

**HEADTRACKING FOR DESKTOP VR DISPLAY USING Wii REMOTE**

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**A thesis submitted in partial fulfillment  
of the requirements for the award of the degree of  
Bachelor of Electronics Engineering (Computer)**

**Faculty of Electronics & Computer Engineering  
Universiti Teknikal Malaysia Melaka**

**JUNE 2014**



## UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

## BORANG PENGESAHAN STATUS LAPORAN

## PROJEK SARJANA MUDA II

Tajuk Projek HEADTRACKING FOR DESKTOP VR DISPLAY USING WII REMOTE

Sesi Pengajian

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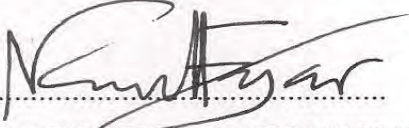
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*Specially dedicated to  
My beloved father and mother,  
To my supervisor and friends  
Thanks for all the encouragement and support*

## ACKNOWLEDGEMENT

Alhamdulillah, praise to Allah S.W.T for HIS blessing and guidance for my Final Year Project. I would like to express my sincere gratitude and appreciation to my supervisor, Dr.Nurulfajar BinAbdManapfor his advice and guidance throughout the entire project. Maximum supports from him encourage me to complete this Final Year Project.

I would like to thank to my family for their morale support and prayer along my study. Family is always being on the top of my inspiration source. A lot of thanks to all my friends for giving their brilliant ideas and knowledge to me for develop this project. Their support has given me enough strength and inspiration in pursuing my ambition in my life as well as to complete this project. They are always been willing to help in any way they can. I would like to thank them for believing in me for helping me to keep my spirits high. This sincere appreciation is conveyed to my friends, especially to my entire course mates who had given me help technically and mentally during the journey to accomplish this project. Thank you all for giving me technical advice, moral support and idea to enhance my project.

## ABSTRAK

Projek tahun akhir ini membentangkan pembangunan dan pelaksanaan tentang teknik pengesan kepala yang menggunakan peranti kawalan jauh Nintendo Wii dalam menghasilkan pengalaman reality maya yang akan di paparkan pada skrin computer dengan pergerakan kepala oleh pengguna yang berkomunikasi dengan peranti kawalan Nintendo Wii. Justeru itu kemungkinan paparan keluaranya akan menjadi sama ada pandangan melalui paksi  $x$ ,  $y$  dan  $z$  dan diikuti oleh ruang dan kedalaman yang berkaitan. Tujuan projek ini adalah untuk mengkaji dan menganalisis bagaimana projek ini dapat digunakan dan dapat dilaksanakan terutama bagi simulasi rekabentuk senibina dan kejuruteraan dimana mereka tiada alat tambahan untuk meningkatkan paparan realiti maya. Kawalan Nintendo Wii merupakan peranti dimana ia mempunyai kawalan mikro didalamnya yang akan melaksanakan penerimaan isyarat yang diterima dan media sambungannya dalah melalui Bluetooth. Ia menggunakan bateri AA sebagai punca kuasa. Kaedah yang akan digunakan dalam melaksanakan project ini adalah peranti kawalan Wii akan di sambungkan ke computer riba melalui Bluetooth. Dan ia akan menerima isyarat daripada pengesan kepala yang dipakai oleh pengguna samaada pada paksi  $x$ ,  $y$  dan  $z$ . Diikuti bahagian mana yang memiliki kedalaman dan ruagan yang dipaparkan pada skrin. Projek tahun akhir ini melibatkan pelaksanaan dan bagaimana system ini direka dan pembangunan program untuk menjalankan projek aplikasi Wii ini.

## ABSTRACT

This Final Year Project presents implement and development of Headtracking technique by using Nintendo Wii remote in order to achieving a virtual reality experience that will display on a typical monitor (LCD) with the motion of a user head by performing Headtracking (IR LEDs) attract with the Nintendo Wii remote. So that, the expected result will be on what axis in viewing the display either in X, Y or Z axis follow by which space and depth include. The purpose of this project is to study and analyse how this project can be used and can be done in simulation especially in architecture/engineering design whereby they didn't have additional tools devices to enhance the display. Nintendo Wii remote is a device whereby it has a microcontroller inside to execute the received signal that was attracted and the medium of the connectivity is Bluetooth. Thus the power to generate this Wii remote it's just using battery AA. The method that will be introducing here in implement this project is the Wii remote, which will be connecting to laptop by using Bluetooth dongle. Then, it sense the movement of Headtracking (IR LEDs) wear by user either in X, Y and Z axis. Follows by which side have more space and depth display by monitor (LCD). This Final Year Project involves implementation and on how the system had been design and program development to run the Wii remote application.



