Building Virtual Realms with Unity: An In-Depth Look at VR Game Development

Mohammed Moin Ahmed[1], Ashik S[2], Jeevan T[3], Faeez Ahmed Khan[4] and Dr. S Tamilarasan[5]
[1,2,3,4]*Student, Department of Information Science and Engineering, HKBK College of Engineering, Bengaluru, India*
[5]*Professor, Department of Information Science and Engineering, HKBK College of Engineering, Bengaluru, India*

***Abstract*— Games are being created, produced, and played in ways that are being revolutionized by virtual reality (VR). In-depth discussion of VR game production with Unity, one of the most widely used game engines for producing immersive VR experiences. The process of creating virtual worlds in Unity is described in depth in this article, along with the creative and technical obstacles encountered and the solutions that were used. The original idea design, the use of Unity's VR-specific tools and assets, and the usage of scripting to build interactive features are important subjects to cover. The study delves into the particular factors that need to be taken into account for VR user interaction, including motion controls, spatial audio, and user interface design. In addition, a case study of a particular VR project is used to contextualize the development process and illustrate the methodical approach that was used to make the virtual world come to life. The results show that Unity offers a feature-rich and flexible VR game creation environment. However, VR game design necessitates a specific focus on user comfort and immersion, among other details. In conclusion, the study offers recommendations for future developments in the industry as well as insights into best practices for developing virtual reality games.**

***Index Terms*— Virtual Reality, Unity, Game engine, Game Design, VR Game Development.**

1. INTRODUCTION

These days, virtual reality is recognized as the technology that makes it possible to substitute the artificial world for the real one, giving users the impression that they are in a different one [1]. Virtual reality games are the most representative kind of application that can actually make someone feel that way. Therefore, there are many similarities between virtual reality and digital games. The two most significant ones are that they both capitalise on technological advancements in a variety of fields, including computer power and electronics, and they both concentrate on producing the most lifelike 3D environments.

My contribution to this article aims to assist someone who has never created a VR game in selecting the finest game engine while also increasing awareness of this field due to the increased demand for this technology. In addition, I will outline the procedures required to create a basic virtual reality game using an example to demonstrate how simple it is to build in virtual reality.

2. OVERVIEW OF VIRTUAL REALITY

Virtual reality (VR), often referred to as virtuality, is a technology that allows us to experience a variety of virtual worlds through our computers—worlds that don't really exist. To put it another way, virtual reality also depicts a convincing, interactive 3D computer-generated environment that users can explore and engage with, giving them the impression that they are actually there.

In other words, virtuality represents a world that is:

- Computer-generated: This component of the equation is crucial to creating a 3D world because only powerful computers can enhance immersion and believable VR experiences.
- Believable: In order to create a convincing VR experience, users must truly feel as though they are in the generated world; otherwise, the illusion of virtual reality will disappear.
- Interactive: In order to replicate the actual world, virtual reality users should be able to engage with the objects that make up the computer-generated

environment; this will ensure that the experience is satisfying.

- Immersive: Virtual reality needs to engage users' bodies and minds in order to ensure a strong link between believable and interactivity. Virtual reality (VR) has several limitations at the moment, despite its promise of being an extremely accurate substitute for the actual world in terms of smell, feel, and taste.
- Explorable: The VR should provide us the same degree of flexibility to investigate our surroundings as the real world does. Stated otherwise, the VR scene need to incorporate a same degree of intricacy and minutiae as the actual world.

At the same time, there are several types of Virtual Reality:

