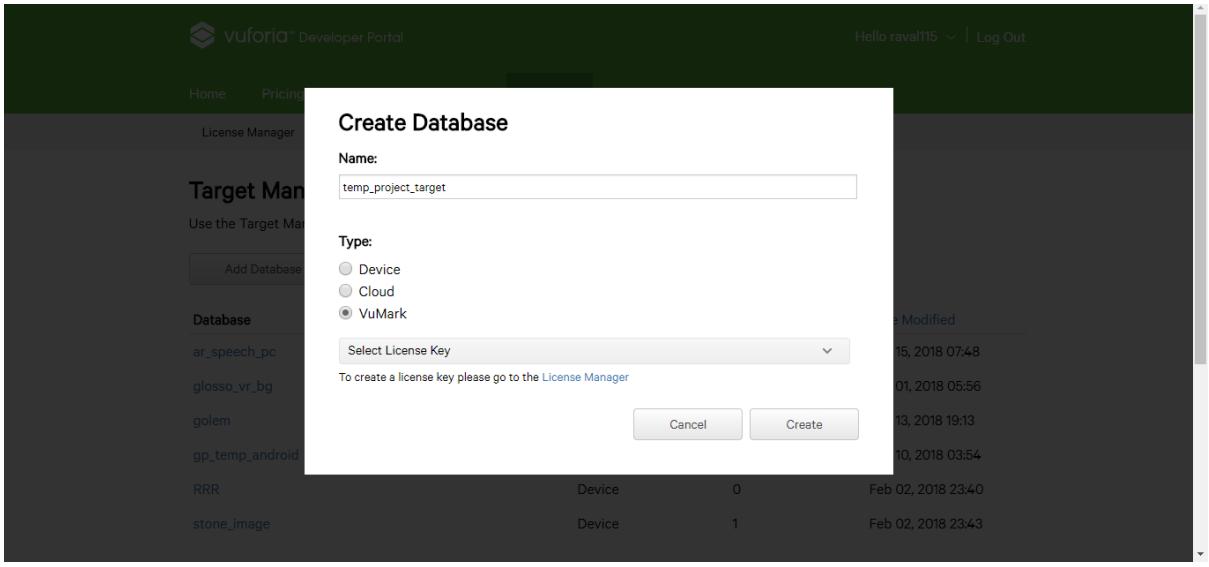

Figure 38 Create image databases

4. *Add database and add an image(s) you want to target.*

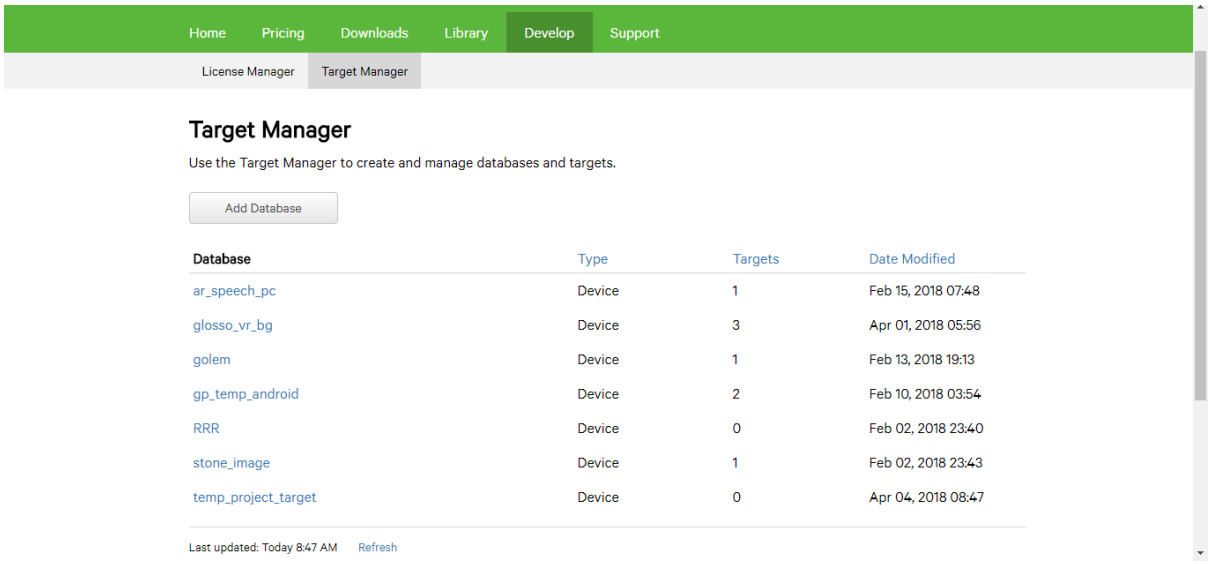

Figure 39 Open newly created database of the image(s)

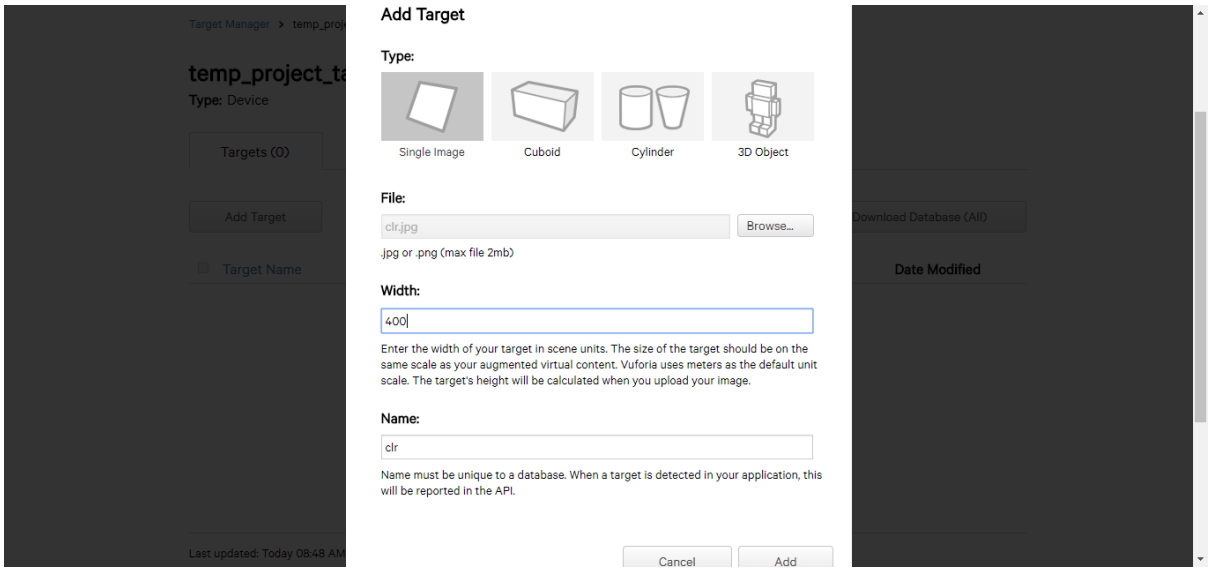

Figure 40 Add image(s)