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**LIST OF ABBREVIATION**

IR	-	Infrared Sensor
LED	-	<i>Light-emitting diode</i>
<i>Sync</i>	-	<i>Synchronize</i>
<i>Wiimote</i>	-	<i>Wii Remote</i>
LCD	-	Liquid Crystal Display
VR	-	Virtual Reality
GUI	-	Graphical User Interface
DirectX	-	Collection of Application Programming Interface
3D	-	Three Dimensional
VB	-	Visual Basic
PDF	-	Portable Document Format
RC	-	Radio Controller
PCB	-	Printed Circuit Board
USART	-	Universal asynchronous receiver/transmitter
%	-	Percentage
NET	-	Dot Net
C#	-	C Sharp

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## CHAPTER 1

### INTRODUCTION

This chapter will explain about the introduction and the background of this project. The explanation will cover who the inventor of this project before this, the objective of this project, the problem statement why this project need to be develop, the scope of this project, which explain the scope more specifically and the outline of this report.

#### 1.1 Background of project

This project is continuation of an idea previously design by Johnny Lee. Lee design the virtual matrix and its intersection with a Nintendo Wii remote to create the three dimensional space that this project is loaded into. Originally, this three dimensional space could be represented by black background and a number of targets randomly set at different locations.

A three dimensional display that does not required red and blue shaded glasses to increase user experience whether in gaming, television and movies or simply just a display of scene. With Lee virtual representation of three dimensional space, I took an opportunity to implement back the scene that allowing the user to create their own three dimensional environment. Lee's original design also made use of pair of safety goggles with infrared LEDs in order to track the user head by Wii-mote. But for my project I have been use the LED reading glasses that had been modified into IR LED glasses that will be my Headtracking that I think much more proper and easy in making the virtual reality seem more realistic[1]

## 1.2 Problem Statement

Nowadays, Wii remote everyone knows that it's a device use for gaming in controlling the movement[2]. Based on the title of this project, the reason why it's one of the idea need to be develop is to create one of the method in findings appropriate interaction and interface especially in visual or image processing development to simulate a viewing and get a good visualize in axis either in X, Y and Z by using Headtracking.

Headtracking is one of the medium that had been use in this project in attracting movement with Wii-mote and IR LEDs from Headtracking. By using Headtracking it will be an additional tool than any other input devices such as keyboard sequence and mouse combination in order to enhance the 3D simulation displays. The reasons why it should be more interesting with other input devices maybe when using keyboard it not very efficient and less effective in making a real movement. Otherwise maybe it's not accurate or not synchronizes very well.

## 1.3 Objectives

The objective of this Final Year Project is to design and develop virtual display by using microcontroller in Wii remote and Headtracking (IR LEDs). This virtual display was develop by using Wii remote as main devices by using the IR camera inside that to attract with IR LED (Headtracking) in numerous positions. To modify IR Sensor Glasses by using LED Reading Glasses for communication between Wii remote and Headtracking.

Here the LED Reading Glasses that were get from online store will be modify from basic LED into IR LED. So that the IR LED will give the ultra-light and it will sense by IR camera of the Wii remote. Thus, it's to implement a tracking technique by using Wii remote. This tracking technique is use a reading glasses whereby it will be more appropriate than other technique like a hat etc.

#### **1.4 Scope of project**

The scope of Final Year Project is the involvement on how these projects are limited to. The scope of this research is to implement the head tracking for desktop virtual reality using Wii remote. In this project, the system will use the infrared camera component of a standard Nintendo Wii-mote to track a user's head motions in the left, right, forward, backwards, up and down directions allowing users to create their own three dimensional environment by using the Headtracking (IR LEDs).

The main scope of this project is to recreate the movement based on X, Y and Z axis then it will move on to modification as good tools development. As we can see, the Wii remote not only used for entertainment but can be integrated into educational purposes. The software that will take place in this project is custom C# DirectX support programming in C/C++, WiiYourself. Libraries (C++) and Wiimote Lib library (C#). Thus, the hardware will be Nintendo Wii-Remote, Bluetooth dongle, Headtracking (IR LED Glasses), laptop and monitor.