- Fully immersive: A VR experience requires three key components to be fully realized. First, a very intricate and detailed computer-generated universe. Second, a strong computer that can adapt the experience to our destination and understands where we are going. Third, the virtual environment is created virtually by hardware additions such as sensory gloves, stereo sound, and head-mounted displays.
- Non-immersive: virtual reality can include, for instance, a very lifelike computer driving simulator that makes use of peripherals like a large screen, surround sound headphones, and a realistic wheel.
- Collaborative: Virtual reality does not include games that just satisfy the following requirements: they must be computer-generated, convincing, interactive, and explorable. Examples of such games are Second Life and Minecraft. In addition to all of this, strong player cooperation is essential for a satisfying virtual reality experience. This is a significant trend that virtual reality is likely to follow in the future.
- Web-based: Virtual reality (VR) was one of the fastest-growing technologies in the late 1980s and early 1990s, but its appeal has decreased due to the widespread use of the World Wide Web. The majority of people were far more interested in the new ways the Web gave them to access real reality, such as new ways to find and publish information and share ideas and experiences with friends through social media, than in the virtual worlds that computer scientists had created on the Web. Given Facebook's increasing interest in VR, it appears that Web-based and collaborative VR is the way of the future.
- Augmented Reality: This technology is an amalgam of the real world and virtual reality. AR essentially refers to the insertion of interactive holograms into the physical environment. Spatial tracking sensors enable all of this, moving the holograms in accordance with the user's movements.

3. NECESSARY HARDWARE FOR VIRTUAL REALITY

To enable everyone who wants to explore the realm of virtual reality, a particular set of hardware attachments is required.

The group described above may include:

- Head-mounted displays comprise two tiny screens, one for each eye, a material to block out light from the outside environment, and a pair of stereo headphones meant to let users feel aware of their surroundings.
- Immersion rooms, an alternative to head-mounted displays, are spaces equipped with specialized projectors that transform the walls into interactive displays. This state-of-the-art space also has a series of specialized sensors that can follow individuals within, allowing the projected visuals to move in tandem with their movements.
- Data-gloves, which allow users to interact with virtual items and enhance the lifelikeness of the experience. With this technique, regular gloves are fitted with incredibly complex sensors.

4. USES OF VIRTUAL REALITY

We may claim that virtual reality has a very wide variety of purposes, from education to medicine, because it can imitate real-world circumstances.

4.1 EDUCATION

For example, learning to pilot an aircraft might be extremely risky for someone who is not experienced. However, in recent years, as virtual reality technology has advanced, an increasing number of flying schools have begun to employ these simulators, which has made learning to fly safer. Students may also pick up

difficult moves more quickly because no lives are at danger.

4.2 SCIENCE

With virtual reality (VR), scientists may naturally visualize their work without the need for instruments like microscopes or computer displays. Because they can see the finished product being used in the actual world thanks to augmented reality technology, it also facilitates their ability to prototype quickly. The University of North Carolina launched the first experiment of this kind in the 1960s under the name "GROPE," which examined the interactions between medication and protein molecules.

4.3 GAMES AND ENTERTAINMENT

VR has grown more common than the other categories stated above when it comes to gaming and entertainment. Virtual reality is developing more quickly in these sectors than in others at the same time, mostly due to increased demand and the ease with which these kinds of applications may be created.

4.4 MEDICINE

With the release of the daVinci surgical robot in 2009, virtual reality has found more applications in the medical field. Essentially, this robot consists of two arms that can be remotely operated by a surgeon using specialized virtual reality technology. This enables surgeons who are located in various locations to participate in a more intricate procedure and work together to solve the issue.

5. VIRTUAL REALITY IN GAMING

Due to the increased demand for virtual reality games in recent years, an increasing number of businesses have begun to invest in creating specialized devices for this technology. Oculus Rift and HTC Vive are now the two major rivals in the VR gaming market. Figures 1 and 2 show a graphic depiction of them.

A part of Facebook Inc., Oculus VR developed and produced the virtual reality headgear known as the Oculus Rift. The publication date was March 28, 2016. This gadget features a Pentile OLED display with a 110 degree field of view, 90 Hz refresh rate, and 1080x1200 resolution for each eye. It also has a set of headphones that are adjusted to produce a 3D sound experience. Two ergonomic controllers and a positional tracking system are further features of the Oculus Rift.

Fig. 1. Orculus Rift Headset

Another VR headset created by HTC and Valve Corporation is the HTC Vive, which debuted on April 5, 2016. With the exception of allowing users to walk throughout a broader area, it is nearly identical to the Oculus Rift in terms of hardware accessories.

