



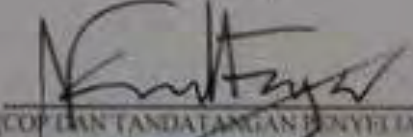
**INTERACTIVE OBJECTS FOR VIRTUAL REALITY (VR) USING
OCULUS RIFT AND MOTION SENSOR**

LOO KUN KHENG

**This Report Is Submitted In Partial Fulfilment of Requirements For The
Bachelor Degree in Electronic Engineering (Computer Engineering)**

**Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka**

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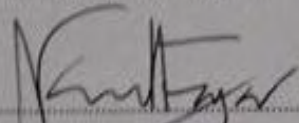
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ABSTRACT

Now is the trend of Virtual Reality, everyone is chasing high technology for the superior and interactive vision. The existing of Pokemon Go and Oculus Rift proved that the world is accepted Virtual Reality and Augmented Reality. The idea of this project is to create an interactive object for virtual reality using Oculus Rift and Leap Motion. In this this project, it is mainly focus on the interactive objects for interactive learning. Currently, the development of virtual reality with the performance of hand gesture sensing was not accurate. Therefore, size and position of the virtual hand model had to be very accurate and match with the real hand in order to improve the hand gesture accuracy. The design of the VR environment with education purpose is built in Unity 5. The interactive objects are built from its properties in the Unity 5. The 3D axis are the main components in Leap Motion calibration. Unity 5 and C# programming are used to calibrate the Leap Motion. This project produced a result which is the improvement of the hand gesture detection. The position and sizing of the virtual hand are adjusted in a better trigger point for the user. Besides, the immersive education based VR environment is built in a interactive way.

ABSTRAK

Realiti Virtual adalah merupakan pola terkini di mana semua orang mengejar teknologi tinggi untuk paparan yang unggul dan interaktif. Kewujudan *Pokemon Go* dan *Oculus Rift* terbukti bahawa dunia boleh menerima Realiti Virtual dan Realiti Tambahan. Idea ini adalah untuk mewujudkan objek interaktif untuk Realiti Virtual menggunakan *Oculus Rift* dan sensor gerakan. Oleh itu, tujuan projek ini adalah untuk memberi tumpuan kepada objek interaktif untuk pembelajaran interaktif. Pada masa kini, pembangunan Realiti Virtual dengan pengesanan isyarat tangan adalah tidak tepat. Oleh itu, saiz dan kedudukan model tangan virtual hendaklah padan dengan tangan pengguna untuk meningkatkan ketepatan isyarat tangan. Reka cipta dunia Realiti Virtual berdasarkan pembelajaran direka dengan menggunakan Unity 5. Objek interaktif adalah direka dengan ciri-ciri dalam Unity 5 *components*. 3D paksi adalah komponen utama dalam penentukuran *Leap Motion*. Unity 5 dan C # pengaturcaraan adalah digunakan untuk menentukur *Leap Motion*. Projek ini menghasilkan keputusan iaitu peningkatan pengesanan isyarat tangan. Kedudukan dan saiz daripada tangan virtual dibuat dalam titik pencetus yang lebih baik untuk pengguna. Selain itu, persekitaran VR berasaskan pendidikan yang mengasyikkan dibina dengan cara yang interaktif.

TABLE OF CONTENT

CHAPTER	CONTENT	PAGE
	PROJECT TITLE	i
	REPORT STATUS APPROVAL FORM	ii
	DECLARATION	iii
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE OF CONTENT	viii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xv
	LIST OF APPENDIX	xvi
I	INTRODUCTION	
	1.1 Project Background	1
	1.2 Problem Statement	2
	1.3 Objectives	3
	1.4 Scope	4
	1.5 Report structure	4

II	LITERATURE REVIEW	
2.1	Virtual Reality (VR)	5
2.2	VR Evolution	6
2.2.1	Panoramic paintings and stereoscopic 3D display	6
2.2.2	The VR HMD for Vision, Audio and Tactile	6
2.2.3	Augmented Reality (AR)	7
2.3	Oculus Rift	8
2.4	Types of Oculus Rift	12
2.5	Leap Motion Controller	14
2.6	Types of Motion Sensor	16
2.7	Vuforia	17
2.8	Summary	18
III	METHODOLOGY	
3.1	System Overview	19
3.2	Block diagram of Project	21
3.3	Setup and flow chart of the project implementation	21
3.4	VR environment Design	26
3.4.1	The steps of Creating VR environment	32
3.5	Integration Between Oculus Rift DK2 and Leap Motion	39
3.6	The accuracy of hand tracking	44
3.7	Compile, build and run	36
3.8	Summary	45
IV	RESULT	
4.1	The accuracy of the hand tracking	46
4.2	Virtual Reality Environment and the Interaction	47
4.2.1	Opening of Newton scene	48
4.2.2	Newton World scene	49
4.2.3	Ending scene	54
4.3	Interaction between user with the interactive object	55
4.4	Summary	59

