

## 3D Zombie Hunting Game using VR

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**Abstract** – A first-person shooter game with full shooting is called 3D VR Zombie Hunter. The game's setting will be a 3D indoor environment model, which will be created in accordance with the game's specifications and improve the appeal and realism of the setting. The mapping of the VR-Box joystick is used in this game to assist with shooting, reloading, and player movement. The joystick has a total of 6 buttons, including the major 4 buttons and a joystick that can be moved 360 degrees. The game's shooting and reloading functions are performed by the supporting 2keys. The addition of a joystick will make the VR-Box experience even more maneuverable. Bluetooth will be used to link mobile head sets and joystick buttons for long-range wireless connectivity and to activate key gaming features. The gadget will translate the joystick buttons you press to enable in game functionality. Players will have an immersive and interactive first-person shooter experience with the 3D VR Zombie Hunter game. Players will be able to direct the movement and actions of their virtual character in the game by using a VR-Box joystick with Bluetooth connectivity and a variety of buttons for various in-game tasks. The game will be more realistic and immersive thanks to the use of a 3D indoor environment model. It will be interesting to see how players' gaming experiences are improved by the joystick's mapping to the VR-Box and mobile headset.

**Keywords** – VR Game, Visualization, Virtual Reality, Three Dimensional (3D), First Person Shooter (FPS).

### I. INTRODUCTION

Video game development is a challenging task that requires a wide range of extremely technical tools and abilities. More researchers are now looking to 3D technology to advance the introduction of Virtual Reality because it has made significant strides in the last ten years.

The user can experience the reality of the product they are using through virtual reality. creating a zombie shooting game set in a post-apocalyptic world where researchers and scientists conduct research but, when something goes wrong, a virus is created that affects humans and turns them into

zombies who then attack humans. They prioritize killing people as their top priority. Now, as a soldier or player, you will try to eliminate those zombies so that we can stop the virus from infecting more people. It completely altered people's mental states, which led to the creation of zombies that tried to exterminate all living things. The user can accomplish the game's goals and take in the behind-the-scenes action thanks to the story. The user must defeat each foe in order to survive the wave and finish the level.

The game features the age - appropriate world scenario presented by other games in the genre, but by utilizing virtual reality, the player will be able to

immerse themselves fully in the game’s narrative and experience true graphics[1]. Because it may be difficult to render high-quality graphics on a mobile device while using virtual reality[5], we’ll use texture filtration and anti-aliasing scripts to reduce frame drops while maintaining overall visual quality of the game-play. High-end mobile devices with less lag and updating typically produce better results.

The rendered main camera is where all of the screen canvas objects for all of the Unity-developed apps are rendered. Each user’s eye has its own separate screen mode on the Google VR display[9]. In comparison to human eyes, the VR device offers two view points, each with a unique perception, simulating what the user would see in real life. The left and right eyes are rendered using the VR device to give the field a complete real-time experience. The device itself does not project the necessary information or graphics onto the screen. While holding the devices in a stand that is provided, the device transfers the image from the device display to the user using two different lenses. According to the user’s preferences and the settings where they find the display to be free of pixel distortion[7], the lens can be changed. The VR SDK splits the actual display into two screens that display the same thing, and when the two screens are viewed simultaneously through the two.

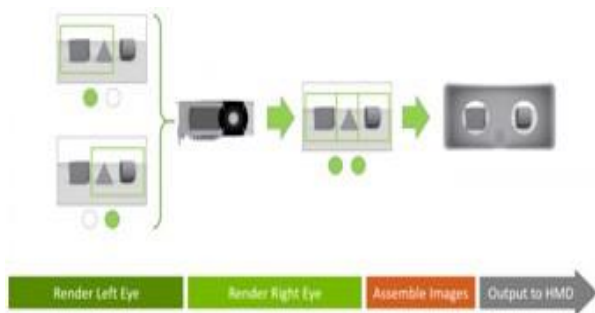


Fig. 1 Virtual Reality split display rendering lenses of the VR device, the user is given a full view and is made aware that the environment or scene is a virtual reality.

As soon as the basic prefab is imported into the Unity scene, the VR provides a basic prefab that is used in the game to render the main camera automatically.