Fig. 2. HTC Vive Headset

Many well-known businesses have already created an amazing selection of virtual reality games using all this technology. Some of the titles include:

- Oculus Rift: Eve: Valkyrie, Lone Echo, Wilson's Heart, The Unspoken, Feral Rite, etc.
- HTC Vive: Fallout 4, Arizona Sunshine, Superhot, Project Cars, L.A. Noire, The Gallery, etc.

6. VR GAME DEVELOPMENT

One of the game engines that completely support VR technology—Unreal Engine, CryEngine, AppGameKit VR, libGDX, ApertusVR, Torque3D, Urho3d, CopperCube, and Skyline—should be considered by developers looking to create VR-ready games. From the aforementioned list, Unity, Unreal Engine, and CryEngine are three of the most widely used VR game engines. From the list above, Unity appears to be the best game engine for someone who is brand new to the VR gaming scene. As we proceed

through this chapter, we'll talk about the advantages of the Unity game engine over others.

Unity not only offers its customers an intuitive and user-friendly UI, but also excellent tutorials and well-organized documentation that are readily accessible on the company's website. A newbie may also find it challenging to locate assets for their projects, however this game engine features an integrated Asset Store where users may share the items they have created.

The ability of Unity to create games across a wide range of platforms, including Oculus Rift, HTC Vive, Gear VR, Daydream, etc., is another benefit of utilising Unity over other game engines. All of the virtual reality systems that Unity supports are shown in Figure 3.

Fig. 3. Unity Supported Platforms

7. A QUICK INSIGHT INTO VR DEVELOPMENT

This article aims to demonstrate how the Unity game engine can be used to easily develop a simple VR game. The following lists the procedures required to create a simple 3D virtual reality maze where the player may travel ahead, stop, and turn left or right.

Initially, we will open a blank Unity project and import the Google VR for Unity plugins. The default camera object will then be removed, and GvrMain from the imported plugins will take its place. Next, as you can see in Figures 4 and 5, we added a skybox that we obtained from the Asset Store and a basic plane that we used as our ground.

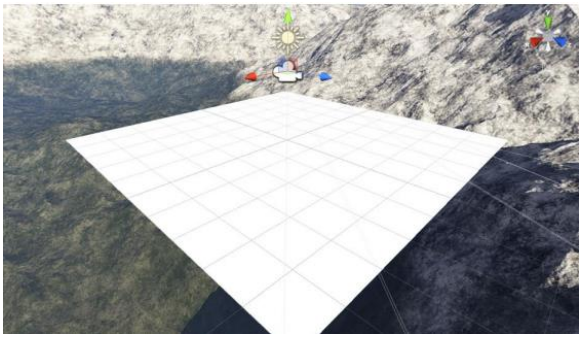

Fig. 4. Unity Scene View (plane and skybox)

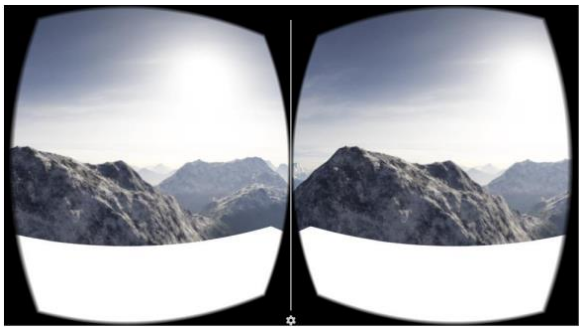

Fig. 5. Unity Game View (plane and skybox)

In order to construct the labyrinth, we first obtained a maze template from the Internet, which we then applied to the plane (see Figure 6). Next, we began building the walls (see Figure 7) by modifying the proportions of basic cubes in accordance with the template.

