3D MODELS FOR VIRTUAL REALITY

An Industrial Internship Report

submitted by

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18BCE2465

in partial fulfilment for the award of the degree of

B. TECH

in

COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

MARCH,2021

DECLARATION

I hereby declare that the Industrial Internship report entitled "**3D MODELS FOR VIRTUAL REALITY"** submitted by me to Vellore Institute of Technology, Vellore in partial fulfilment of the requirement for the award of the degree of **B. TECH** in **Computer Science and Engineering** is a record of bonafide industrial training (coursera course) undertaken by me under the supervision of **Dr Sylvia Xueni Pan, Lecturer, Department of Computing Goldsmiths, University of London.** I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Signature of the student

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School of Computer Science and Engineering

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This is to certify that the Industrial Internship report entitled "**3D MODELS FOR VIRTUAL REALITY"** submitted by ASHUTOSH DEVKOTA **(18BCE2465)** to Vellore Institute of Technology, Vellore in partial fulfilment of the requirement for the award of the degree of B. Tech in Computer Science and Engineering is a record of bonafide Industrial Internship undertaken by him/her under my supervision. The training fulfils the requirements as per the regulations of this Institute and in my opinion, meets the necessary standards for submission. The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Signature of the Supervisor

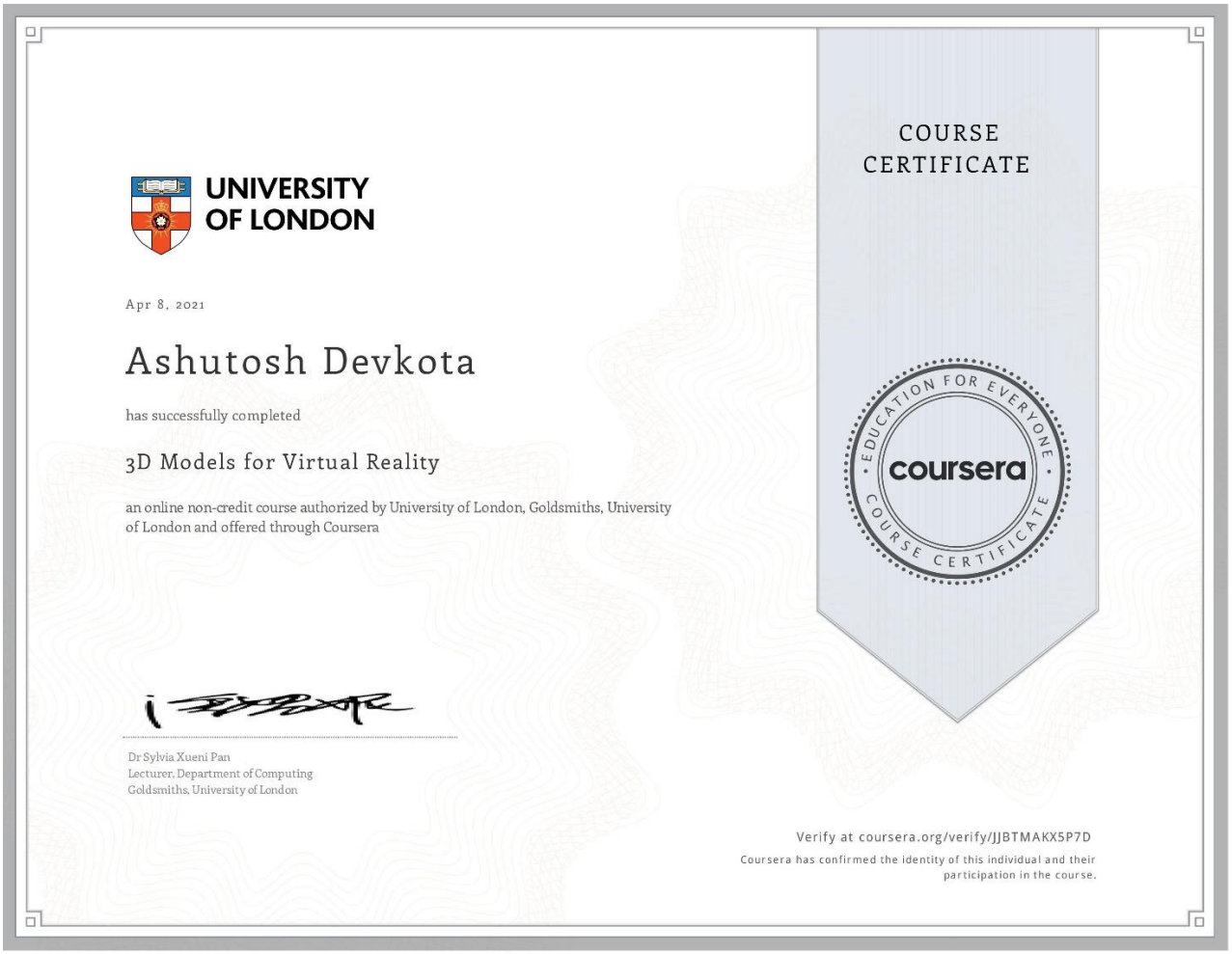
Date:

Date:

Internal Examiner (s)

External Examiner (s)

CERTIFICATE



ACKNOWLEDGEMENT

I would like to express my heartful thanks of gratitude to the VIT University, who gave me this wonderful opportunity to complete this wonderful online course as a part of the internship training on the topic, "**3D Models for Virtual Reality**", which also helped me in doing a lot of Research. I came to know about so many new tools and concept that can be implemented in the field of Virtual Reality.