Unity 3D was the best development tool for the project. Users with Play Developer accounts will have access to the project that is currently under development. Initial access to the app will only be through Android devices, but it will soon also be accessible through the Play Store and App Store. Our contribution in this paper describes how to combine a Google VR plugin and a basic FPS plugin built on Unity. Then, a VR-ready update was made to the generic display. The keyboard’s fundamental controls were subsequently changed to support the buttons on VR controllers and, in the future, Xbox controllers as well. The game does not support the on-screen keys because we eliminated them in favor of a joystick controller because VR was used.

We used the FPS plugin to reduce our initial effort on the project’s core functionalities. The plugins include a basic First Person character with a body connected and 3d animation weapons. Our entire project benefits from the plugin’s functionality[11]. The plugin allows users to project the game’s canvas onto a screen using a generic display. The plugin is designed to enable keypad control systems on a desktop for a typical game view. The plugin did not include built-in controls for smart phones, but it did include a keyboard for trying to control the necessary features. The plugin would include a first-person character with armaments and increased health and damage.

The paper is organised as follows: We provide a summary of the literature review on virtual reality in gaming and other domain in Section 2. Sections 3 discusses the theoretical and mathematical foundations of VR technology and results and conclude the paper in Section 4.

## II. LITERATURE REVIEW

Numerous virtual reality-based projects have been developed especially for android mobile devices. Virtual reality technology has advanced to the point where it can now support a range of human endeavors in recent years. Virtual reality is currently being used by military personnel to help them better understand and visualize the battlefield before. Juan Wu, et al. [4] discuss about this system is a first-person shooter, implements a number of interactive

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roaming features, including user-attacking enemies, key-switching weapons, enemies who automatically seek out users to attack, picking up equipment, etc. Process of VR game and technology development: Developed using the "Dotween" plug-in for animation and the Unity 3D platform. LOD technology to increase the effectiveness of rendering. Non-controlled indexing is known as INSPEC.

Muhammad Nabeel, et al. [1] Discuss about the implementation of Google VR, FPS plugin, and shooting game. A post-apocalyptic world where a serum to help people withstand harsh conditions was developed by a renowned scientist was used to create a zombie shooting game. Playing the zombies that were created as a result of an unknown reaction to this retinol in the atmosphere allowed the person's body to sustain the severe conditions but totally destroyed the psychological stage of the people, allowing them to encounter the behind-the-scenes and complete the game's objectives. To survive the wave and complete the level, the user must defeat each foe.

K. Nop, et al. [15] Discuss about the concept of affine transformations (ATs) is difficult and abstract. Audiovisual demonstration and repetitive knowledge application are achieved by encoding AT knowledge in Game Mechanics (GMs). By giving these GMs a serious game to play, knowledge can be learned in a way that is both engaging and efficient. The current study also assesses how well a debriefing system and improved audiovisual knowledge encoding work. The outcomes demonstrate that knowledge encoding in GMs is a successful method for achieving knowledge learning. According to the study, an improved audiovisual encoding has a minimal impact on learning outcomes and VR is advantageous for learning quality overall.

S. Kazempourradi, et al. [2] Discuss about a collection of teeny, inexpensive, standalone, wireless inertial motion sensor units is created. These sensor units are able to identify user gestures and provide comfort controls in game applications. Despite the widespread use of motion sensor units in numerous applications, we develop two VR

games using an Oculus Rift DK2 and a variety of detached, inexpensive controller units for the first time. In one application, the user can move his or her hands to steer a spaceship. The other game is a first-person shooter where aiming and shooting are accomplished using a variety of sensors.

Diego Monterio, et al. [3] Discuss about since there isn't a study of 2D or 3D HMD views, controllers, or their interactions, this is essentially a study of Head Mounted Display on First Person Shooting games. They set up to look into how different controller types and 2D and 3D views affected immersive VR first-person shooter gameplay. Daniel Hufnal, et al. [6] The authors looked at how playing FPS and strategy games in Virtual Reality (VR) differed when using a native VR controller versus a conventional game controller. The outcomes demonstrated that the two controllers in the strategy game were equally effective in terms of perceived sense of presence and UX satisfaction. The Oculus controller, however, received higher marks for feeling more natural in the first-person shooter game. The study emphasizes how video game input techniques have developed over time and how these changes have enhanced gaming experiences.

Farzam Kharvari, et al. [5] Discuss about the benefit of VR technology in architectural education is examined in this essay. This essay demonstrates how VR is advantageous for architectural education because it provides quick and affordable ways to learn about historical precedents. The player had to collect every cube in order to win the game, and the score was displayed on the screen.