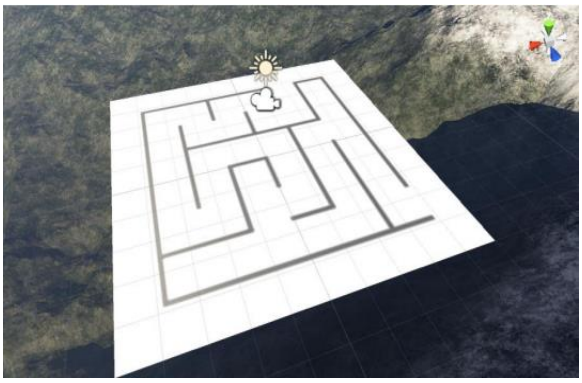

Fig. 6. Unity Scene View (plane, skybox and maze template applied)

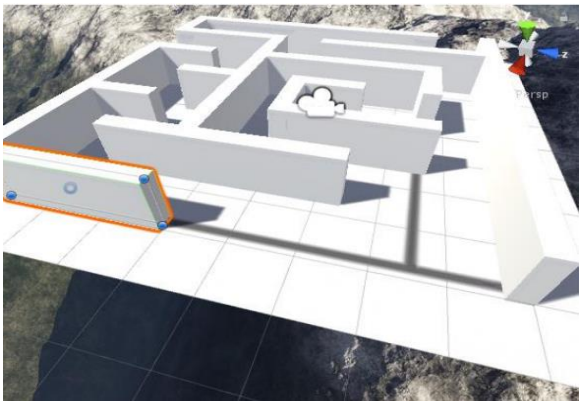

Fig. 7. Unity Scene View (plane, skybox and maze template applied with constructed 3D walls)

At the same time, we downloaded a grass texture from the Internet and we added it to the walls and the plane (see Figure 8).

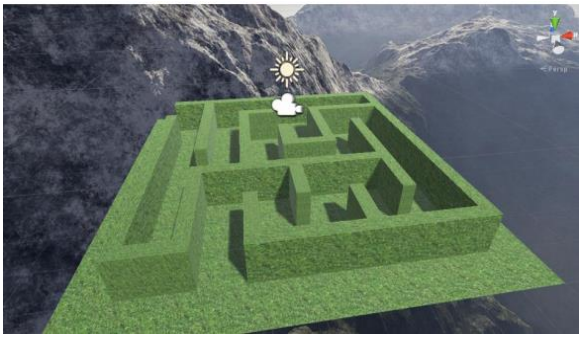

Fig. 8. Unity Scene View (the final maze scene)

To make it behave like a character, we next added a "Rigidbody", a Capsule Collider, and a C# Script called Controller to our GvrMain object (see Figure 10). The character now walks automatically and stops if it looks down. We have also implemented a script that stores the character's staring location, so after the player completes the maze, he will return to the beginning spot (see Figure 9). Figure 11 displays the project's finished product.

```
public class Controller : MonoBehaviour {

    private bool walking = false;
    private Vector3 spawnPoint;

    0 references
    void Start () {
        spawnPoint = transform.position;
    }

    0 references
    void Update () {
        if (walking == true)
        {
            transform.position = transform.position + Camera.main.transform.forward * 0.5f * Time.deltaTime;
        }
        if (transform.position.y < -10f)
        {
            transform.position = spawnPoint;
        }

        Ray ray = Camera.main.ViewportPointToRay(new Vector3(0.5f, 0.5f, 0));
        RaycastHit hit;
        if (Physics.Raycast(ray,out hit))
        {
            if (hit.collider.name.Contains("plane"))
            {
                walking = false;
            }
            else
            {
                walking = true;
            }
        }
    }
}
```