Secondly, I would also like to thank my parents and friends who provided us a helping hand whenever required ensuring the completions of this course within the limited time frame.

Place : Vellore

Ashutosh Devkota

Date : 23rd April, 2021

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CHAPTER 1 INRODUCTION

1.1.Virtual Reality

Virtual reality (VR) alludes to a PC produced reenactment in which an individual can associate inside a counterfeit three-dimensional climate utilizing electronic gadgets, for example, unique goggles with a screen or gloves fitted with sensors. In this reproduced counterfeit climate, the client can have a reasonable inclination experience.

The idea of virtual reality is based on the normal mix of two words: the virtual and the genuine. The previous signifies "almost" or "reasonably," which prompts an encounter that is close reality using innovation. Programming makes and presents virtual universes that are capable by clients who wear equipment gadgets like goggles, earphones, and uncommon gloves. Together, the client can see and associate with the virtual world as though from the inside.

To comprehend virtual reality, how about we draw a corresponding with true perceptions. We comprehend our environmental factors through our faculties and the insight systems of our body. Faculties incorporate taste, contact, smell, sight, and hearing, just as spatial mindfulness and equilibrium. The information sources assembled by these faculties are handled by our cerebrums to make understandings of the target climate around us. Virtual reality endeavors to establish a fanciful climate that can be introduced to our faculties with fake data, causing our brains to trust it is (just about) a reality.

Mechanical advances have empowered further improvement past standard 3D glasses. One would now be able to discover VR headsets to investigate much more. Supported by PC frameworks, one would now be able to play "genuine" tennis (or different games) directly in their lounge room by holding sensor-fitted racquets for playing inside a PC controlled game recreation. The VR headset that players wear on their eyes gives the deception of being on a tennis court. They move and attempt to strike

contingent on the speed and bearing of the approaching ball and hit it with the sensor-fitted racquets. The precision of the shot is surveyed by the game-controlling PC, which is appeared inside the VR game likewise—showing whether the ball was hit excessively hard and left limits or was hit excessively delicate and was halted by the net.

Different employments of this VR innovation include preparing and recreation. For instance, those needing to get a driver's permit can get a direct encounter of street driving utilizing a VR arrangement that includes taking care of vehicle parts like the controlling wheel, brake, and gas pedal. It offers the advantage of involvement without the chance of causing a mishap, so understudies can build up a specific degree of aptitude in driving before really being out and about.

1.2. About the Course

This course starts one’s excursion to making Virtual Reality encounters. A Virtual Reality experience is another world that you venture into and are totally submerged in. Making a VR experience implies making that world and every one of the articles in it.

In this course we get familiar with the nuts and bolts of 3D illustrations: how we make items and how to spread them out to establish a climate. We learn strategies like materials and finishing that cause your items to seem sensible. We find out about sound procedures to guarantee that your encounters sound incredible just as looking extraordinary.

In these subjects we will focus on the specific prerequisites of Virtual Reality, including traps and execution issues: ensuring your current circumstance runs quick enough in VR. We get familiar with the entirety of this utilizing the expert game and VR motor, Unity3D. Unity is quite possibly the most utilized game engine and is a generally simple, however completely highlighted, prologue to 3D turn of events.

The course comes full circle in an undertaking in which one will make his/her own VR scene. VR improvement is something you can just learn by doing it without anyone else's help, so chipping away at your venture will be the most ideal approach to learn.

Syllabus:

Week 1

3D Graphics

The first week we begin developing 3D Virtual Reality Environments. We will cover the basics of 3D graphics, including a number of 3D engines and development environments that you can use. We will particularly focus on the Unity3D engine.
(16 videos, 7 readings, 3 practice quizzes, Graded: 3D Graphics)

Week 2

VR Graphics

In this module we continued on learning about 3D graphics, including how to use transforms to lay out a 3D scene and how to use materials to give your objects a distinctive appearance. We also submited the first draft of your project.
(16 videos, 4 readings, Graded: VR Graphics Quiz Graded: Content Creation Work in Progress)

Week 3

VR Audio

In this week we learnt about using sound in Virtual Reality and how we can use advanced 3D Audio techniques to enhance one’s experience.
(14 videos, 2 readings, Graded: Audio and Revision Quiz)

Week 4

Content Creation: What works in VR?
In the final week of the course, we put together everything we have learned to think about how to create compelling VR worlds. We will start by looking behind the scenes at how 3D graphics hardware works and why VR can be so demanding of computing power. Then we will think about the particular requirements of content creation for VR. You will finish by submitting the final version of your project for a peer review. (11 videos, 5 readings, 2 practice quizzes, Graded: Creating VR Environments Project)

1.3. Synopsis

In this report, I have included my learnings throughout the 4 weeks of this course. I have also included the project that I completed as a part of this course in this report. The Online course "3D Models for Virtual Reality" provided by University of London, through Coursera was very Informative towards the field of VR development. Before taking up this course I had a little knowledge about creating a virtual reality. I would even say I had some misunderstanding regarding the topic. For instance, I did not know what tools were used to make a virtual environment.

