

# 3D VIRTUAL REALITY GAME

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**Abstract:** Video games have attracted the attention of many people, regardless of age or gender. Games are controlled using various types of input devices that have been developed over time. In recent years, virtual reality (VR) games that require VR-specific devices like a head-mounted display (HMD) provide an immersive gameplay experience and is growing among gamers. The Oculus Rift and HTC Vive is one of the most widely used for VR based Games. This paper describes the design and implementation of a VR game that is operated using three different types of device. It uses Oculus Rift or HTC Vive controllers as input device in order to increase user convenience and provide an immersive experience. The developed VR game provides a greater degree of user control, thus giving a competitive edge over existing games employing only one or two input devices.

**IndexTerms - Head-mounted Display, Oculus Rift, HTC Vive, Computer, Virtual Reality Game.**

## I. INTRODUCTION

Game developers and gamers are constantly waiting for something new in the Gaming world. For example, the Oculus Rift is an upcoming HMD for virtual reality games. The growing popularity of VR has brought about a steady increase in VR content along with continuous innovations in VR devices. In particular, HMD technology has attracted significant interest from industry. Virtual Reality games that require VR-specific devices like a head-mounted display have become popular. One of the most widely known HMDs is the Oculus Rift, and now HTC Vive which is also a relatively cheap and easy-to-use VR HMD. Looking at the Consumer market which indicates that VR concept combined with an HMD like the Oculus Rift or HTC Vive will be used in a wide variety of industrial sectors, such as video gaming, film and media, education, sightseeing, the healthcare and medical field, sports, and advertising etc.

However, the majority of VR games that have been in development over the past few years rely on traditional controllers like a keyboard, a mouse, and a gamepad. The expectations of fully immersive VR and gameplay cannot be met by such devices. Nevertheless, there are still some types of inputs that need to be explicitly given via an input device, which makes the use of wired and wireless input devices inevitable. The FPS, a full-fledged VR game developed in this work, is controlled with a combination of Oculus rift or HTC Vive HMD. It also uses its controllers which acts like human hands and behaves in somewhat same way.

The FPS was implemented using Unreal Engine and the method used was Blueprint method. The FPS allows the player to manipulate the gun aiming based on the player's movements tracked by the Oculus Rift or HTC Vive controllers. The controllers were chosen as the primary input device because of its flexibility and increased interactivity and accuracy. Although HTC Vive controllers work in a similar fashion to that of Oculus rift, A full-fledged experience can be gained by using Oculus rift which is on a higher end in the price range. The function spec and flow-chart of FPS is introduced. Also the map design is showed. The VR game is implemented by using two different types of VR device, which allows players to make diverse kinds of motions to operate the game.

## II. LITERATURE SURVEY

### HTC VIVE:

- **Vive Headset:** The Vive headset has a refresh rate of 90 Hz with a 110-degree field of view. It includes 2 screens, one for each eye with a display resolution of 1800 x 1200 pixels.

Safety features include a front-facing camera that allows the user to observe their surroundings without removing their headset. The software can also use the camera to identify any moving or static objects in a room; this functionality can be used as part of a "Chaperone" safety system, which will automatically display a virtual wall or a feed from the camera to safely guide users from obstacles or real-world walls. The headset has multiple sensors which include a dozens of infrared sensors which detect the current position of the headset in space.

- **Vive Controllers:** The wireless controllers act as the hands of virtual reality, making a more immersive experience for the player. This controller has multiple input methods included a track pad, grip buttons, and a dual-stage trigger. It also includes 24

infrared sensors that helps to detect and to determine the location of the controller. The Steam VR Tracking system is used to increase the connection of the controller by giving wireless real time feedback of 360 degrees to the host.

- **Vive Base Stations:** Also known as the Lighthouse tracking system are two black boxes that create a 360-degree virtual space which is up to 15x15 foot radius. The base stations emit timed infrared pulses at 60 pulses per second that are then picked up by the headset and controllers with sub-millimetre precision. Wireless syncing lowers the amount of wires making the base stations practical to use in a home.
- **Vive Tracker:** It's a motion tracking accessory; it is designed to be attached to physical accessories and controllers, so that they can be tracked via the Lighthouse system. Vive Trackers feature a connector that can be used to communicate with the accessory it is attached to.
- **Vive Deluxe Audio Strap:** It adds an integrated over-ear headphone as well as improved the HMD's comfort through better weight distribution.

### Oculus Rift:

The Oculus Rift headset uses an OLED panel for each eye, with each panel having a resolution of 1080×1200. These panels have a refresh rate of 90 Hz and it refreshes globally, rather than scanning out in lines. They also use low persistence, meaning that they only display an image for 2 milliseconds of each frame. This combination of the high refresh rate, global refresh and low persistence means that the user experiences none of the motion blurring or stutters that is experienced on a regular monitor. It uses lenses that allow for a wide field of view. The separation of the lenses is adjustable by a dial on the bottom of the device, in order to accommodate a wide range of perspective.