#### **1.5 Thesis plan**

These reports consist of four chapters. In first chapter, it discuss about the objective and scope of this project. Chapter two contain about theory and literature reviews. Literature review is about the Headtracking for desktop Virtual Reality using Wii remote that the way other author implement and modified in different things especially in device for Headtracking and others.

In chapter three, the discussion will be on methodology system design for implement the virtual reality, hardware and software implementation of this project. Result and analysis are discussed in chapter four. Conclusion and future work will be discussed in chapter five.

## CHAPTER 2

### LITERITURE REVIEW

In this chapter it's only focuses on the related research and case study of previous projects. Reading and study process are conducted by books, paper, journal, articles and previous thesis as material selection. Nowadays, most of the online references are not only focusing on web based protocol but references from interactive video sharing website and online discussion and sharing portal make it possible for better resources gathering. Online search by image browsing is another effective and efficient method of research.

#### 2.1 Nintendo Wii

Nintendo Wii is a home video game console that released on November 2006[3]. As a seventh generation of game console Wii competes with Microsoft Xbox 360 and Sony PlayStation 3. Wii become worldwide sale in 2009 which it break sales record due to other video game console Microsoft Xbox 360 and Sony PlayStation 3.

Nintendo Wii has introduced the Wii Remote as their main control pointing devices and detects movement in three dimensions. The concept of Wii is focusing on interaction. This Nintendo Wii powered by IBM PowerPC processor which have 512MB internal flash memory and SD card. The Wii connectivity system supports Wi-Fi IEEE 802.11 b/g, Bluetooth, and LAN Adapter (via USB). Figure 2.1 show the Nintendo Wii.



Figure 2.1 Nintendo Wii

The operation of Nintendo Wii is by using Bluetooth connectivity system between Wii remote and the Wii console. The operating to process the data it required the Wii sensor bar that placed at the bottom or at the top of the TV that will transmit the IR light that connected to Wii console by using USB. The camera inside the Wii remote will attract with the IR light to create movement follow the player gesture when playing game.

## 2.2 Microsoft Xbox 360

The Microsoft Xbox 360 is a video game console developed by Microsoft released on November 2001. Microsoft Xbox 360 is a sixth generation console that processor unit is Intel Pentium III and support NVidia graphics. The storage is 10 GB internal Hard Drive and the connectivity system support only 100Mbit Ethernet. Figure 2.2 show the Microsoft Xbox 360 that acquired Xbox controller for player to control the game.



Figure 2.2 Microsoft Xbox 360

Kinect is one the input device that uses for sense the motion that enable user to control their console without need a game controller. The concept of Kinect is using gesture and spoken commands. Kinect competes with several motion controllers with other home console such as Wii Remote for Wii, PlayStation Move for PlayStation 3 and PlayStation camera for PlayStation 4.

Xbox 360 operated by using breakaway cable controller and Kinect for user play games. The connectivity for the Kinect is 2.0 USB that will connect to Xbox console so the data that received from Kinect will transfer into Xbox console.

### 2.3 Sony PlayStation



Figure 2.3 Sony PlayStation 3

Sony PlayStation figure 2.3 is home video game consoles that develop by Sony Computer Entertainment. It's a part of seventh generation of video game and it was released on November 2006. The CPU of this console is generated by 3.2 GHz Cell Broadband Engine with 1 PPE and SPEs which storage 20GB up to 500GB, 2.5 inch SATA Hard Drive. Besides Dual Shock as controller, it also has PlayStation Eye/Camera that uses for computer vision and gesture recognition to process image taken by camera. Figure 2.4 show the PlayStation Eye.



Figure 2.4 PlayStation Eye / Camera

PlayStation 3 operated when CD games are inserted into console and the wireless controller will control all the system. For gesture recognition and computer vision, it required PlayStation Eye for user play with their body gesture and voice.

#### 2.4 Wii Remote

Wii remote is a primary controller for Nintendo Wii console. The main feature of the Wii Remote is a motion sensing capability, which allow player to interact and manipulate things on the screen via gesture recognition and pointing by using accelerometer and optical sensor technology[4]. Figure 2.5 show the Wii remote.



Figure 2.5 Wii Remote

Wii remote will be chosen compare than the other home consoles motion controller. The chosen is based on the specification on those devices especially on their price and the ability in interact with their console in reverse engineering.