I got to learn the basic of 3D modelling. During this course I was given a project to build a 3D environment using the Unity tool and I chose to replicate my hostel room. I learnt how to use the platform to make an interactive space. I learnt about animation and sound to. I also implemented sound in my project. Each week had either a week quiz or a peer graded assessment. So, I got a chance to see other peoples' creation too and grade then on the given criteria. On a whole it a an interactive course.

CHAPTER 2 SKILLSETS

2.1. Before the training

i. I had a little knowledge about the virtual reality sector. I did not know how to make the environment or even which software is used for the same.
ii. I had the knowledge of coding in C and C++.
iii. I knew what 3D objects were but did not know their fundamentals.
iv. I had learnt a little bit of graphic designing and how to use colors and shapes.
v. I did not know how sounds worked in virtual environment or how they are used for different objects.
vi. I had not taken up any courses related to VR in my university yet.

2.2. Knowledge acquired from the training.

Unity is the world's leading platform for creating and operating interactive, real-time 3D content, providing the tools to make amazing games and publish them to a wide range of devices. The Unity core platform enables entire creative teams to be more productive together. The engine can be used to create three-dimensional (3D) and two-dimensional (2D) games, as well as interactive simulations and other experiences. The engine has been adopted by industries outside video gaming, such as film, automotive, architecture, engineering, and construction.

Learning To Use A-Frame: A-frame is a web-framework for developing VR Apps. It allows you to publish VR experiences on the web. If you are a web developer the framework will be familiar but it might be a steep learning curve if you have not done web programming before.

Learning Unity: Unity3D is the main engine we will be using for this course. It is accessible enough for it to be a great place to start developing VR content, but it is a

professional engine used by a large proportion of VR studios, which can achieve a lot of high end graphics effects. One of the best things about unity is the documentation and community that will support your learning. The interface and essentials tutorials are a good starting point and there is a dedicated set of VR tutorials. If there is a specific feature you need to learn about you can refer to the manual.

If none of this help there are a lot of community forums where you can ask questions of experienced unity developers. One of the best places to start looking for 3D objects is the unity asset store. You can filter your search by 3D meshes. The VR Samples project is a great starting point for working in VR. The Asset Workflow section of the manual explains how to import your own assets.

Transforms and Cameras: Transforms are introduced in the Game Objects tutorial. These manual pages explain the transform component. Cameras This tutorial goes into depth on Unity Cameras. And this is the manual page. Setting up Unity for your device This section will guide you through setting up unity for the device you will be using to run VR, which will either be a PC or a mobile device. This will involve 2 steps: install additional software needed to run the device set the builds settings to the correct device. You access from the File menu->Build Settings and they allow you to choose different software platforms.

The Graphics set of tutorials provide a lot of resources. The rendering and shading tutorials cover a lot of the same materials as we have in the last few lectures.
Lights This tutorial explains the basics of lights. The lighting tutorials go into a lot more detail than we could explain in this course. This page describes the different types of lights you can use.

Learning More About Audio in Unity: As usual, the best place to start with learning unity audio, is with the tutorials page and the manuals. You might also want to find audio files to use in your projects. If you are doing so it is very important that you use audio that you have the rights to. You can find audio on the Unity Asset Store.

Unity Shaders: Shaders are programs that run on the GPU and perform a lot of the graphics operations. Unity includes some very powerful shaders, that can create very impressive graphics effects. This section of the manual explains how they works and how to use the built in shader to best effect. Another excellent option is the renderer that valve used to develop their "Lab" demo. It is available on the asset store. Off the shelf shaders will probably do most of what you need.

Techniques for Optimizing a VR Experience: Unity has an excellent page drawing together resources on how to improve the performance of your VR experience. This includes anti-aliasing, which is mentioned an is an important way of improving the appearance of your scene and avoiding artefacts that can cause discomfort. The Oculus Rift best practice guide also includes some very useful advice about what techniques to use.

I was able to fulfill the following requirements for the project:

- You should have a brief description of your scene.
- This description should give instructions.
- The description should give any restrictions on hardware needed to run the scene.
- The scene should contain several 3D objects,
- The object should be arranged with transforms to form a scene.
- The scene should be viewable in VR.
- The objects should have materials including textures.
- The scene should be scaled appropriately for VR.
- The scene should have appropriate lighting.
- The project should represent a real or imaginary scene.

2.3. Self-Evaluation

To be honest I feel like I have learnt something very important through this course. Mainly because it was a topic that I had not learnt about in my regular classes. I had only learnt a little about VR in Human and Computer Interaction course. But it was on a surface level. In this course I got a chance to experience the making process of the VR environment although in a small scale. Still, I got to learn about a new game engine called Unity which has been used to make so many VR environments and games. It feels good to know on which game engine your favorite game was made and even use it.

I was given a project to create a simple scene that could be real or imaginary. I decided to replicate my hostel room. Even though it was a simple project I got to know the importance of lighting, detailing, positioning and textures which I had no knowledge of before. I got to experience what actual developers go through day and night. Also, before this course I had a little knowledge about sounds in the virtual world. I got a chance to play around with it. I also added a sound file in the scene I created. I also got to see work of other fellow learners and got to see how creative people can be. I also got to score their project which helped to critically analyze the scene and develop an observant nature.