Department of Digital Multimedia, et al, [16] discuss about the project that uses cutting-edge VR technology to enhance information visualization. A game's development and management data is used as the basis for the pilot study. Modern algorithms are used to develop data analysis algorithms in data cluster, data correlation, and data regularity checks. In this study, three-dimensional space is presented using the KMeans clustering algorithm, and then information visualization and virtual reality are linked. Information visualization is a method used to present data and its structure with

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multiple dimensions and attributes when it comes to large amounts of unstructured data. In this clustering analysis, this research suggested some benefits, such as: Highly immersion undiscovered data mining, an added dimension of space, intuition mode of operation, unlimited display area.

Huyen Nguyen, et al. [7] discuss about the idea of "immersive analytics," which entails using VR and AR to more interactively and intuitively analyze and visualize massive amounts of data. The authors demonstrate their system for interactive, immersive analytics that combines tools for clustering and decision tree construction with the visualization techniques of Star Plot and Star Coordinate. There are still some things that could be done better, like making the connection between graphs and nodes bidirectional. The study comes to the conclusion that three-dimensional visualization can significantly improve the analysis and abstraction of data by utilizing D3.js, WebGL, and Unity 3D software. The study combines information visualization with virtual reality to gather information about users, time, and game context while also providing a variety of data for quick decisions.

Lauren Carroll, et al. [8] discuss about they used a camera movement and device orientation in the Captain Carroll mobile virtual reality game. The wearable VR goggles for Captain Carroll make use of eye-tracking technology from Tobii Tech that is fully integrated. According to the user's eye direction, eye-tracking technology adjusts image quality; however, this setup is pricey and only functions with wearable VR goggles. In order to provide a seamless VR gaming experience, the authors suggested using camera movement and device orientation as triggers for procedural generation in a mobile VR environment. Panagiotis Drakopoulos, et al. [9] discuss about a cuttingedge method for mobile VR eye tracking that only makes use of the selfie camera on the headset. To reduce reflections from the headset lenses, the system improves the poor quality camera images and applies a pipeline of unique image enhancements. Realtime eye tracking is achieved by using the authors' efficient circle fitting algorithm to estimate the iris center and a calibration and gaze mapping

algorithm to translate the detected eye center coordinates to screen coordinates. Current smartphones can be used to implement their suggested method for iris detection and pupil tracking, which requires no hardware modifications. When the eyes are in the middle of the screen, preliminary results demonstrate that their front camera-based mobile eye tracker is precise and comparable to commercial VR headset eye trackers.

Shu-Yu Chen, et al. [10] discuss about a technique for reconstructing 3D eye gaze and facial expressions in real-time using VR glasses with infrared LEDs and cameras. The process begins by identifying feature points by taking pictures of various facial regions with three infrared cameras. The authors marked 57 feature points, including 14 in the eyes and 29 on the face, on the IR images of 30 subjects. Then, a multilinear model with 150 subjects and 47 expressions for each of them is used to reconstruct the 3D facial expression. The intrinsic and extrinsic parameters were obtained by the authors using a multi-camera self-calibration technique, and Google-Ceres was used to model and resolve complicated non-linear least squares issues. The technique is simple to use, accurate, and reliable, and it can be applied with inexpensive tools.

Kongdee Nop, et al. [15] discusses the effect of gaming software on conceptual frameworks in animation. The research team carried out an experimental project and discovered that the gaming software had an impact on the frameworks for the animation arts, creating a new processing pattern. The article also highlights the significance of polygon count and arrangement in 3D workflows by comparing the outcomes of 4 polygon models and 5 real-time rendering techniques. In this project, there are two distinct character design phases: pre-production and semi-production, and production and post-production. The creation of animation and 3D concept art comes from the second phase, which entails converting a 2D illustration to a 3D platform. The framework plays a crucial role in deciding the final traits of the character.

Ali Rastegar, et al. [12] discuss about the value of accurate audio in Virtual Reality (VR) games. The

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VR headset creates a realistic simulation of the user's physical presence in the virtual environment, along with sound and other components. The ability of the user to interact with and change the virtual world through input is a crucial component of VR and has been extensively studied, including in the area of art. Moving toward and looking around a sound source are both considered important forms of input in virtual reality.

Kohei Kanamori et al. [13] discuss about the authors suggest a VR navigation system that aids users in avoiding obstacles by figuring out a secure route to their destination automatically. Testing revealed that the system successfully offers a safe path without lessening the immersive experience of the VR content. The experiment's findings also showed that users' preferences for 6-DoF and 3-DoF degrees of freedom when using VR while moving around in real space varied.