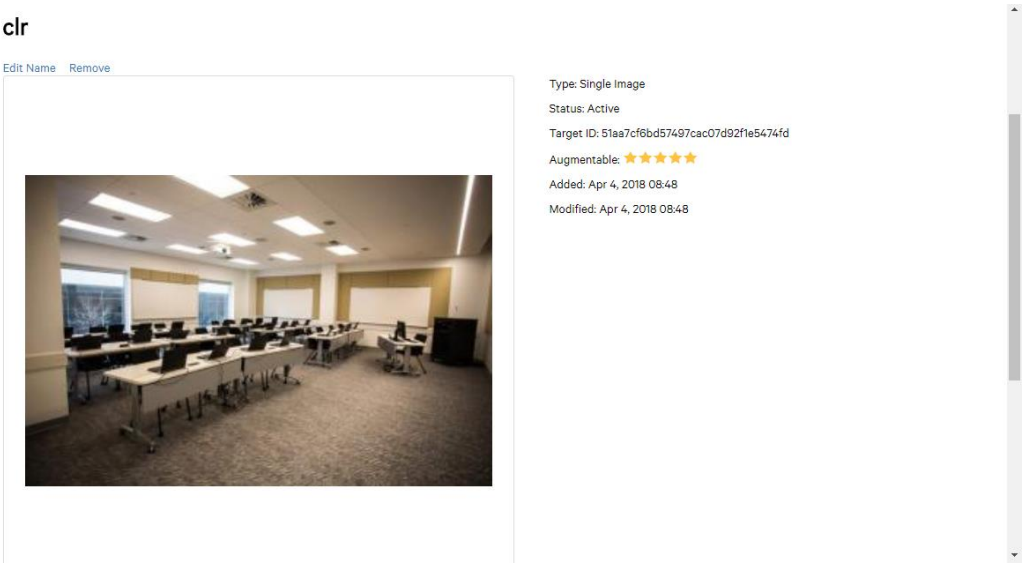

Figure 41 Image view

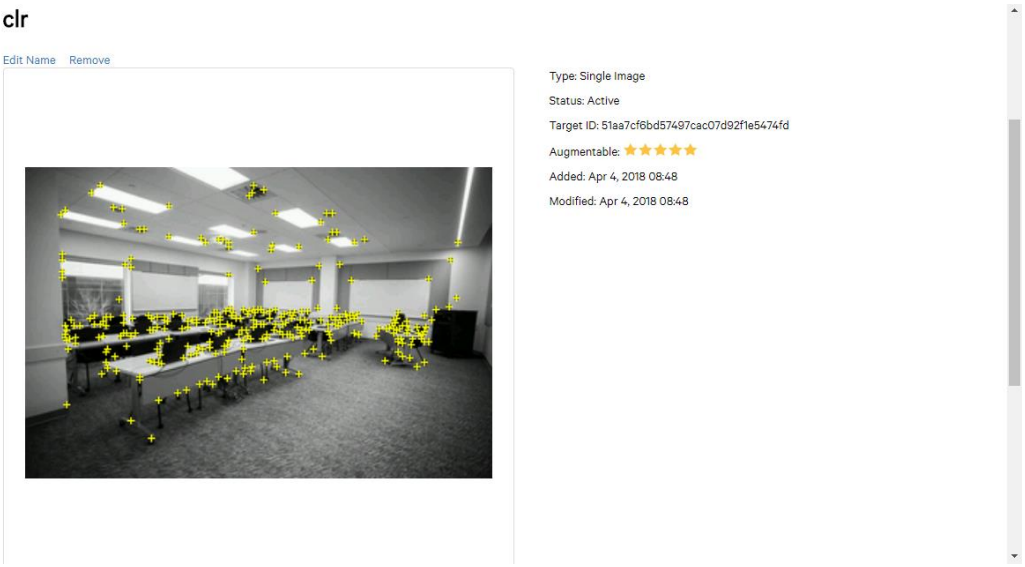

Figure 42 See the features of the uploaded image(s)