CHAPTER 3 FINAL PROJECT (APPLICATION)

3.1. Description

Here is the project that I completed:

HOSTEL ROOM

Description and Instruction

- Here I have tried to replicate my hostel room.
- It is a room for 3 people.
- It has 3 beds, 3 tables, 3 chairs, 1 clock, 1 table lamp and an open shelf.
- I have also made walls and door to give a room like feel.
- I have added chairs, clock, and lights in week 3-4 of this course.
- While entering from the door on your left you have 1 bed and, on your right, you have the open shelf.
- Further ahead you have 2 beds on your either sides and you can see 3 tables and chairs next to each bed.
- Straight on the wall you can see a clock and I have added a ticking sound in the clock.
- The table lamp has a point light, it is in the corner so you can see it emitting light.
- You can see all the materials(including textures) I have created/used in the Assets.
- Here upon opening you can select “SampleScene” in hierarchy to view my work.

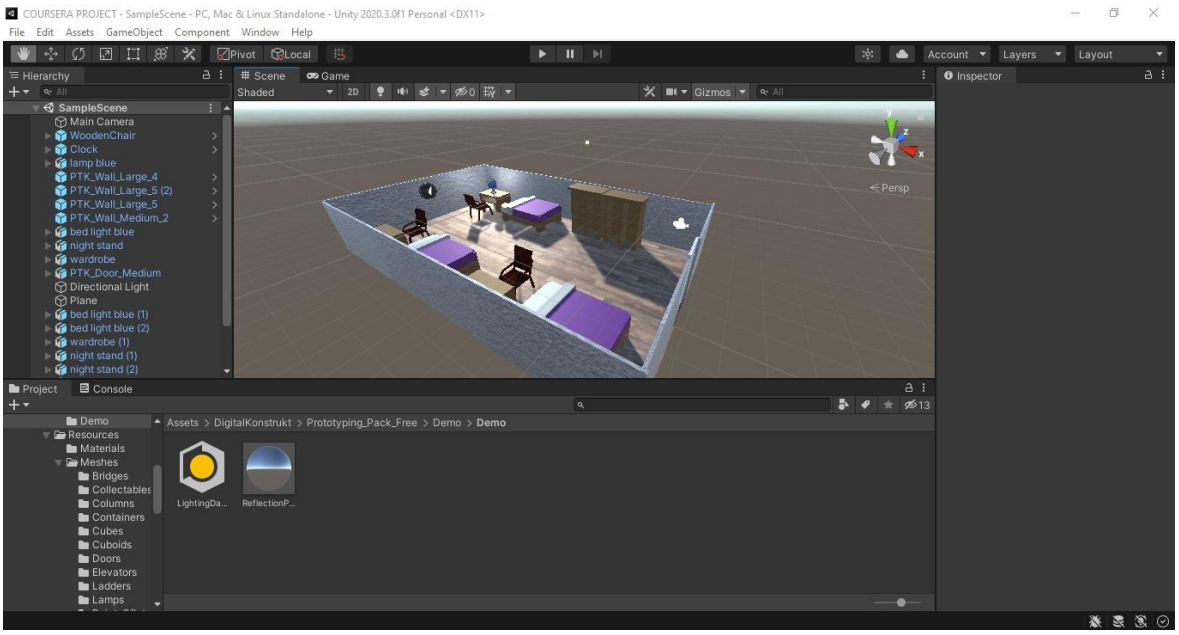


Figure 1: Hostel Room (Project)