Samira Yeasmin, et al. [14] discuss about Virtual Reality (VR) is becoming more and more common in the gaming industry. Numerous industries, including medicine, education, engineering, and entertainment, are utilizing virtual reality technology. The article's main topic is a proposed VR escape room game that will help players improve their skills by having them work through puzzles in various culturally themed rooms. The VR system consists of output devices like a Head Mounted Display (HMD) and 3D sound, input devices like tracking, point, and voice devices, and a computer or VR engine. The processing power of the computer, I/O devices, degree of immersion, and graphic output are some of the variables that must be taken into consideration when choosing a VR engine. Samira Yeasmin, et al. [16] Discuss about that it is suggested that a Virtual Reality (VR) escape room game be created for instructional and recreational purposes. The player must solve puzzles to get out of various rooms that represent various cultures in the game. The game uses teleportation for in-game movement in an effort to lessen VR sickness. The purpose of using VR is to teach players about various cultures and stories while also having fun and using their skills. By

linking their VR devices to the game, players' skills are improved and they gain knowledge.

The paper was designed to work with real-world objects that were connected to a virtual reality device to detect when an enemy enters the area. Players can highlight their uniforms in the game by using tar, which is a substance that is supported by multiplayer. Paintballs can be fired at these highlighted uniforms by users. Both inside and outside, two or more players could play the game.

### III. MATERIALS AND METHOD

With our project, players will be able to fully control the game, including movement, interaction, and shooting, using a controller connected to an Android device. Once the user is connected to their device and playing our game, they can take advantage of all the Virtual Reality features. The user can play and control the overall features and activities of the game using the controller thanks to the controller mapping we developed. In contrast to all other games on the Play Store, which really only require players to gaze from their viewpoint and make eye movements in the X, Y, and Z aspects, in both, to start generating the impact of the moving aim for the provided weapon, the movements can be monitored from the controller. Other related projects' graphics were not realistic; rather, they were fairly distinct from low-poly or lowgraphic assets, giving the game a very out-of-date appearance. Only character-related mechanics and physics were utilized because character movement was not included in the game; instead, these mechanics and physics were only displayed and experienced through the movements and animations of the enemies.

The game was unrealistic due to the collision properties of all the artefacts and strongly interacting, that also made it simple for the player to hit the collider. This was due to the fact that both the head and the arm suffered equal damage from the weapon's shooting effect. The Zombie Hunting was developed using the Unity 3D game development engine. Unity 3D supports C#, a well-liked programming language. Additionally, Unity3D provides a ton of helpful, user-friendly features. The project allows Android-powered devices to be used with virtual reality. The shooting game's gameplay

hasn't changed despite the addition of a survival theme. C is one of the popular programming languages that Unity3D supports. The forums on websites for Unity 3D are well-known for their support and tutorials. There are subject matter experts on the forum who can help you whenever you need it.

#### A. FPS Plugin Controls

Due to the very basic functionality of the plugin, it is designed to support keyboard controls for an overall perspective of the game. The plugin did not have built-in controls for mobile devices, but a keyboard was provided for controlling the necessary features. W, A, S, and D were the keyboard controls configured for movement, mouse left and right keys were used for shooting and aiming, and mouse cursor movements were used for looking around. The space bar was designated for jumping, while the R key was designated for reloading, among other features. We worked with the display and controls to make the project functional in VR mode and with portable joystick input controls. We utilized the Google VR plugin for unity, which Google has made available for apps that support virtual reality. Considering the B section, we combined the standard support display with the VR display. Then, we put a lot of effort into mapping every keyboard key to the VR controller and coordinating mouse movements with the x and y coordinates of the joystick. We put the keys from the joystick through rigorous testing using an online gamepad tester in order to perfectly map them to unity inputs. The designated key would highlight to let the system know when we opened this Gamepad Tester in a browser while the wireless joystick was connected to the mobile device and we used it to press buttons or move the joystick. The keys assigned to the controller are A-Button for firing, Y, B-Button for changing weapons, X-Button for reloading, Esc for leaving the game and returning to the main menu, and M-Button for selecting modes. When the horizontal axis is greater than 0 and has a negative value of 1+ve (0, -1) or when the horizontal axis is less than 0 and has a positive value of 1+ve (0, 1), the joystick moves. The vertical attribute of the character is set to be greater than 0 with a +ve value (0, +1) and less than 0 with a -ve 1 value (0,-1) to

control the game's horizontal and vertical joystick movements as shown in figure 2.