5. *Download image asset for Unity that will be used later on.*

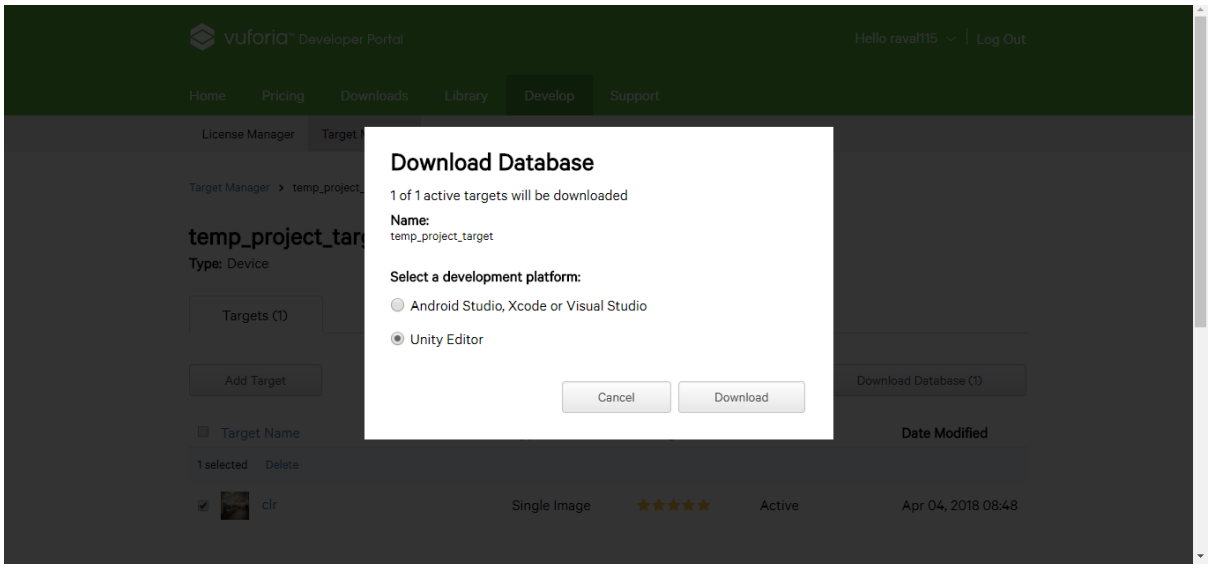

Figure 43 Download the database

Unity

1. *Create a new 3D project.*

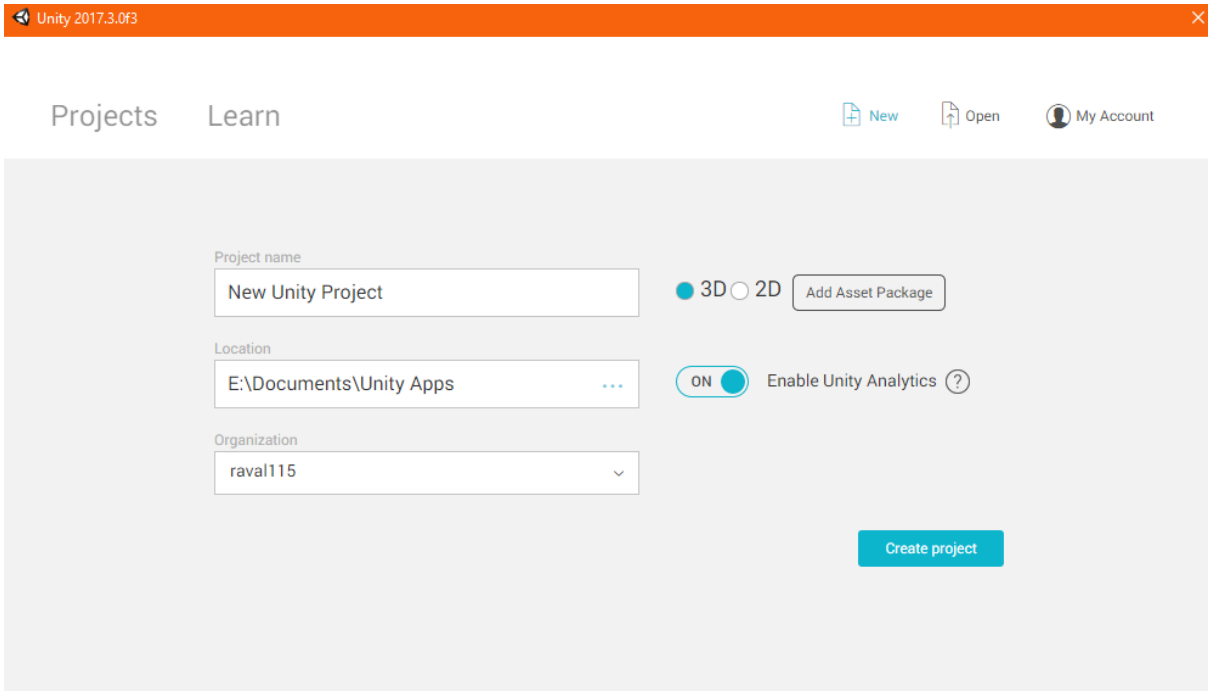

Figure 44 Create a new project in Unity

2. *Import asset of imageset which was downloaded from Vuforia.*

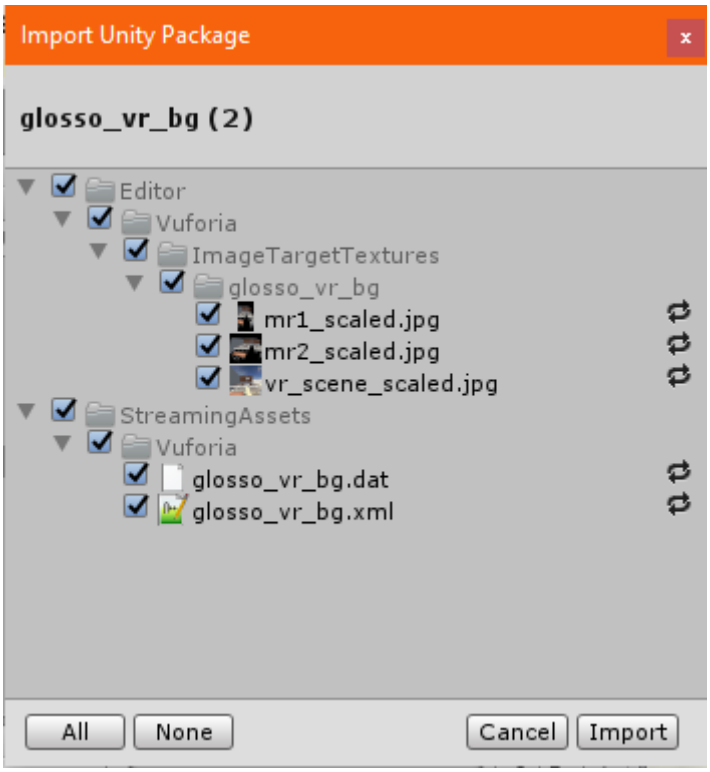

Figure 45 Import the database from vuforia

3. *Download Google VR SDKs and import them into Unity.*

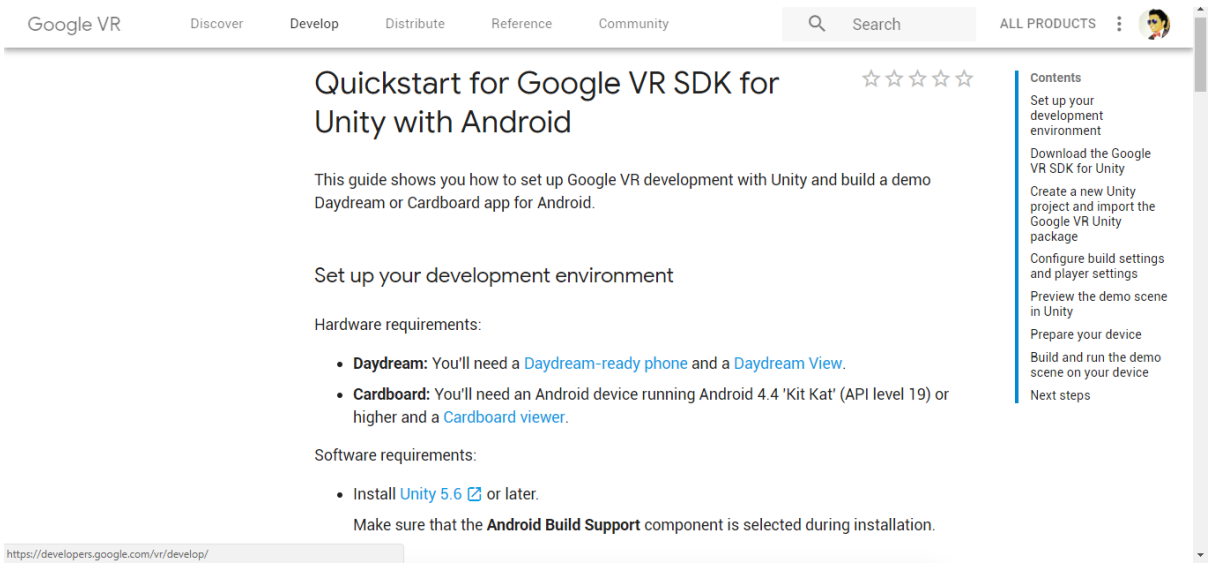

Figure 46 Download GVR SDKs

4. *Download 3D model objects from Unity asset store.*

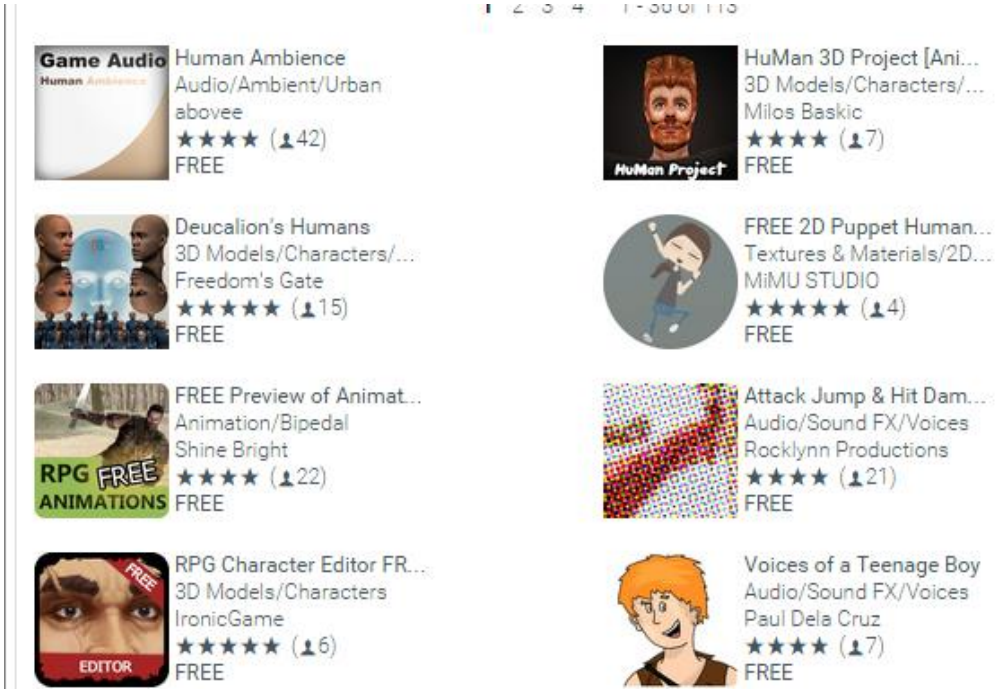

Figure 47 Download 3D models

5. *Download skybox (VR environment) from Unity asset store.*

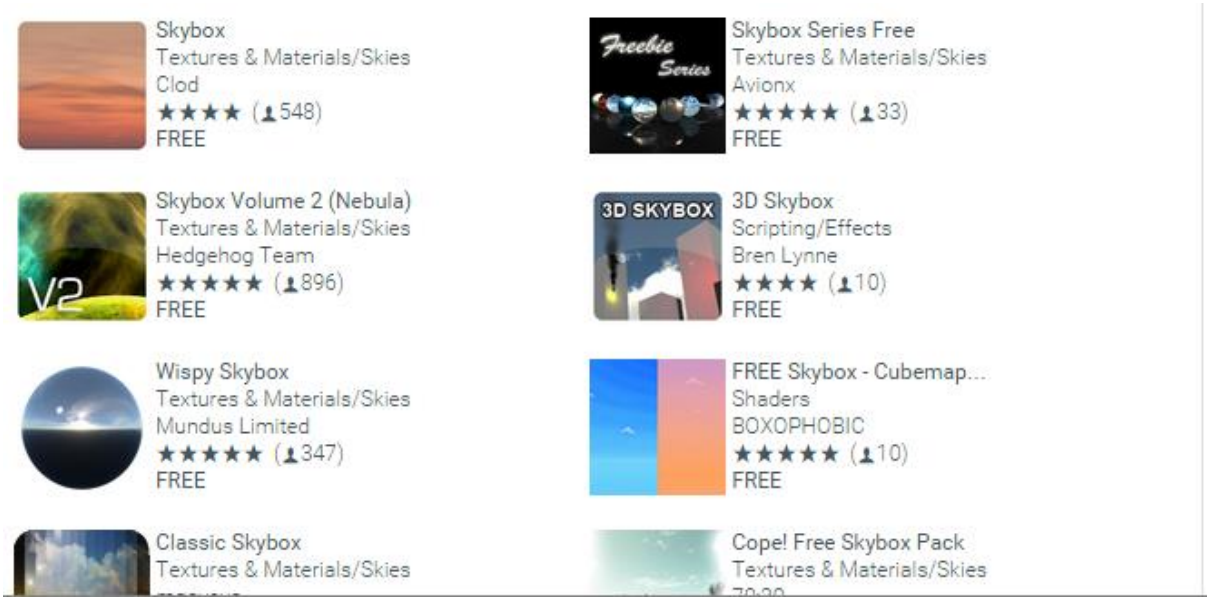

Figure 48 Download VR skybox

6. *Download and import Vuforia toolkit in Unity.*

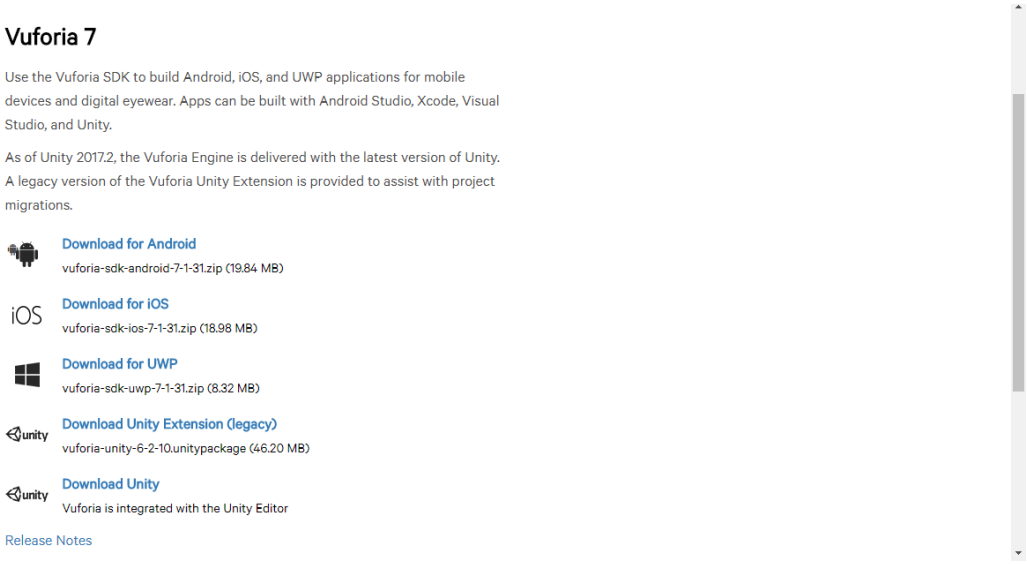

Figure 49 Download Vuforia toolkit and import it into Unity

7. *Download classroom 3D model from cgTrader.com and import in Unity and add as sub VR environment.*