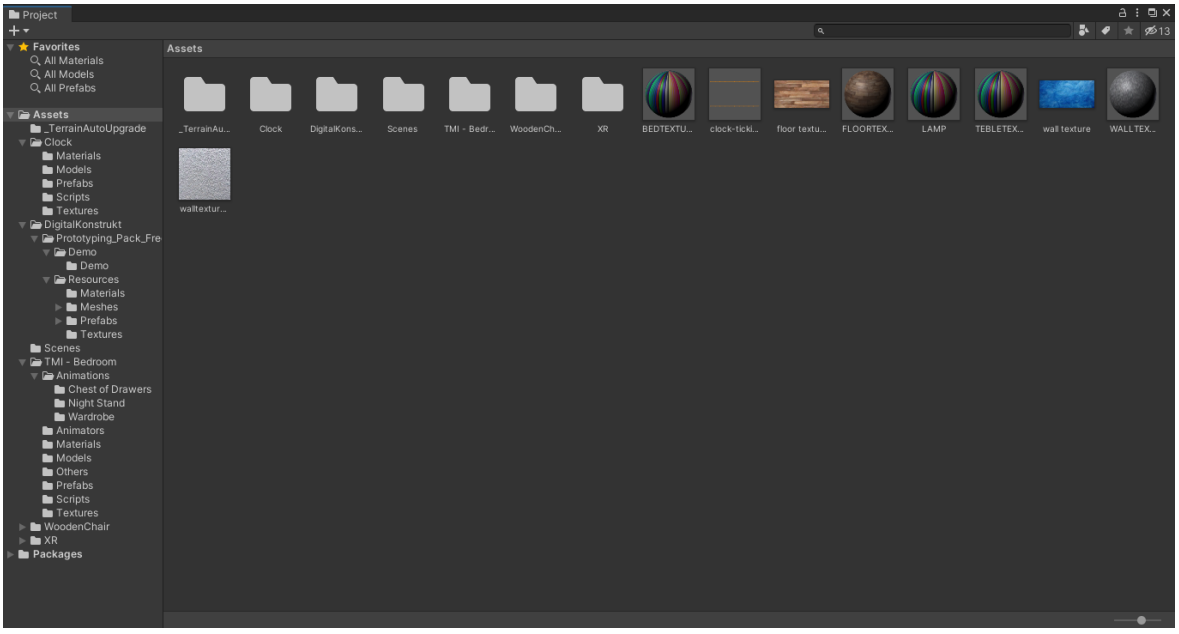


Figure 2: Assets

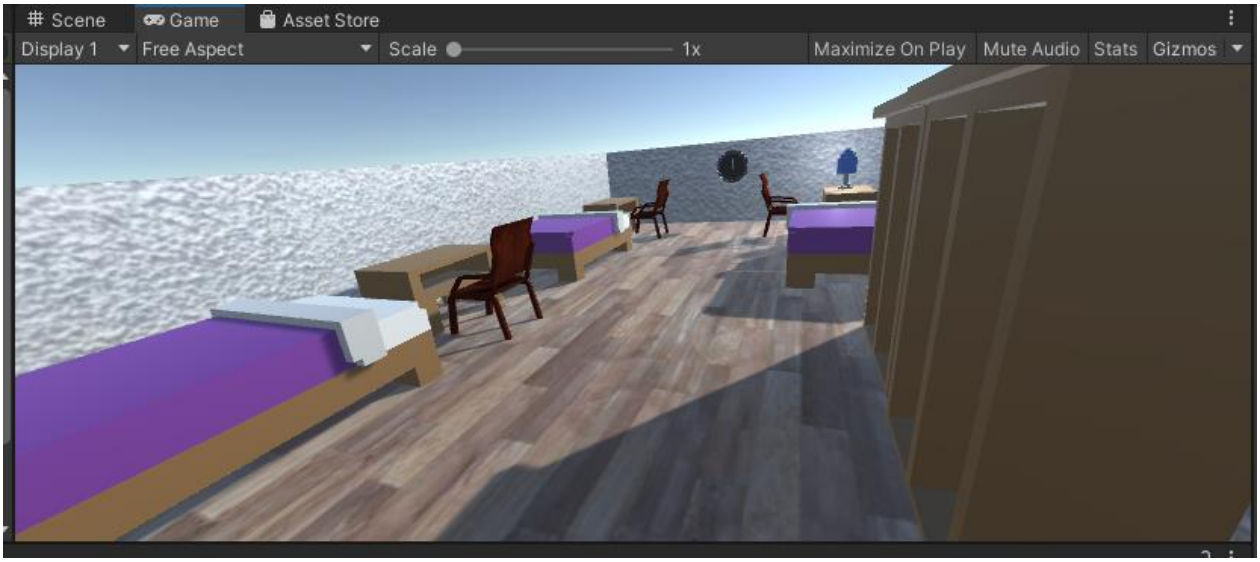


Figure 3: Camera View

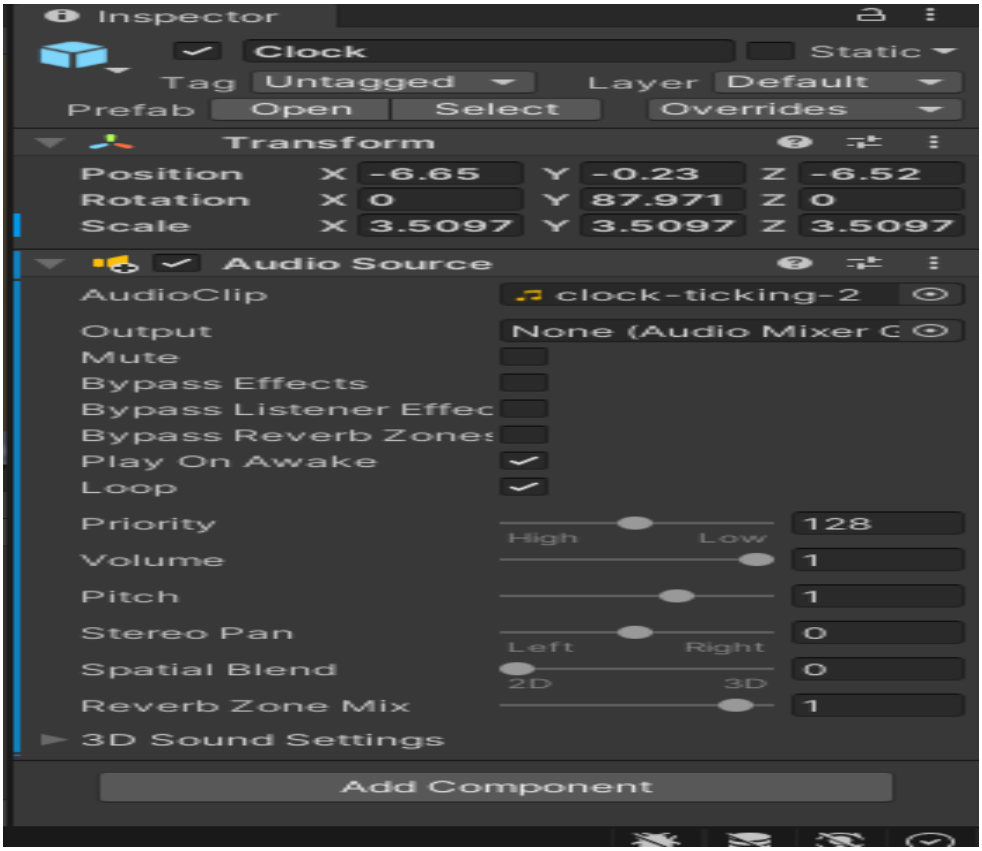


Figure 4: Clock audio

CHAPTER 4 DAY TO DAY ACTIVITIES

4.1. WEEK 1

DAY	TOPIC	DESCRIPTION
1	Introduction to 3D Graphics	This was the first session of the course. Here a brief introduction was given about the course. Also, a practice quiz was taken to check my skills for VR work.
2	Introduction to 3D Graphics	Here I learnt the basics of the 3D graphics.
3	3D Engines	Here I was introduced to Integrated Development Environment (IDE) for virtual reality. A- Frame and Unreal are the two engines that I learnt about in day 3.
4	3D Engines	In day 4 I learnt about Unity which is the main tool that is used in this course. I also downloaded Unity and set it up in my windows 10 environment.
5	Components of 3D Graphics	In this session, I learnt what is 3D space. I learnt about the interface of Unity. I learnt what are objects and meshes in Unity.
6	Components of 3D Graphics	Here I learnt about the 3D Assets. How to create an asset and also how to find the required asset in the asset store of Unity and importin assets into your project.
7	Starting Project	Firstly, I gave a quiz on 3D graphics. After that I was given briefing about the project that I had to work on during this course.

Table 1: WEEK 1

4.2. WEEK 2

DAY	TOPIC	DESCRIPTION
8	3D Graphics in VR	This was the first session of week 2. Here a brief introduction was given about how we can use the 3D graphics to create a virtual environment.
9	Transforms and Cameras	Here I learnt what does Transforms mean in context to Unity and what are compound objects. I was learnt how to position those object in the environment.
10	Transforms and Cameras	Here I was introduced to cameras in Unity. How to set them up and also how to move them around according to our need. I learnt how to keep my Unity project in VR mode such that it can be viewed like a virtual environment.
11	Transforms and Cameras	In day 11, I learnt about Keyframe Animation. And how is it possible to create a keyframe animation in Unity.
12	Materials and Textures	In this session, I learnt what materials is in Unity. I also learnt how to insert different types of light in the environment and make them work. I learnt to change lights intensity if required.
13	Materials and Textures	Here I learnt about the Textures and Graphics in Unity. Texture are very important as they give the feel of an object being real in a virtual world.