Controller	Function
A Button	Fire
R Button	Reload
Y Button	Gun Change
Esc	Main menu
M	Mode Change

Fig. 2 Controller Key Functions.

We could have easily added the keys in Unity by using the FPS plugin controller script, but we chose a different approach that didn't require any coding or programming. The keys were mapped using unity inputs. We changed the controller type to keys or buttons and mapped controller movement to the X axis, which is where horizontal movement would occur. We then set up the game to utilize each attached controller. It would be advantageous if the device configured a different controller or mouse instead of this one. All the keys for shooting, picking up, and switching weapons, along with all of the controller and body movement functions, were mapped after this key.

#### B. Environmental Assests

Every developer has access to the free resources in the online Unity asset store, which can be used in both professional and academic settings. All that is required to make the environmental packs and assets function properly in your product is to place the objects and merge them in your scene because they are already used and pre-built by unity editors. We used a variety of assets and packs to create the game's maps and stages. The assets required some finishing in terms of light and shadow as well as object collisions. The demo scene for each asset was used and altered to make the necessary changes for our game's theme as shown in figure 3.





**.Fig. 3 Tunnel Environment**

### C. Virtual Reality (VR)

To determine the final values of the appropriate input, the VR plugin validates the handset accelerator and gyroscope inputs. In contrast to pitch, which describes a person's head nodding when looking up towards the sky and down towards the ground, yaw describes the longitudinal motion of the user's head from left to right. Last but not least, When a user bends their face towards their shoulder while keeping the same horizontal and vertical proportion, the roll is defined. Because of these features, the VR can deliver the precise explicit images required for the current scene.

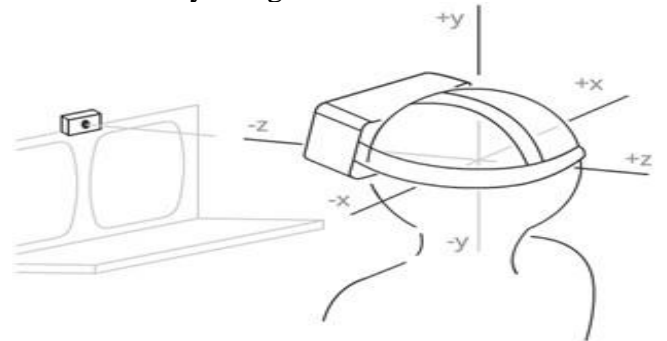
Realistic audio is essential to the VR gaming experience because it makes characters interact and behave realistically. In addition to other elements, virtual reality headsets and sound assist in realising its end objective, which is to simulate a user's physicality in a virtual environment. Another critical aspect that has been the subject of extensive research, much of it in the field of art, is the user's input to modify and communicate with the virtual world. However, even the ability of the user to transform their head or move towards a noise waves can be regarded user input. which, when used with virtual reality, instantly decides the route the user should take to keep away from nearby obstacles. Furthermore, we conducted the experiment in a real-world environment simulation as shown in figure 4.



**Fig. 4 VR Controller Guide**

The roll, pitch, and yaw properties of head movement within the game are maintained by the VR SDK using the gyroscope built into mobile devices. If the gyroscope accuracy was precise, the effects would appear more realistic. The roll of a gyroscope indicates whether the device or the user's head has twisted to the right, similar to the roll, pitch, and yaw of a VR device. The right side is positive, while the left side is negative. Pitch, which is equivalent to positive and negative in those properties, regulates a user's movement from the top of the sky to the bottom of the ground, much like the yawn does. The yaw is what causes the user to move when attempting to look left or right with positive or negative properties in the scripts.

The Unity Main Camera and the VR split screen prefab are the only aspects of the screen that are affected by the use of the VR plugin, which also disrupts the generic user interface. The game aims to lessen VR sickness in users as seen in figure 5, when they use different VR applications. The goal of the game is to encourage players to utilize VR while effectively using their skills and free time.



**Fig. 5 Virtual Reality headset movements**

The system creates real-time picture motion inside the mobile device that is displaying the virtual reality by fusing the gyroscope properties in real-time with the user's head movements and the placement panel of the virtual reality device.