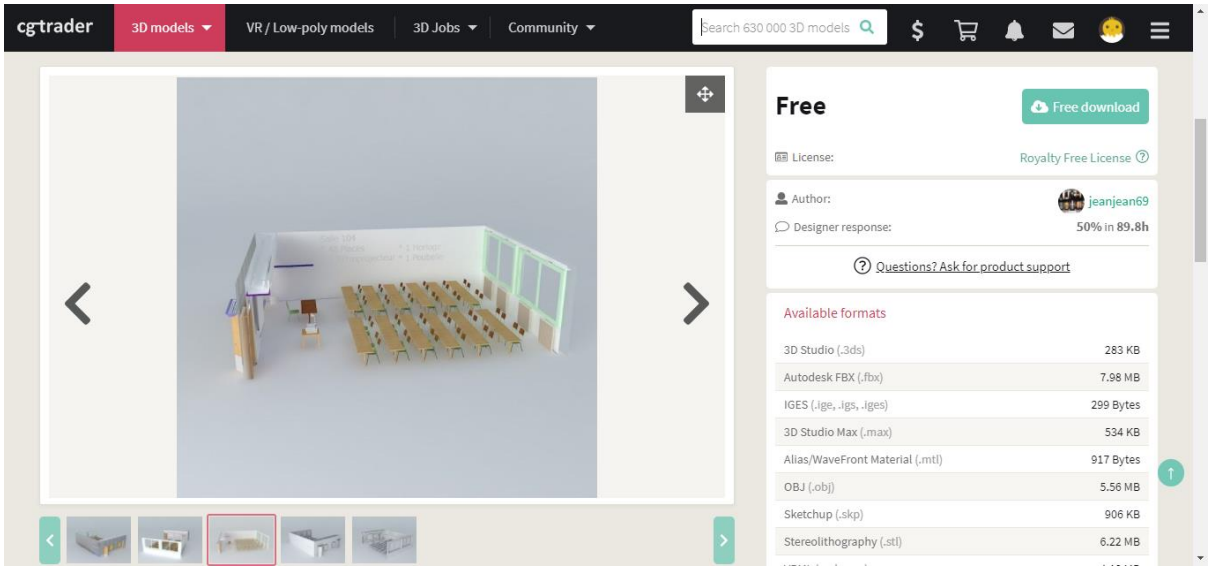

Figure 50 Download classroom 3D object

8. *Apply textures from PNG image to the classroom wall and desk and chairs.*

Figure 51 Apply this texture to classroom walls, etc.