14	VR Content Project: Work In Progress	On day 14 I upload my half completed project as the course included checking how much I have learnt and what can I create knowing the knowledge that I have received up to this point.

Table 2: WEEK 2

4.3. WEEK 3

DAY	TOPIC	DESCRIPTION
15	VR Audio	This was the first session of the week 3. Here a brief introduction was given about the audio.
16	VR Audio	Here I learnt what the sound is and how we humans perceive the sound.
17	VR Audio	Here I was introduced to the concept of digital audio. I also learnt how the sound was useful in creating a real-life experience in VR.
18	VR Audio	In day 18 I learnt about how to use sound in VR environment and also what are filters and how to use them.
19	Components of 3D Graphics	In this session, I learnt what all audio formats are appropriate to use in Unity. Also, I learnt how the source of audio and position of listeners can be crucial in VR.
20	VR Audio	Here I learnt about the audio effect in Unity. I learnt what are audio clips and what are audio files. I also learnt what audio mixers are in Unity.
21	VR Audio	I gave a quiz on VR Audio. And there was a short revision of the concepts learnt.

Table 3: WEEK 3

4.4. WEEK 4

DAY	TOPIC	DESCRIPTION
22	The VR Graphic Pipeline	This was the first session of week 4. Here a brief introduction was given about the task to be completed in week 4. I also learnt about polygons to pixels.
23	The VR Graphic Pipeline	Here I learnt the basics of motion to photon and I also learnt about global illumination.
24	The VR Graphic Pipeline	In day 24 I learnt about Unity Shader. I also learnt the importance of lights and shadows to give a realistic experience to the user. I finally learnt what techniques work in VR.
25	Creating VR Content	Here I learnt why do we need different graphic techniques for VR and what are the techniques for optimizing VR experience. In this session, I gave a practice quiz. I also learnt some more concepts that can be used in Unity.
26	Creating VR Content	Here I learnt about Unity Resources. Unity resources are easy to access. Also the community of developer in Unity are helpful so that whenever one is tuck we can always seek out help.
27	Creating VR Environment: Final Project	Here I received final instructions for the project. I completed the project and uploaded it. It was a peer graded assessment so my project was evaluated by other students. I was evaluated 3 projects. I got a chance to see what other had made.

