

INTERACTIVE HEAD TRACKING FOR DESKTOP VR DISPLAY WITH MOTION
SENSOR

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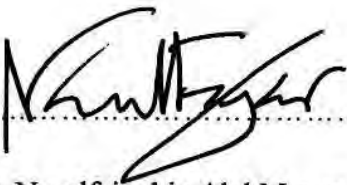
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To my beloved parents and family,

Who loves and supports me unconditionally and not letting me give up,

To my super cool and supportive supervisor,

Thank you for your patience and for pushing me farther than I thought I could go,

To all my awesome best friends,

Who always there through my ups and downs

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ABSTRACT

This project is about interaction in Virtual Reality (VR) desktop display by using three dimensional (3D) input device. VR is a computer-generated and 3D space representation of real world environment where the user can interact just like in real world. The aim of the project is to create a simple implementation and low cost of VR environment with motion gesture controller. The major benefits of this project are to increase user's immersion experience, for instance, within intense gaming application and to boost training-through-simulation for diverse field, like e-learning, military, healthcare, and entertainment industries. This project are implemented by using Leap Motion controller and webcam. The system will track the head movement and provide a 3D environment, which can interact with human gesture. The simplicity of implementation of these devices to create an interactive VR environment makes them very interesting and unique. This project are able to integrate the VR environment and human gesture-based interaction seamlessly, producing an interactive head tracking desktop VR display with motion sensor.

ABSTRAK

Projek ini adalah mengenai interaksi dalam Realiti Maya (VR) paparan komputer dengan menggunakan peranti input tiga dimensi (3D). VR adalah perwakilan janaan komputer dan ruang 3D persekitaran dunia sebenar di mana pengguna boleh berinteraksi seperti di dunia sebenar. Tujuan projek ini adalah untuk mewujudkan pelaksanaan yang mudah dan kos rendah persekitaran VR dengan pengawal isyarat gerakan. Manfaat utama projek ini adalah untuk meningkatkan penglibatan pengguna, sebagai contoh, dalam aplikasi permainan yang serius dan meningkatkan keberkesanan latihan-melalui-simulasi untuk bidang yang pelbagai, seperti e-pembelajaran, tentera, penjagaan kesihatan, dan industri hiburan. Projek ini dilaksanakan dengan menggunakan pengawal Leap Motion dan kamera web. Sistem akan mengesan pergerakan kepala dan menyediakan persekitaran yang 3D, yang boleh berinteraksi dengan isyarat manusia. Pelaksanaan yang mudah dengan alat-alat ini dapat mewujudkan persekitaran VR interaktif yang menjadikan mereka sangat menarik dan unik. Projek ini dapat menyepadukan persekitaran VR dan interaksi berasaskan isyarat-manusia dengan sempurna, menghasilkan system pengesanan kepala paparan VR desktop dengan sensor gerakan yang interaktif.

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ABBREVIATIONS

| | | |
|------|---|------------------------------------|
| 3D | - | Three Dimensional |
| DOF | - | Degree of Freedom |
| FOV | - | Field of View |
| GUI | - | Graphical User Interface |
| IR | - | Infrared |
| NUI | - | Natural User Interface |
| PC | - | Personal Computer |
| VR | - | Virtual Reality |
| VRPN | - | Virtual Reality Peripheral Network |

CHAPTER 1

INTRODUCTION

1.1 Background

Head tracking for VR desktop display is one of the method used to improve human and computer interaction and break the constraints of traditional way of communicating with computer. There are several ways to achieve VR display that exist such as by using time-of-flight depth sensor, optical-inertial tracking system, Nintendo Wii remote and by using the webcam. This project focuses on creating the VR desktop display by using webcam because it is achievable and low cost method.

Motion tracking, or sometimes called motion capture is a process of recording the movement of an object or people. This tracking works by sampling the movement of object or people many times per second. The webcam will track the position and movement of user's face and render the view dependent on the on-screen image. This will transform the display into virtual environment as it reacts to the head and body movement, creating the depth of view.

The goal of motion gesture is interpreting human gesture into mathematical algorithm and hence, detection movement and location of hand or body. There are many approaches has been made and current focuses in the field of gesture recognition includes emotion recognition from face and hand recognition. This project aims to impose hand gesture recognition, complementing the VR desktop display to enrich the virtual 3D experience.