V	CONCLUSION	
5.1	Conclusion	60
5.2	Future development	61
	REFERENCES	62

LIST OF TABLES

NO	TITLE	PAGE
2.1	The minimum requirement of a virtual reality HMD	12
2.2	The comparison between Oculus Rift HMD	13
2.3	The comparison between the motion sensors	16

LIST OF FIGURES

NO	TITLE	PAGE
1.1	Project Flow	2
1.2	Evolution of Computer	2
1.3	Evolution of Camera	2
1.4	Evolution of Learning Process (no change)	3
2.1	AR application	7
2.2	Body of Oculus Rift	8
2.3	The inner component of the Oculus Rift DK2	9
2.4	The View	10
2.5	The interpapillary distance of the HMD	10
2.6	The FOV of Oculus Rift	11
2.7	The Leap Motion Controller	14
2.8	The infra-red camera of the Leap Motion Controller	15
2.9	Component of Leap Motion Controller	15
3.1	Overview of the System	19
3.2	Front view of Oculus Rift DK2	20
3.3	Top view of Oculus Rift DK2	20
3.4	Block diagram of the project	21
3.5	The connection of the ports in CPU	22
3.6	Result of wrong connection	23
3.7	The overall flow chart of the project	24
3.8	Calibration of the leap motion	25
3.9	The workspace of VR	26
3.10	The flow chart of scene 1	27
3.11	The flow chart of the instruction box in scene 2	27
3.12	The flow chart of the sound system in the scene 2	28

3.13	The flow chart of the interactive object in scene 2	29
3.14	The flow chart of second interactive object in scene 2	30
3.15	The flow chart of the restart button in scene 2	31
3.16	The flow chart of scene 3	32
3.17	Unity 5 interface	33
3.18	The 3D objects component	34
3.19	The light component	35
3.20	The text component	35
3.21	Transform component of GameObject	36
3.22	The Main Camera Component	37
3.23	Adding new component	37
3.24	Oculus Rift DK2 with attached Leap Motion	39
3.25	Option of allow unknow source	39
3.26	Leap Motion Asset Control Panel	40
3.27	Hand modelling of leap motion work perfectly in VR	40
3.28	The detection of hand in leap motion controller	41
3.29	Leap motion core assets	42
3.30	Calibration Verification	42
3.31	Triggering with poor accuracy	43
3.32	Triggering with high accuracy	43
3.33	The adjusting of position and size	44
3.34	Build settings window	44
3.35	The game view of Unity and Oculus Rift	45
4.1	The not accurate hand tracking	46
4.2	The poor sizing of hand model	47
4.3	High accuracy hand model (after calibration)	39
4.4	Opening Scene	48
4.5	Newton world scene	49
4.6	First interactive object of the scene	50
4.7	Second interactive object of the scene	51
4.8	Before touch	52
4.9	After touch	52
4.10	The third interactive object - slamming cube	53

4.11	Restart Cube	54
4.12	Ending scene	54
4.13	First tracking object	55
4.14	First pop out	55
4.15	Second tracking object	56
4.16	Second pop out	56
4.17	Third tracking object	57
4.18	Third pop out	57
4.19	Fourth tracking pop out	58

LIST OF ABBREVIATIONS

VR	Virtual Reality
AR	Augmented Reality
HMD	Head Mounted Device
USB	Universal Serial Bus
VGA	Video Graphics Array
DVI	Digital Visual Interface
HDMI	High Definition Multimedia Interface
DK2	Developer Kits
VPL	Visual Programming Lab
FOV	Field of View
GUI	Graphical User Interface
PCB	Printed Circuit Board
RF	Radio Frequency
LED	Light-emitting diode
OLED	Organic light-emitting diode
RAM	Random access memory
OS	Operation System

LIST OF APPENDIX

Newton world Coding	58
Apple Coding	62

CHAPTER 1

INTRODUCTION

1.1 Project Background

Virtual Reality (VR) is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. Basically, VR will give user a virtual world that acts as the second world which giving a great visual experience. Inside the VR world, there is a lot of interactive object. The objects can take actions when the user input commands to it. For example, touching or grabbing it.