Fig. 9. C# Script for Character movement and reset

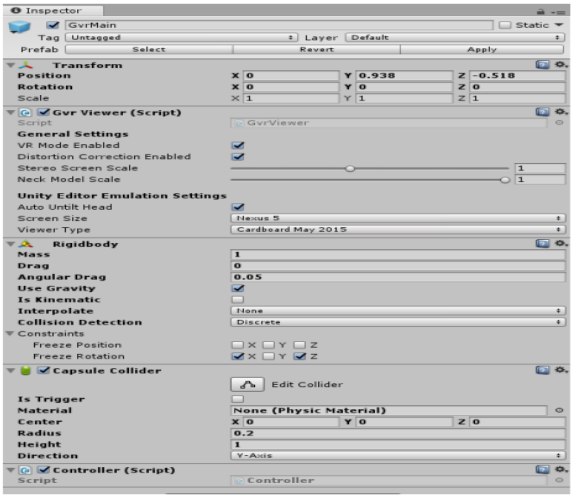

Fig. 10. The Components added to the Character in the Inspector panel

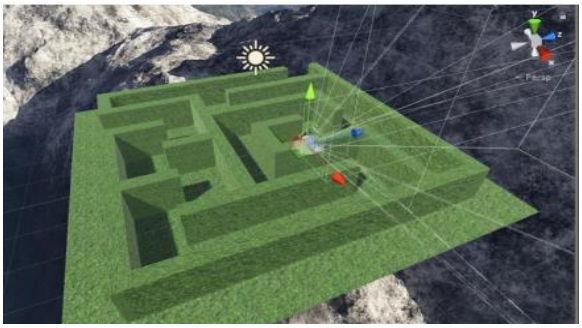

Fig. 11. Unity Scene View Final Result

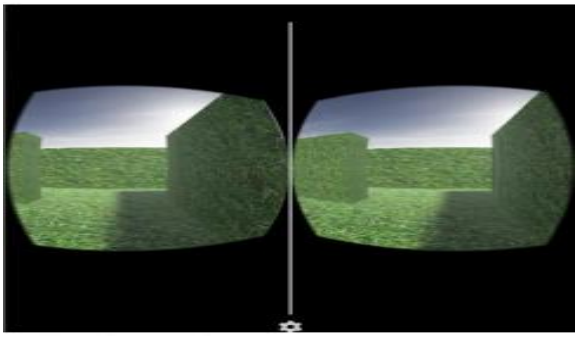

Fig. 12. VR Unity Scene and Game View Final Result

8. CONCLUSION

In this paper, we come to the conclusion that virtual reality is a potent tool that individuals may use to their advantage by enabling them to produce incredible projects. Because of its ease of use, ease of learning curve, and well-organized documentation on its website, the Unity game engine is a great place for anybody interested in starting to design a virtual reality game. It is also more approachable because of the widespread community support it receives from third parties due to its popularity.

ACKNOWLEDGMENT

We are profoundly grateful to our guide Dr. S. Tamilarasan for his expert guidance and continuous encouragement throughout to see that this project rights its target. At last we must express our sincere heartfelt gratitude to all the staff members of Information Science and Engineering Department who helped us directly or indirectly during this course of work.

REFERENCES

[1]C. Cruz-Neira, M. Fernandez and C. Portales, “Virtual Reality and Games,” ResearchGate, May 2018.

[2] P. Bouvier, F. Sorbier, P. Chaudeyrac and V. Biri, “Cross benefits between virtual reality and games,” ResearchGate, May 2018.
[3] N.R. Raajan and S. Gayathri, “Augmented Reality Based Virtual Reality,” International Conference on Modeling, Optimization and Computing, Tamil Nadu, India, 2012, pp. 1559-1565.
[4] L. Chen and H. Lin, "Virtual Reality Game Development with Unity: A Comprehensive Review," 2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR).
[5] J. Lee, J. Kim, and D. Lee, "Unity and Virtual Reality: A Survey of Game Developers," 2020 IEEE Conference on Games (CoG).
[6] M. Smith and K. Johnson, "Unity VR Game Development: Design, Implementation, and Evaluation," 2021 International Conference on Cyberworlds (CW).
[7] A. Jones and B. Smith, "Exploring Virtual Reality Game Development with Unity: A Comparative Analysis," 2022 International Conference on Game Development and Interactive Entertainment (GDIE).
[8] E. Garcia and F. Martinez, "Interactive Storytelling in Virtual Reality: Unity Game Development Techniques," 2020 IEEE International Conference on Virtual Reality (ICVR).
[9] G. Wang and H. Zhang, "Immersive Gameplay Design for Virtual Reality Games in Unity," 2023 IEEE Transactions on Games (ToG).
[10] H. Kim and I. Park, "User Experience Design in Unity-Based Virtual Reality Games: Challenges and Solutions," 2021 International Conference on Human-Computer Interaction (HCI).