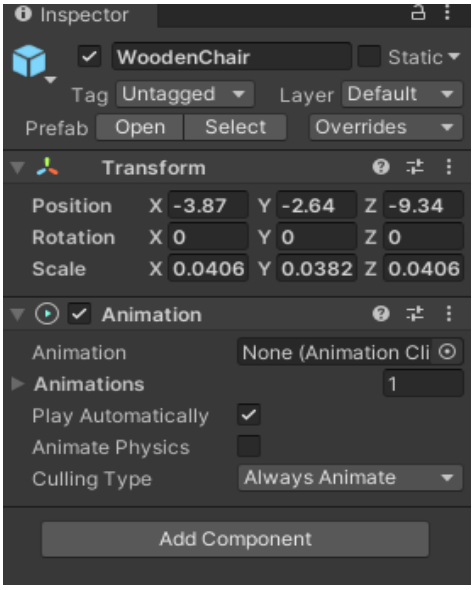
Table 4: WEEK 4

APPENDICES

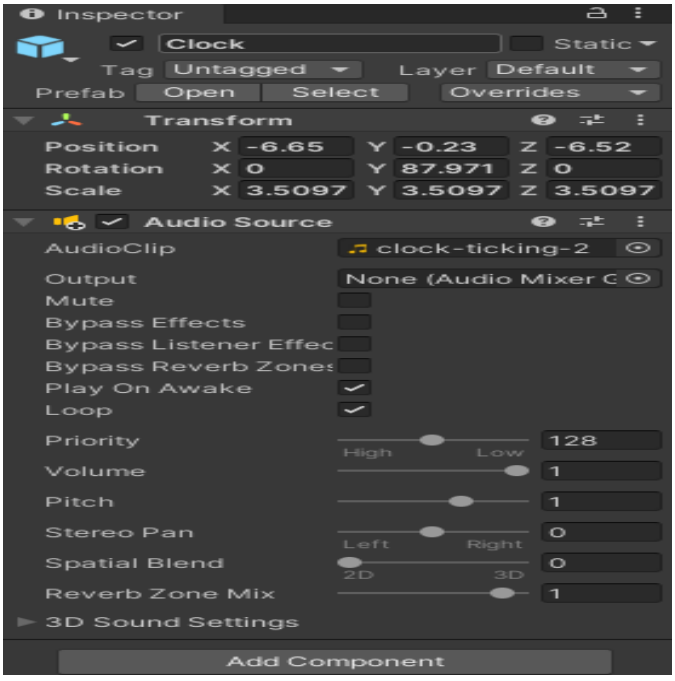
Appendix 1: Assets Details

I used various assets for my projects which would be too lengthy to include in main report so I am including them here.

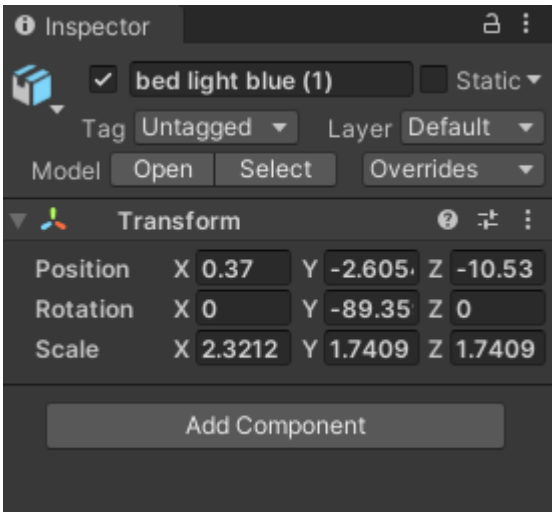
- Wooden chair.