Initially, VR is used on gaming or entertainment purposes only. As the growing of technology, the importance of education is being concerned by the society. Therefore, this project is implementing VR into education learning process. Oculus Rift DK2 and Leap motion are used to make the learning process a better interactive experience rather than reading a passive book. User can carry out the learning process in any situation. There is varies of virtual situation that can be designed in VR. For example, an interactive atom or body organs which can let the user interacts with and experience the virtual situation. Therefore, the process of learning is conducted in an attractive and effective way.

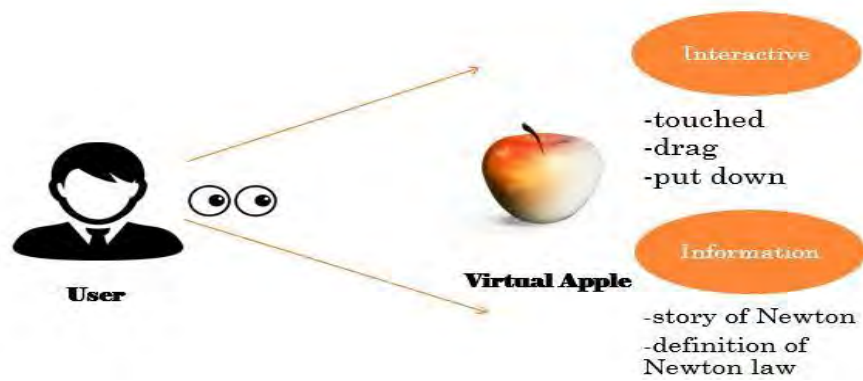


Figure 1.1: Project Flow

Figure 1.1 is the project flow of this project. User wears a head mounted device (HMD) for the display of virtual environment. The immersive interactive object will be pop out in the view of user. For example, user can interact with the virtual apple in their view by using hand movement in front of motion sensor. Command is given to the virtual apple by touching it, dragging it or grabbing it. This result the feedback of the virtual apple like displaying the story of Newton and definition of Newton law.

1.2 Problem Statement



Figure 1.2: Evolution of Computer



Figure 1.3: Evolution of Camera



Figure 1.4: Evolution of Learning Process (no change)

From past till now, the things are keep on changing to have a better experience. A personal computer with varies features from a personal computer with limited feature as shown in Figure 1.2. A portable and small size camera is transformed from a huge size of camera as shown in Figure 1.3. But, the way of study environment is the same no matter old time or recent time as shown in Figure 1.4. This shown that there is no obvious transformation of study environment. Therefore, the problem is the education learning process today is lack of evolution. Students will feel boring and lack of attention when they study like a robot every day. The next problem is the accuracy of the hand gesture detection. The triggering accuracy is not stable.

1.3 Objectives

The aim of this project is to create interactive objects for Virtual Reality that focus in education learning. In order to achieve this, there are three objectives as stated below.

- i. To design and develop the interactive objects by using Oculus Rift and motion sensor.
- ii. To implement adaptive 3D objects in Virtual Reality for interactive learning
- iii. To evaluate the accuracy and sensitivity of the hand gesture detection for virtual hand control system.

1.4 Scope of Project

This project included two parts which are virtual reality design and calibration of hand gesture sensor. For virtual reality, Oculus Rift DK2 is used as the headset hardware to display the VR. Unity 5 and Microsoft Visual Studio act as software tool in coding writing and execution. For calibration of hand gesture sensor, Leap motion is the hardware to sensor the hand movement. The C# and Unity 5 are used to coordinate the hand modelling position.

The limitation of this project is the version of the Unity 5 and Leap Motion. In order to use the latest asset from the asset library, the version of the Unity 5 and Leap Motion needed to be updated to latest version. Unfortunately, the work station is not meet the requirement of the latest version of leap motion due to the installation of the old version of Leap Motion. Therefore, limited assets can be imported into Unity 5 for VR design. Besides, the functionality of the Leap Motion is not perfect. This is because the Leap Motion cannot be detected if the Leap Motion is overheated. Therefore, the Leap Motion needed to be cooled down for few minutes after doing several experiments.