There are a multitude of input devices that can perform hand gesture recognition task, for example, the wired glove, depth-aware camera, stereo camera, single camera and controller-based gestures. Leap Motion is a fairly new controller-based gesture device and this project intent to manipulate the potential of this device to the fullest. The Leap Motion is a hardware device that supports hand and finger motions as input, analogous to a mouse, but required no hand contact or touching, instead of the usual keyboard or joystick to interact with the virtual objects.

1.2 Objectives of the Project

The aim of this project is to create an interactive head tracking desktop VR display with motion sensor. This may enhance user experience when interacting in VR environment. The objectives of this project are:

- i. To design an interactive head tracking for desktop VR display with motion sensor.
- ii. To develop the head tracking for desktop VR display by using webcam
- iii. To implement basic gesture-based interaction by using Leap Motion controller.

1.3 Problem Statement

VR provides unique viewing experience and literally is the only way to “show” one another what they are trying to say in detail when words are exceptionally ineffective. However, it suffers several limitations, for example, it is visually unconvincing.

Mouse-based interaction is common in VR because of its robustness but it is geared towards menus and icons user interface instead of interaction in 3D space. Recently, major shifts can be seen where “natural” user interface started replacing the mouse-based interaction.

Most VR system utilize mouse-based interaction which defy the interaction ability for the system to be as close as possible with real world interaction. In order to overcome this problem, an intuitive gesture-based interaction will be implemented to elevate the VR experience. User can interact with on-screen object in a VR world by using basic hand gesture through Leap Motion controller.

1.4 Scope of Project

The project focuses on designing an interactive head tracking for desktop VR display with motion sensor. The hardware involve in this project are webcam and Leap Motion controller for the gesture-based interaction.

1.4.1 Functions and Applications

This project is develop to demonstrate the head tracking for desktop VR display with motion sensor. The system features a webcam used to produce a head tracking for desktop VR display and Leap Motion controller as the interaction device for the motion sensor. The project will brings multitude of benefits to user in entertainment industries and medical field and healthcare as well as other fields such as e-learning and military.

1.4.2 Project Limitations

This project was conducted with the aim to produce an interactive head tracking for desktop VR display with motion sensor. However, the implementation are limited to several choice of project design which are to produce an interactive head tracking for desktop VR display with basic and limited to single hand-gesture with preconfigured object only. The entire project is developed by using Unity software and all the necessary coding are written in C# programming language.

There are also several restrictions that cannot be reasonably dismissed which can have impact on the project design and the results. This system will only work under specific condition as listed below.

- i. User must be in range for the head tracking to work which is approximately 70 centimeter to 1 meter from the webcam

- ii. For the gesture to work, user's hand must be in range of sight of the Leap motion controller, with the minimum height of six centimeter, maximum height of 30 centimeter and maximum width of 35 centimeter.
- iii. The head tracking for desktop VR display will only work for one user at a time.
- iv. The system is tested to be used while the user is in seating position.

The limitations are associated with the approach taken in developing this project. This is to ensure replicability and so as not to move out of scope of interest of this project.

1.5 Significant of Project

This project is conducted with some significant use in the future. The integration of this project will increase user's immersion experience, for instance, within intense gaming application while significantly narrowing down the constriction related to 3D oriented tasks. Training-through-simulation for diverse field, like e-learning, military, healthcare, and entertainment industries will reap the most benefits from this project by providing realistic and engaging experience. This project will provide solution for a more natural and fluid movement in such conditions mention above.

1.6 Report Structure

This report is a written documentation of the generated idea, concepts applied and completion of tasks. It comprises of five chapters. The followings are the summary of each chapter in this report.

Chapter 1 provides readers with a brief introduction on why and how this project is developed. This chapter contains the introduction, objectives of the project, problem statement, scopes of work, significant of project and the report structure.

Chapter 2 contains the literature review of concepts applied in this project. This chapter present several background study of previous projects that are related to this project. Apart from that, this chapter also provide readers with the general idea of what hardware will be used.

Chapter 3 presents the methodology on completing the project. This section includes a module of implementation, block diagram of proposed technique, the hardware that will be used and the summary of implementation of the project.

Chapter 4 will be discussing the outcome of this project. Each module will be discussed in detail up until the integration of each module. The results will be analyzed and the result will be reviewed.

Chapter 5 is the conclusions of this project. This chapter will conclude the findings in this projects. This portion will include some suitable recommendations to further improve this project in the future.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a way to analyze existing research to acquired related information in order to enhance the understanding of the concept and how they are executed that are analogous to this research. This chapter is discussing the journal, thesis and article of past researches related to VR implementation and gesture-based interaction including Leap Motion controller and each journal will be analyze and criticize accordingly in order to complete this project.