Figure 52 Textured classroom

9. *Keep GVR setting as shown below.*

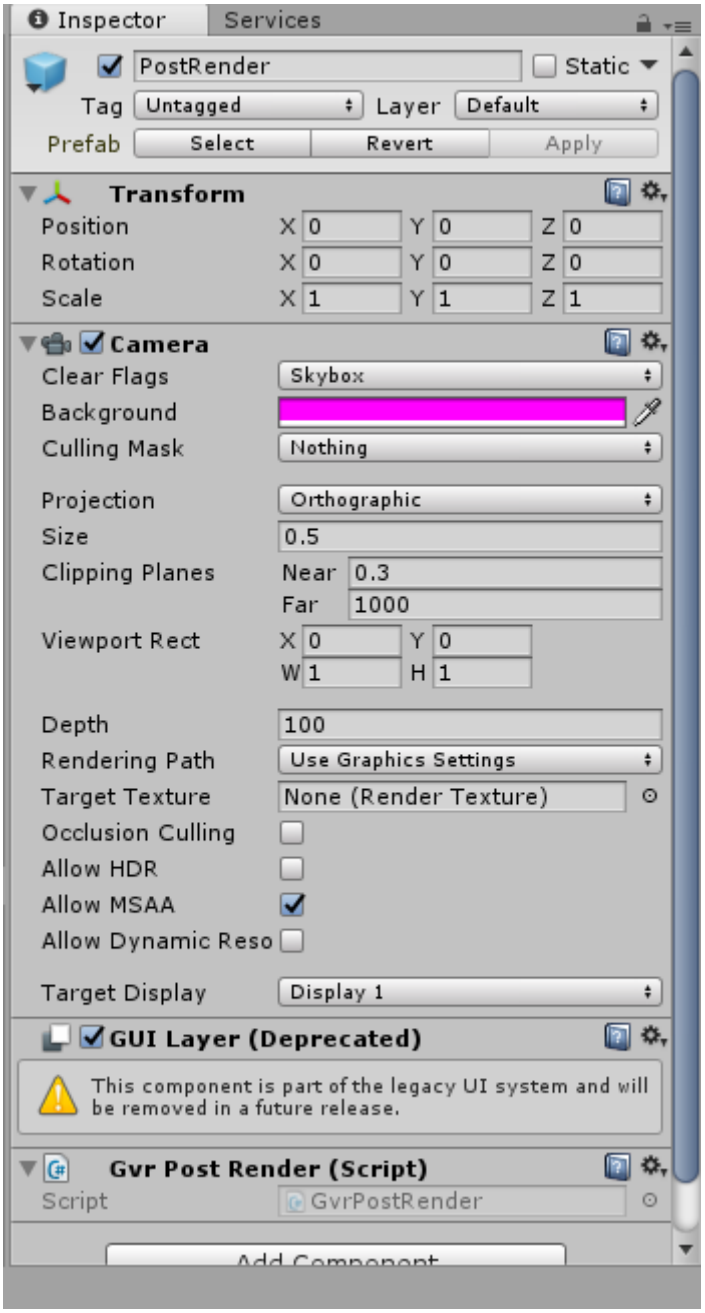

Figure 53 GVR PostRender settings

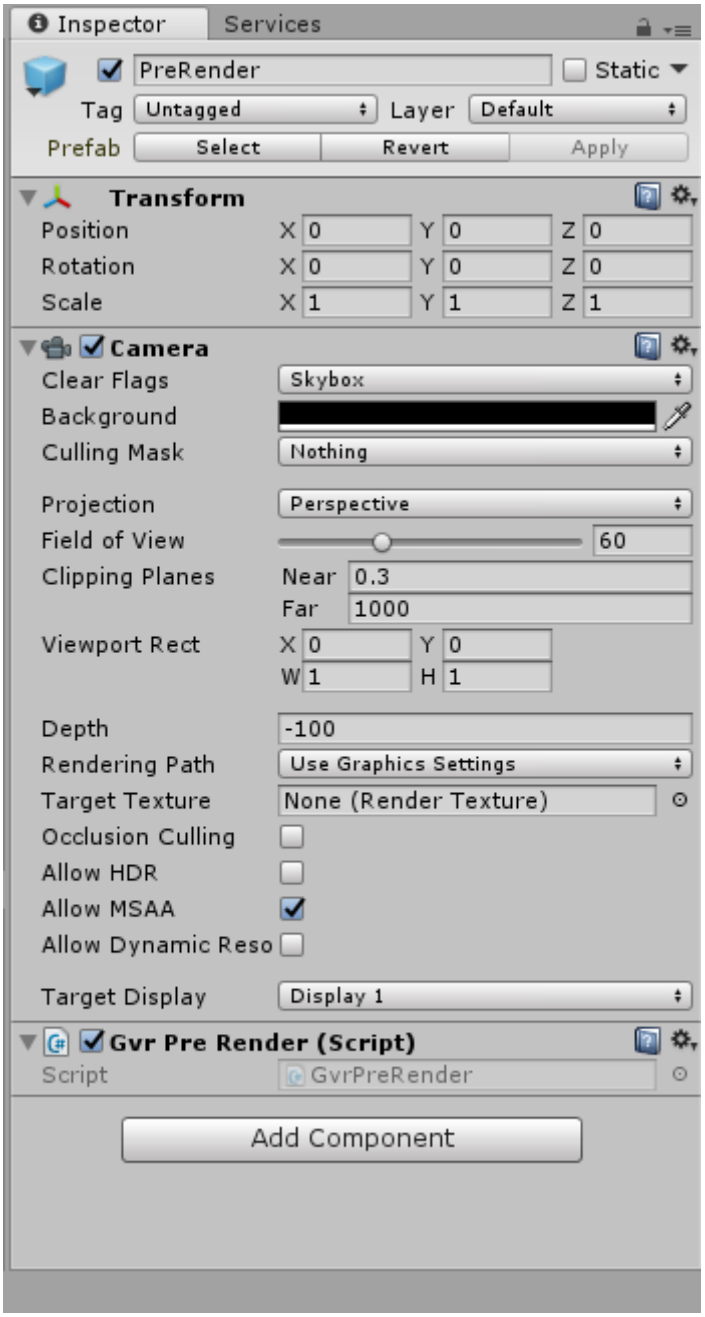

Figure 54 GVR PreRender setting

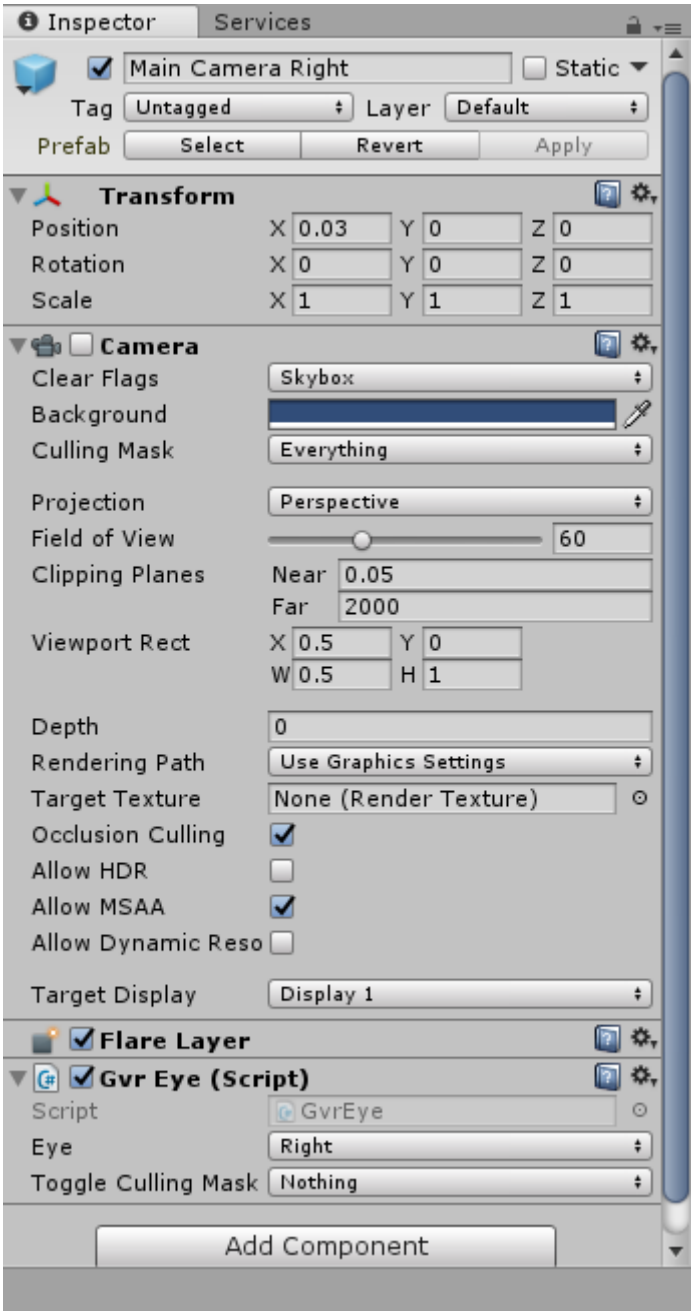

Figure 55 GVR right camera setting

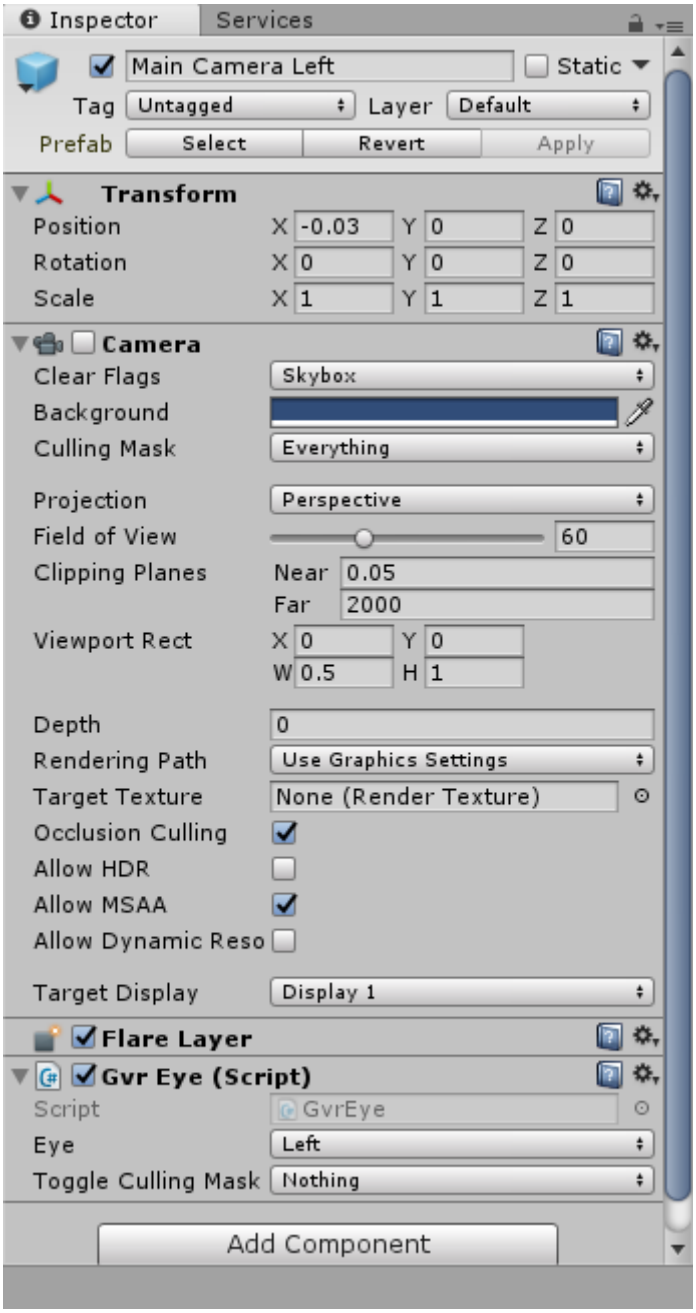

Figure 56 GVR left camera setting

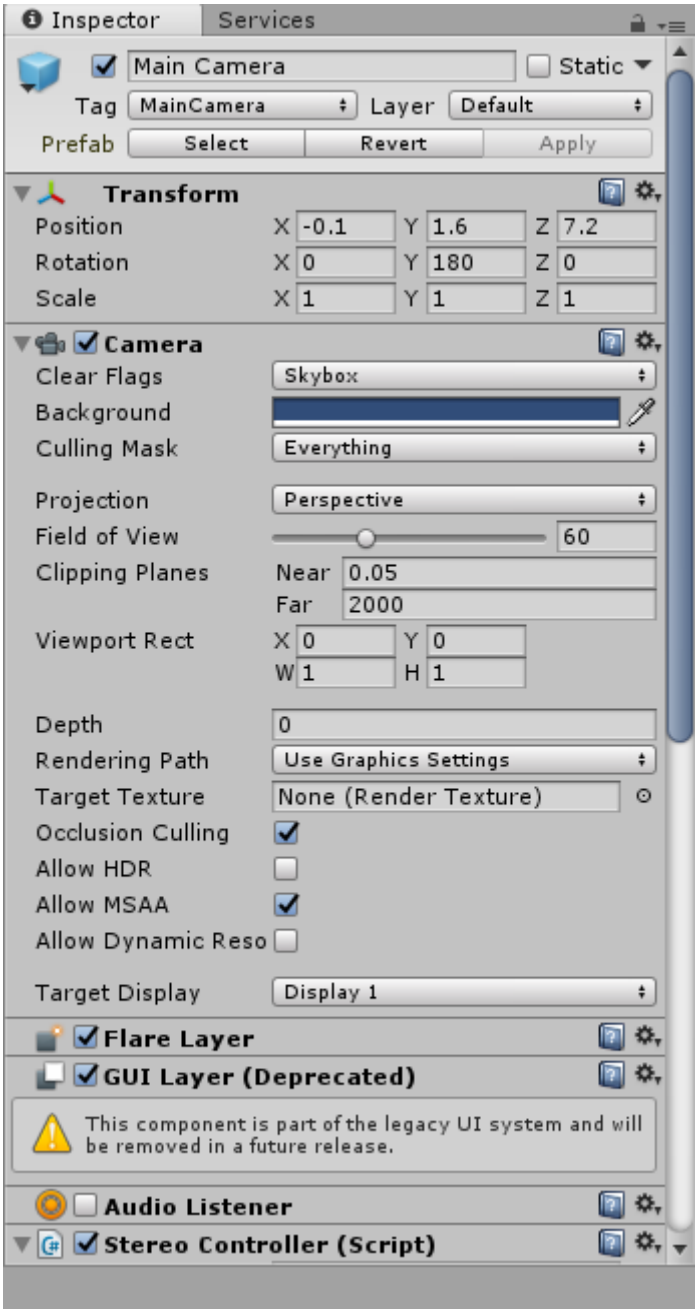

Figure 57 GVR main camera setting

10. Keep AR camera setting as shown below.

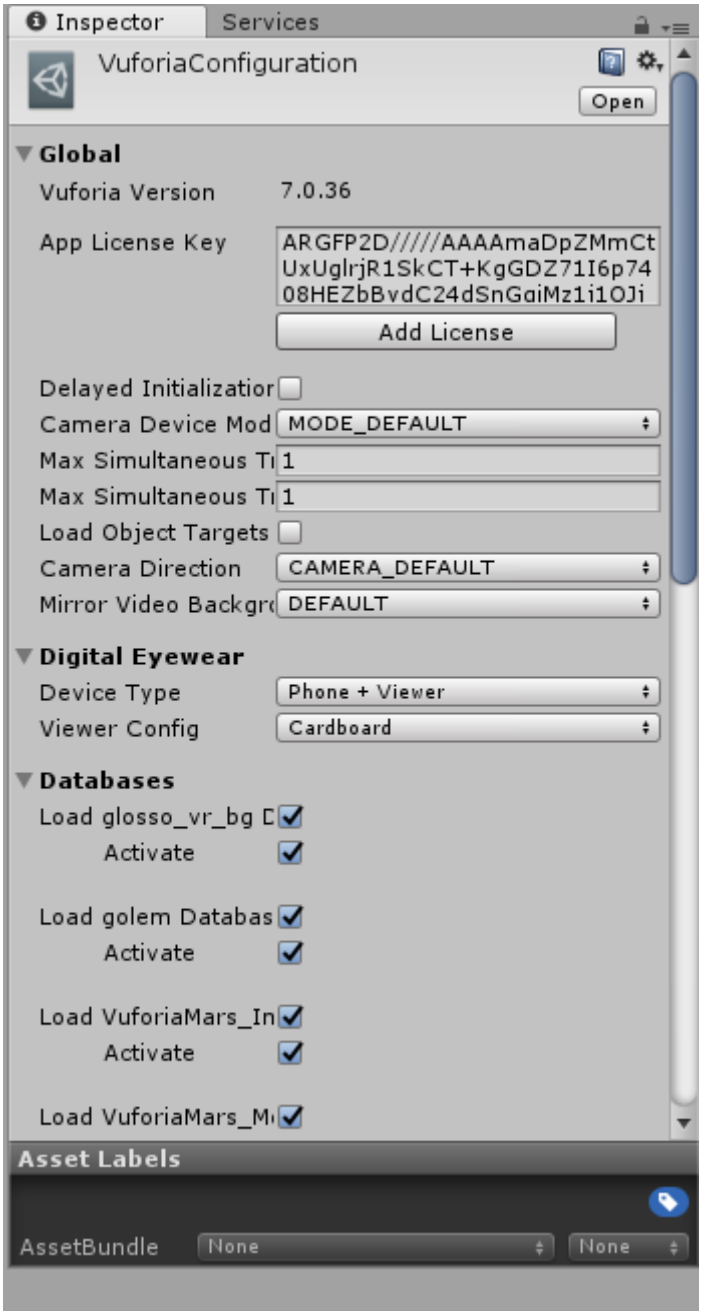

Figure 58 Vuforia configuration for AR camera

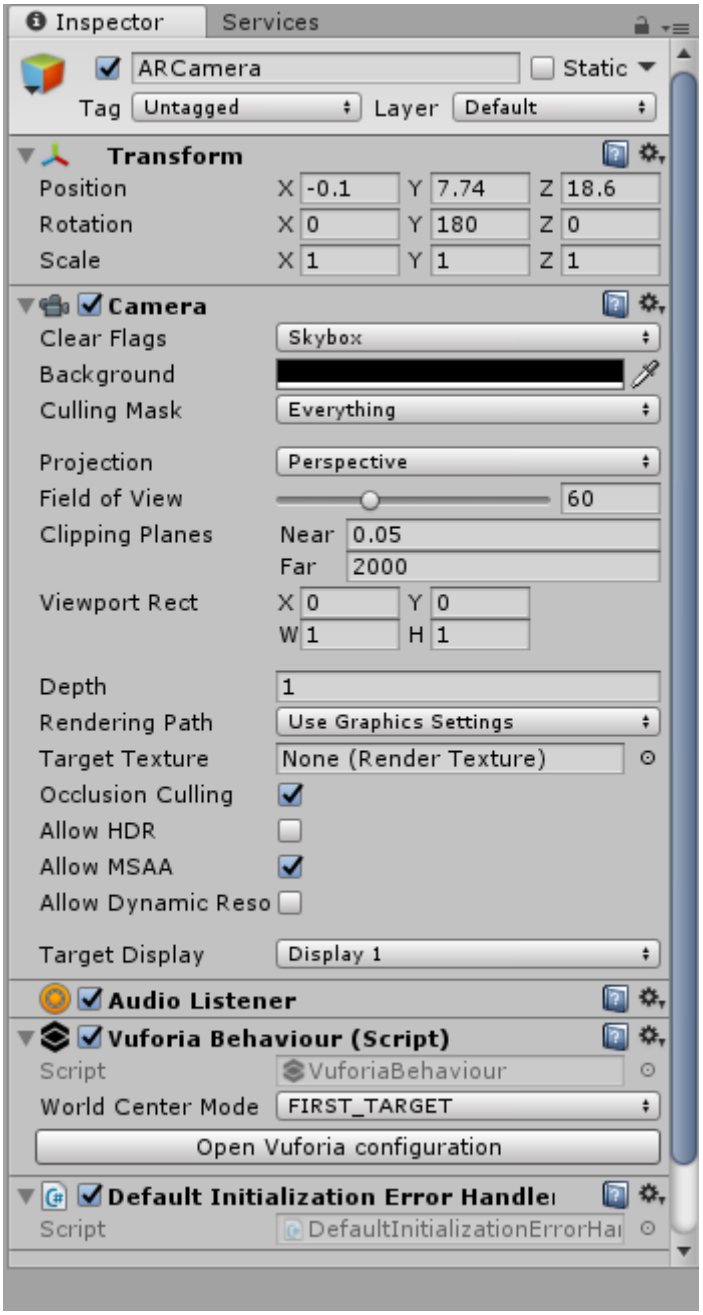

Figure 59 AR camera setting

11. Keep image target and 3D model setting as shown below.