1.5 Report structure

This report separated into five chapters as stated. Chapter 1 is the Introduction of the project. This chapter covers the overview of the project such as project background, problem statement, objective and scope. Chapter 2 is the Literature Review. This chapter will discuss the past studies related to the project. Background theory will be included in this chapter. Chapter 3 is the Methodology. All relevant experiments and techniques used in the project will be discussed in Chapter 3. The details of the flowchart of the system design will be explained in this chapter. Chapter 4 is the Results and Discussion. The result of the project from experiments will be recorded and interpreted in Chapter 4. This chapter also will analyze and discuss the data which get through the experiment. Chapter 5 is the Conclusion and Recommendation. This chapter will make a conclusion from the project and recommendation for the future plan which related to the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Virtual Reality (VR)

Virtual Reality (VR) is the creation of a virtual environment presented to our sense in such a way that the experience of being inside the virtual world. VR represents computer interface technology that is designed to leverage our natural human capabilities. Today's familiar interfaces – the keyboard, mouse, monitor, and GUI – force us to adapt to working within tight, unnatural, two-dimensional constraints. VR changes that. Technologies of virtual reality provide the user a better vision experience for architecture, sport, medicine, arts and entertainment. These technologies are becoming cheaper and more widespread. Oculus Rift DK2 is one of the virtual reality headset that interact with human. Jaron Lanier mentioned the imagination of one people can be shared to others by using Virtual Reality [1]. A VR system lets people experience data and communication directly. For example, today's advanced interfaces let people look and move around inside a virtual model or environment, drive through it, lift items, hear things, feel things, and in other ways experience graphical objects and scenes much as people might experience objects and places in the physical world. On the other hand, VR serves as a problem-solving tool that lets people accomplish what was previously impossible. It's also a communication medium, and ultimately, an artistic tool/medium. VR, in general, is widely used in the fields of education and training due to its potentials is stimulating interactivity [2] and motivation [3,4]. Furthermore, it offers an ideal manner to approach, study and

remember new knowledge for all those who prefer a visual, auditory or kinaesthetic learning style [5]. Learning in an environment that providing a good visual, audio and kinaesthetic is much more intractable. This can give the user a clear vision of the concept of educational material rather than imagine it. Therefore, the brain cell of body will receive and store the information more easily and efficiently.

2.2 VR Evolution

Virtual reality has beginnings that preceded the time that the concept was coined and formalized. In this detailed history of virtual reality of how technology has evolved and how key pioneers have paved the path for virtual reality today.

2.2.1 Panoramic paintings and stereoscopic 3D display

Virtual reality as a means of creating the illusion for the user. The earlier attempt at virtual reality is the 360-degree murals (or panoramic paintings) from the nineteenth century. These paintings were intended to fill the viewer's entire field of vision, making the user feel present at some historical event or scene. After that Charles Wheatstone [6] demonstrated brain can process the different two-dimensional images from each eye into a single object of three dimensions. Viewing two side by side stereoscopic images or photos through a stereoscope gave the user a sense of depth and immersion.

2.2.2 The VR HMD for Vision, Audio and Tactile

The First Flight Simulator was created by Edward Link [7] to give the training program to pilot. This is the first simulator tool that display in virtual reality vision. After some years, the first VR Head Mounted Display was introduced for the non-interactive film medium without any motion tracking. The HMD provided stereoscopic and wide vision with stereo sound. Then, Ivan Sutherland described the "Ultimate Display" which is conceptualized by 3 elements: Vision, Audio and Tactile

Feedback [8]. All these 3 elements are providing an interactive virtual world for the ability of the users to interact with objects in the virtual world in realistic way.

2.2.3 Augmented Reality (AR)



Figure 2.1 AR application

Augmented reality is a technology that superimposes a computer-generated virtual image on a user's view of the real world, thus providing a composite view [9]. The famous AR mobile application – Pokémon GO shown in Figure 2.1 is implementing AR technology in the application. This provide the user a gaming environment with the real-time camera capturing.

2.3 Oculus Rift



Figure 2.2 Body of Oculus Rift

Oculus Rift is a head mounted device that capable to display virtual reality. It was developed and manufactured by Oculus VR, a division of Facebook Inc which released on March 28, 2016. Figure 2.2 is the body of the Oculus Rift which is wearable by the user. The outlook of Oculus Rift may look like a simple device but it is an amazing piece of kit packing a wealth of cutting-edge tech. This simple virtual reality headset is built up by many parts of the component. The Oculus Rift chosen is the Oculus Rift DK2.