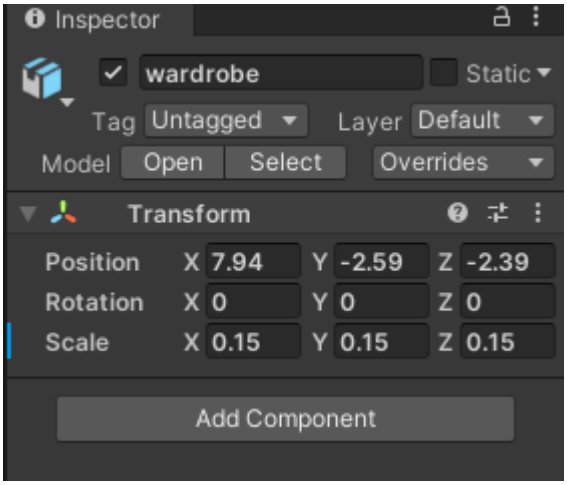
- Clock



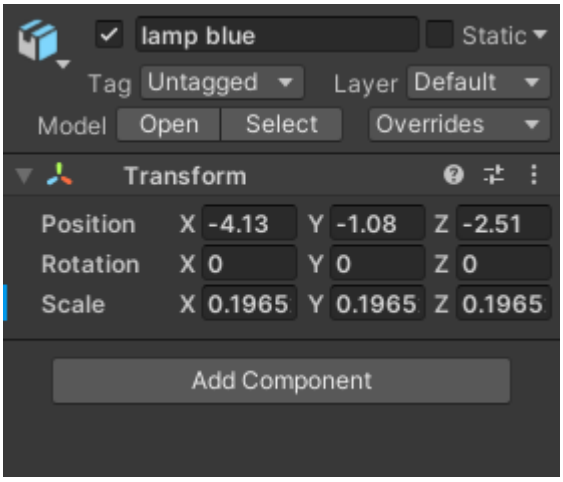
- Bed



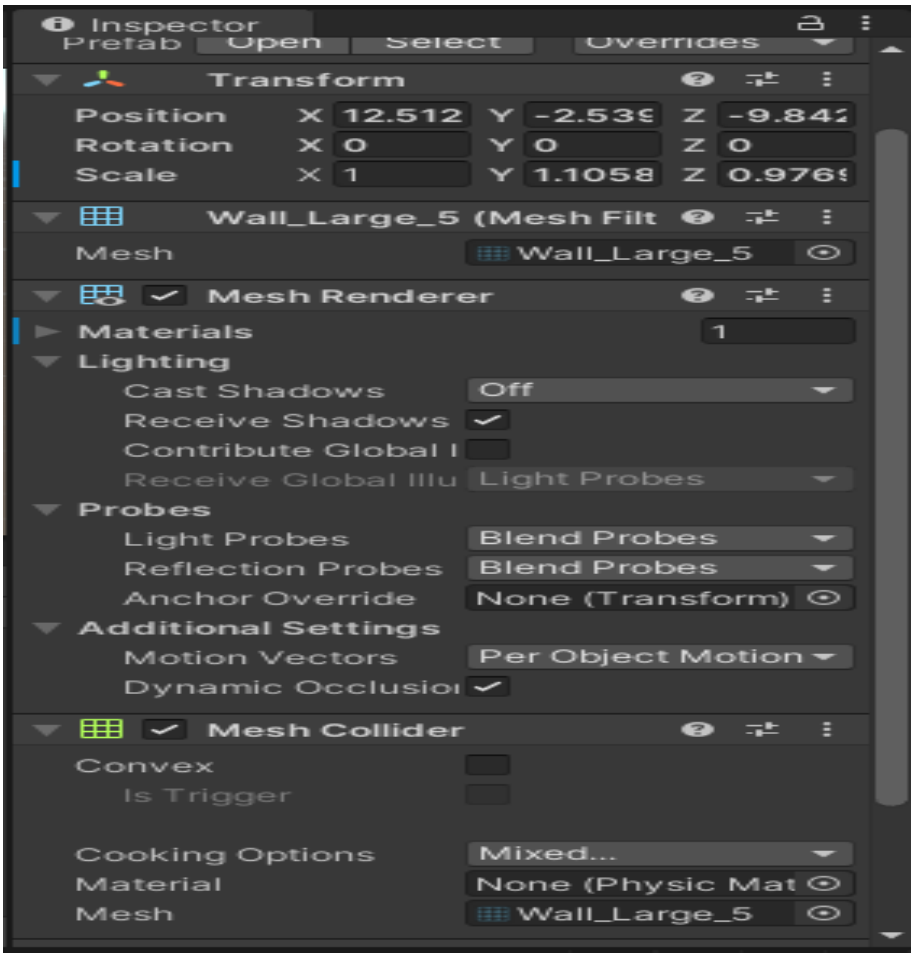
- Wardrobe



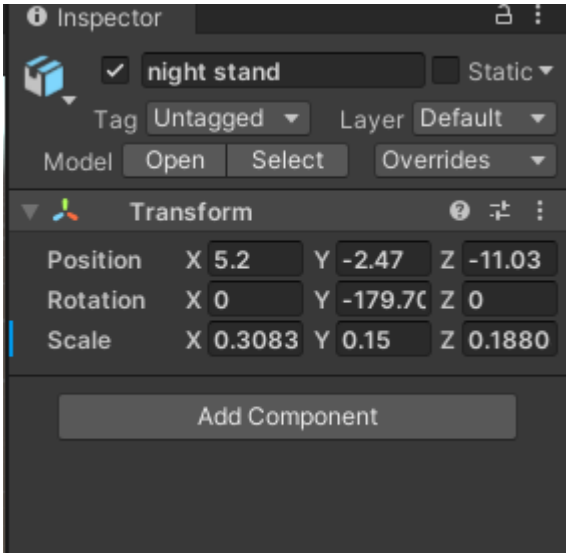
- Lamp



- Wall

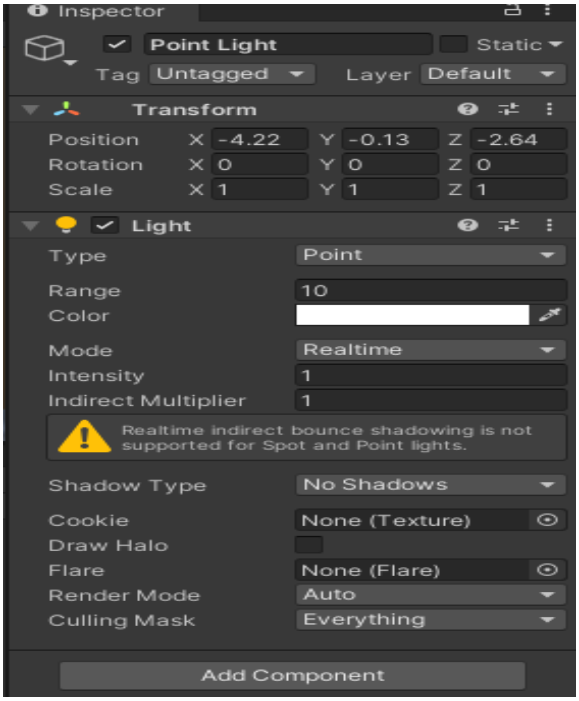


- Nightstand (table)



- Door

- Point Light(for lamp)



CONCLUSION

With this internship course 3D Models for Virtual Reality, I got an opportunity to learn about different kinds of VR development engines mainly Unity. I also got to learn about the importance of factors like lighting, shading, texture, audio, etc to make an effective VR environment. With so many examples explained by the trainer it made me understand each topic in this course more in depth. I also got to work on an actual project which helped me gain the experience an understand what professionals use. Even though this course is not directly related to my current curriculum, but I believe the knowledge I gathered from this course will be beneficial for me in the coming days for courses such as game programming.