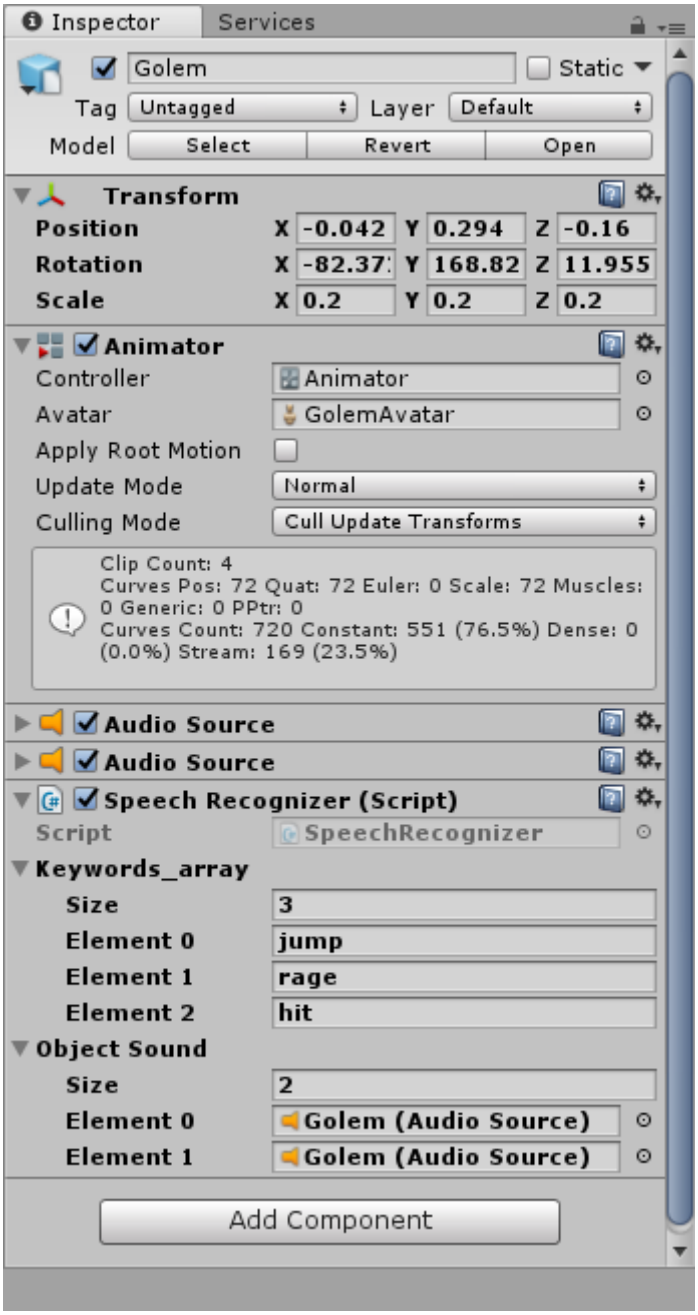

Figure 60 3D object setting

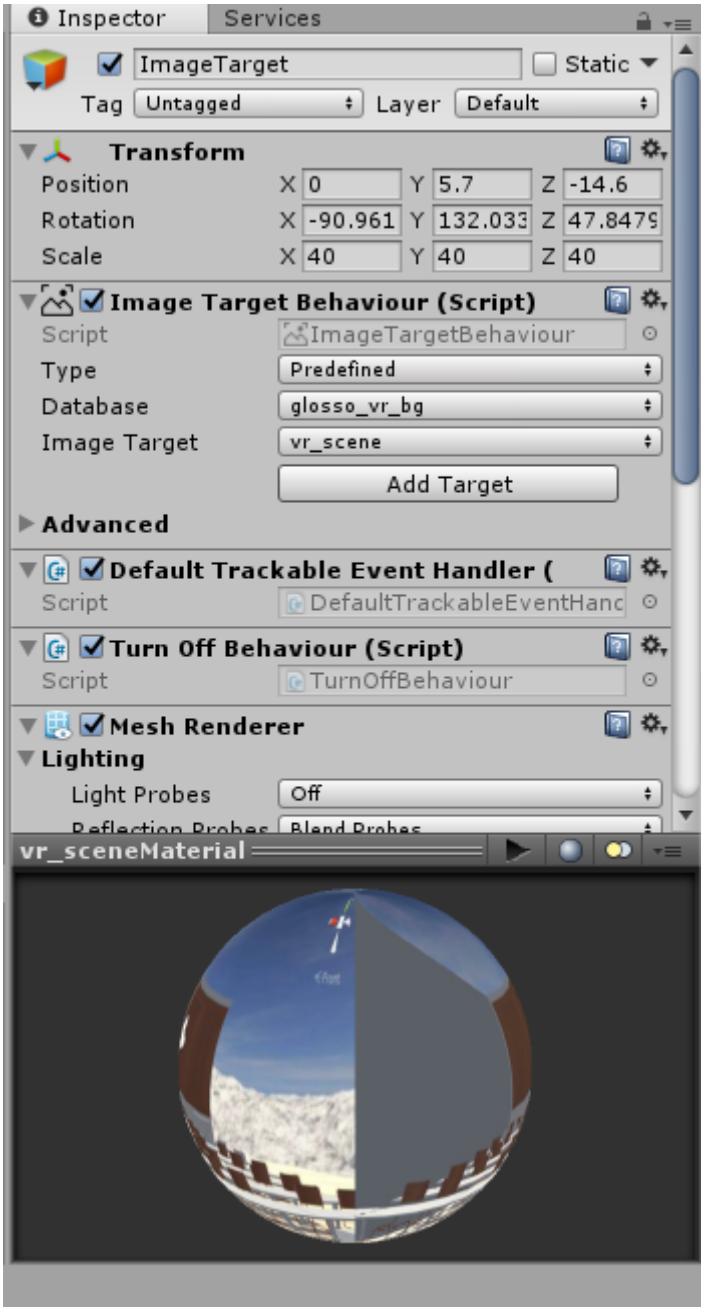

Figure 61 Image target setting

12. Create a script in Script folder as shown below.

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

using UnityEngine.Windows.Speech;


public class SpeechRecognizer : MonoBehaviour {

    KeywordRecognizer KeywordRecognizerObj;
    public string[] Keywords_array;

    private Animator anim;
    public AudioSource[] ObjectSound;

    // Use this for initialization
    void Start () {

        KeywordRecognizerObj = new KeywordRecognizer(Keywords_array);
        KeywordRecognizerObj.OnPhraseRecognized += OnKeywordsRecognized;
        KeywordRecognizerObj.Start();

        anim = GetComponent<Animator>();
        ObjectSound = GetComponent<AudioSource[]>();

    }

    void OnKeywordsRecognized(PhraseRecognizedEventArgs args)
    {
        Debug.Log("keyword: " + args.text + " ; Confidence " + args.confidence);
        ActionPerformer(args.text);
    }

    void ActionPerformer(string command)
    {
```

Figure 62 Speech recognizer codes 1

```
    void ActionPerformer(string command)
    {
        if (command.Contains("jump"))
        {
            anim.Play("jump", -1, 0f);
            ObjectSound[0].Play(0);
        }
        if (command.Contains("rage"))
        {
            anim.Play("rage", -1, 0f);
            ObjectSound[1].Play(0);
        }
        if (command.Contains("hit"))
        {