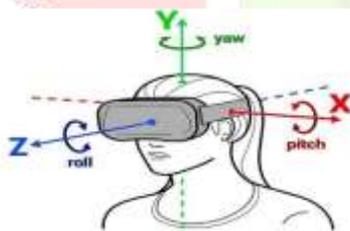
Headphones are integrated, which provide real time 3D audio effects. The Rift has full 6 degree of freedom rotational and positional tracking. This tracking is performed by Oculus's Constellation tracking system and is precise, low-latency, and sub-millimetre accurate.

## III. FUNCTIONS AND IMPLEMENTATION

### 3.1. Function Analysis-

The developed FPS game can be divided into three parts: the Unreal engine implementing the VR game, the VR devices as an input device, and the Computer responsible for the communication between the Unreal Engine and the VR device. The communication between the Engine and the Device is performed using Input/output Completion Ports (IOCP). The FPS Game includes features such as head tracking and display capabilities relying on the Oculus Rift, player motion sensing capabilities relying on the HMD, gun aiming manipulations, and conversion is handled by the VR controllers.

*Figure Coordinate system:*



### 3.2. Oculus Rift-

The FPS game was developed using the Oculus Rift DK2, the latest development kit for the Oculus Rift. The Oculus Rift requires graphic rendering for two different viewpoints of the left and right eyes. In addition, fish eye rendering is made for the left and right screens at a significant computational cost. The use of Oculus Rift thus increases the time of graphic rendering, which is a big obstacle in improving graphic quality and gaming performance. This is why the implemented FPS game includes only lighting calculations with regard to the diffuse texture and bump mapping, without introducing shadow and blur effects.

### 3.3. Input Devices-

The FPS game presented in this paper uses the VR controllers as input device. The controllers have a number of built-in sensors, such as gyroscopes, accelerometers, proximity sensors, ambient light sensors, and Hall sensors, that are useful in capturing player gestures

and movements. The use of VR controllers also gives an advantage that an application that communicates with a PC can be built using tap, swipe, and drag gestures.

### 3.4. Map Design-

The map was designed by arranging the objects in 3Ds Max, Maya, etc. However, to utilize these 3d objects in game it must be modelled using other software's such as substance painter, z-modeller etc.

### 3.5. Aiming Function utilizing VR controllers-

The VR controllers moves the gun aiming point along the x and y axes of the screen based on the x and y coordinates of the player's hand detected by the Device. To shoot, the FPS game computes the 3D ray direction of the current x and y coordinates of the hand on the screen using the camera's view and projection matrix.

### 3.6. View of Left and Right eyes of Oculus Rift, Projection Matrix Calculation-

The FPS uses Oculus Rift's head tracking information and the camera's view and projection matrix in order to compute the view and projection matrix for the left and right eyes.

## IV. RESULT ANALYSIS

Main MDI Screen:



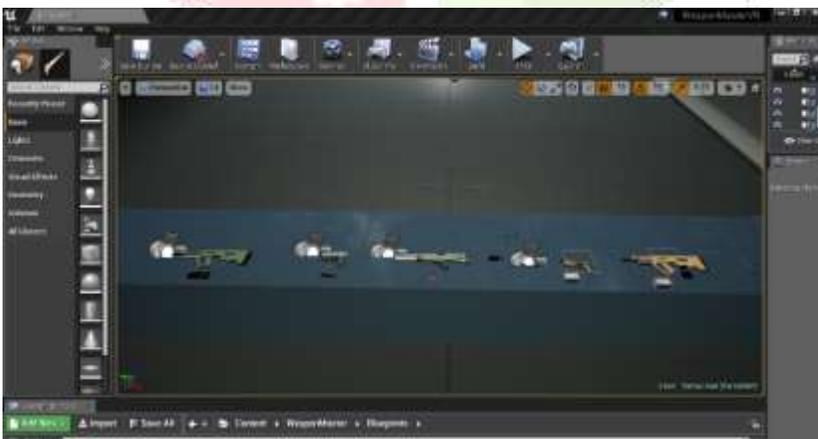
Practice Level and How to Information:



AI Zombie:



Different Types of Guns available:



## V. CONCLUSION

The implemented VR game Oculus Rift devices which enable players to control and interact with objects in a virtual world, but it is not possible to use mouse or keyboards to play the VR game. The VR Controllers provides an accurate motion sensing feature, but it may be difficult to use it in a limited space due to the need for a practical tracking area. With the Oculus Rift, the wearer's movement range can be further restricted. Apart from Oculus Rift, other types of input devices that are suitable for use in VR is HTC Vive. One

can use any VR device as input devices at the same time but it is also possible to use them selectively—i.e., only one or two devices best suited to the characteristics of a game are used. The developed game has user interfaces on a three-dimensional plane in the 3D game world and renders a 3D scene to a texture. The developed VR game provides a greater degree of user control, thus giving a competitive edge over existing games employing only one or two input devices.

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