### D. Generic Canvas Display to VR

The plugin offered a keyboard with basic functionality so that users could experience the plugin's demo, which only supported PC keyboard controls with mouse movements. The plugin was not created with mobile apps in mind, so we had to map each key and function to the mobile app. Instead of having to write every control script from scratch, it

was advantageous to have the keys and controller synchronized, even though it might take more time. By itself, the Unity 3D engine provides cross-platform inputs for mobile devices that are fully scripted to match your game controls.

A 360-degree joystick is used to control the player's movement, so the player's movement within the game will depend on the joystick's angle of motion. The other buttons mentioned above operate normally when there is no mode specified. Once the mode is selected, the game's functions, such as switching between weapons, firing, and reloading, are activated as seen in figure 6, by pressing the four buttons Y, A, X, and B. As a tutorial within the game-play, the app will disperse and discuss the correct key features. in order for the user to be able to easily understand how to use the controller and how to play the game in order to fully enjoy all of its features.



Fig. 6 Killing Zombies by using Controller.

In order to learn more about the our application's potential, we conducted some experiments on two different group of people: technical users who have knowledge of VR and interest in virtual reality, as well as non-technical users who have neither knowledge nor experience with virtual environments. We used 10 participants from each group, ranging in age from 12 to 40, to test this application. All testing and experiments were carried out with a standard Android smartphone, preferably the MI A3, a Shinecon VR headset, and a Shinecon joystick as a controller.

The accuracy of technical users was 93 %, while that of non-technical users is 88.01 %, according to the experiments and calculations we carried out to identify various activities, as shown in Table 1 and 2.

Table 1. Feedback from Non-technical users

Dataset	Precision	Accuracy	Recall
Walking	0.92	0.98	0.95
Head Movement	0.87	0.79	0.77
Total	0.89	0.88	0.86

Table 1. Feedback from Technical users

Dataset	Precision	Accuracy	Recall
Walking	1	0.99	1
Head Movement	0.95	0.87	0.62
Total	0.97	0.93	0.81

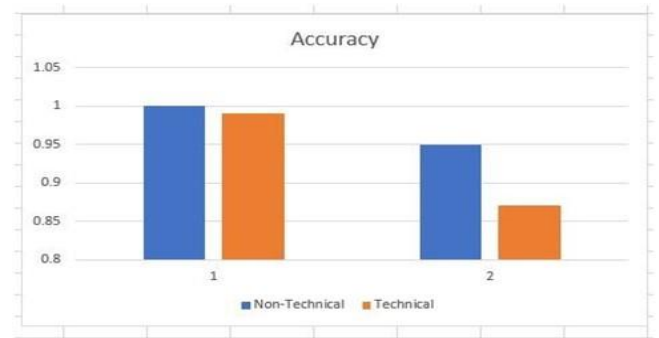


Fig. 7 Accuracy

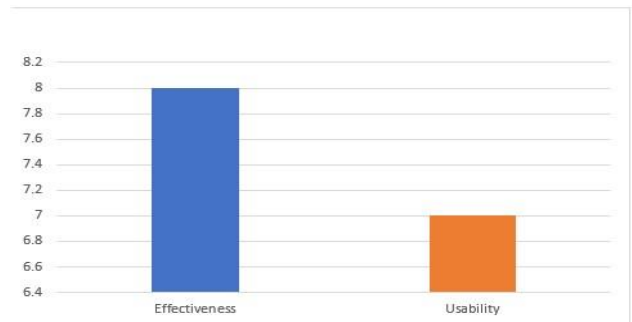


Fig. 8 Effectiveness and Usability of Application.

But we can always improve our application in the future with some user feedback, ideas, and criticism. When technical users used the application, they raised a serious issue with the user's movement. According to them, a user can only move forward and cannot go back; in order to do so, they must turn around and proceed in that direction.



#### IV. CONCLUSION

We supported the innovation of 3D virtual reality as a capability. The results of our investigation into the application of 3D virtual reality technology were encouraging, and as we move the innovation from the development stage to the present, it is likely to play a significant role in our project. The capabilities and features of our project indicate that the player will be more engrossed in the handheld game's 3D realistic graphics and effects and virtual reality experience than in traditional shooting games. This project has the potential to be a significant accomplishment that motivates other programmers in this field as we move forward. Our contribution to this field has resulted in the combination of basic FPS templates or plugin from mobile or computer controls with virtual reality controls, and the normal display is displayed on the Google VR plugin for better VR support the app will experience a rapid rise in the play store in terms of user interest and revenue thanks to the business model we developed for this project. The app will experience a rapid rise in the play store in terms of user interest and revenue thanks to the business model we developed for this project.

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