        }
    }

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

    }
}
```

Figure 63 Speech recognizer codes 2

13. Add audio sources as shown below.

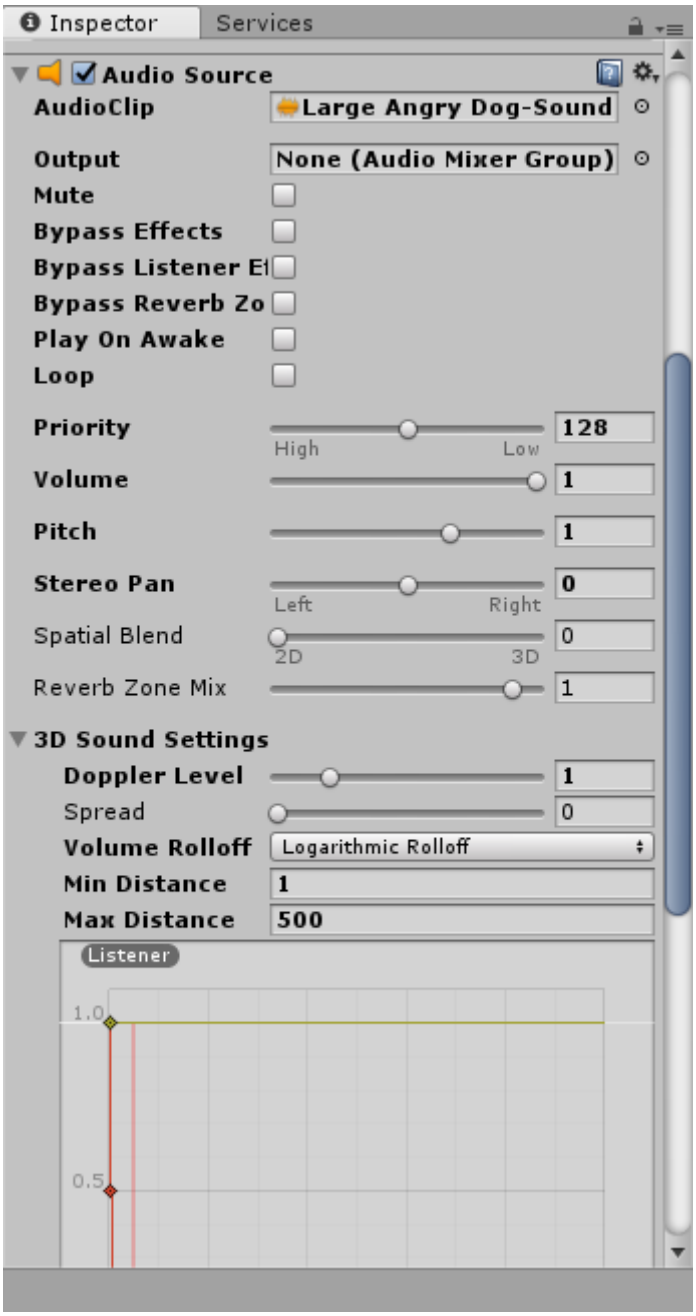

Figure 64 Audio source setting 1

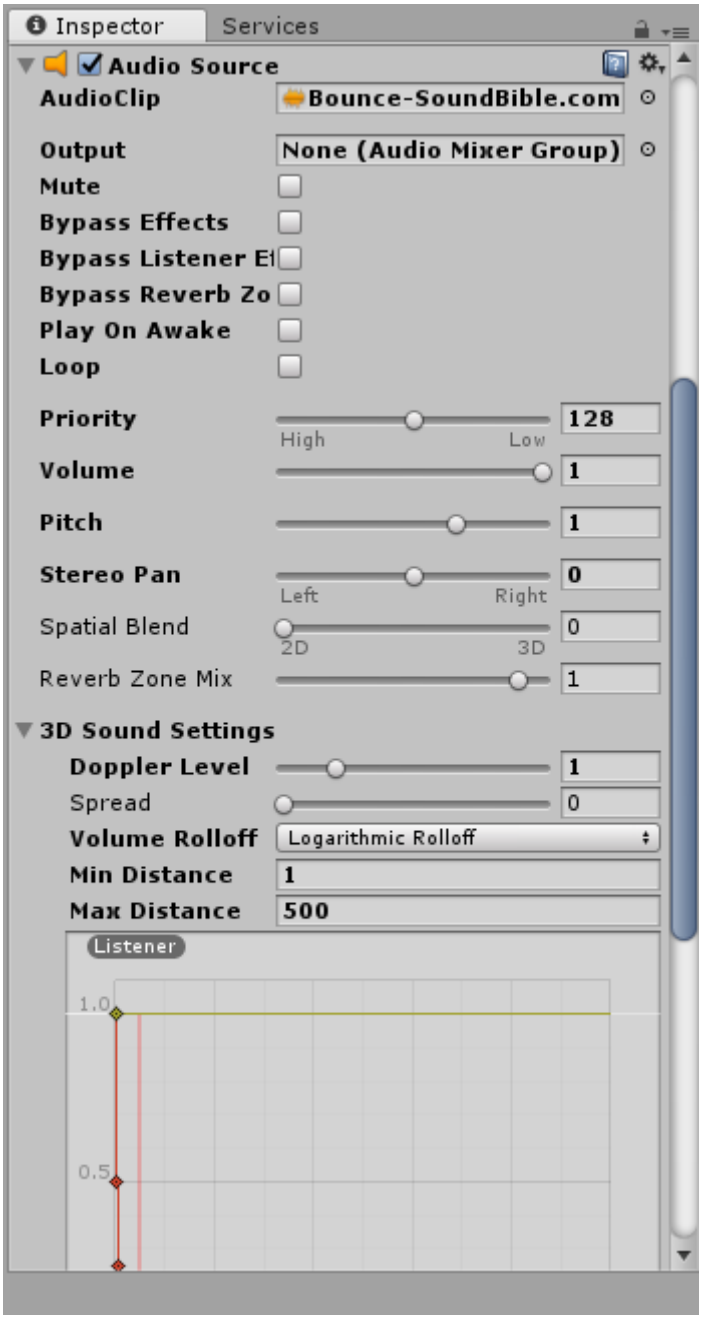

Figure 65 Audio source setting 2

14. Animator flow should go as shown below.

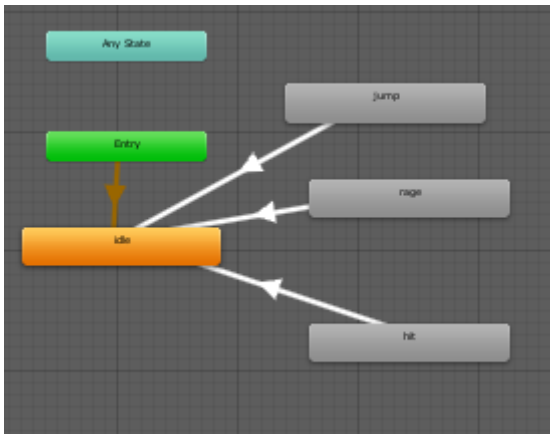

Figure 66 Animator setting of the 3D object

15. The player setting should be as shown below.

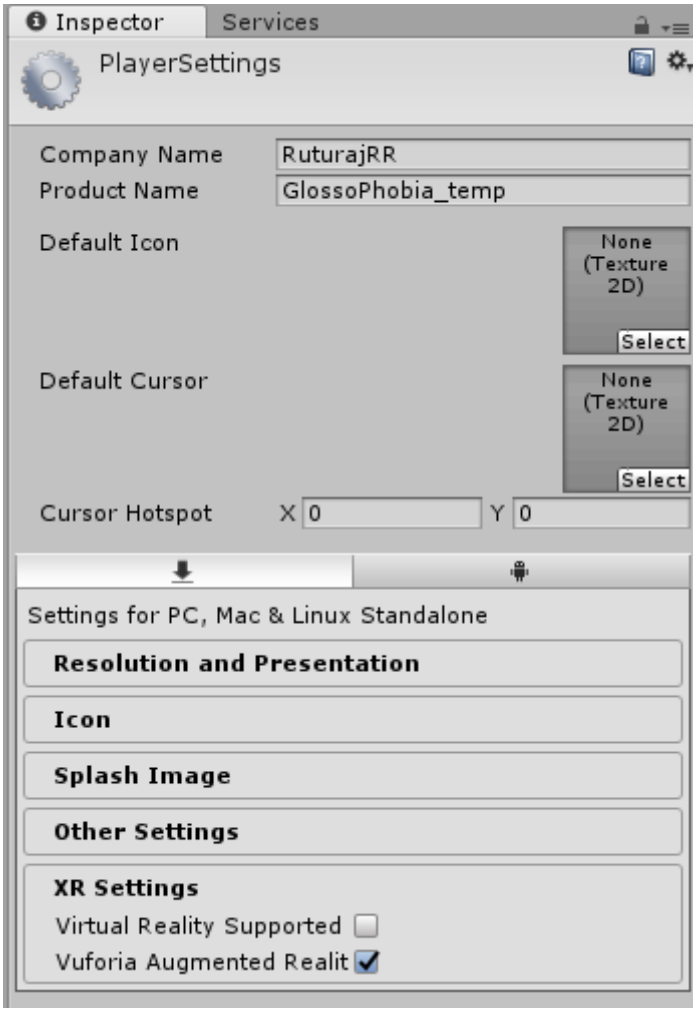

Figure 67 Player setting

16. That is how final project will be built.

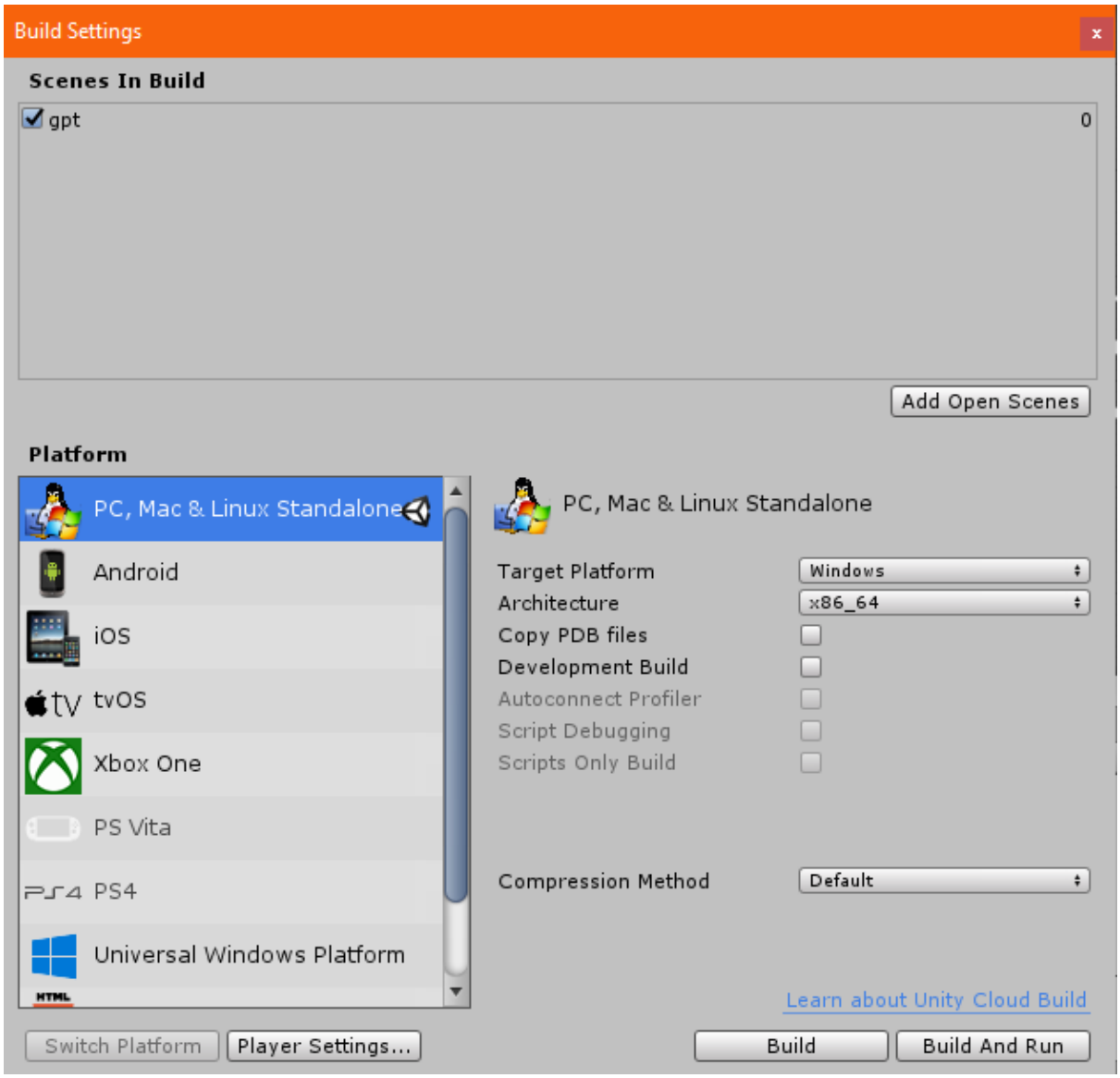

Figure 68 Project build setting