DEVELOPMENT OF INTERACTIVE AR PLAYBOOK USING UNITY 3D FOR OCULUS RIFT WITH LEAP MOTION

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in partial fulfilment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

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DEDICATION

Specially dedicated to my beloved family and friends for helping me a lot. Giving me the motivation and courage to complete this project. Thank you to my supervisor, Prof. Madya Dr. Nurulfajar bin Abd Manap and my mentor, Yap June Wai for teaching me a lot of things related to the project.

ABSTRACT

Augmented Reality is a new technology to blend the digital computer-generated information such as audio, text, video, animation and 3D models seamlessly to the real-world environment. It is believed that this awesome technology is going to change the way how people imagine, see and learn in the future. This project aims to design and develop an interactive object for augmented reality by integrating Oculus Rift, Leap Motion and Webcam. A video-display augmented reality device will be created to work together with an augmented reality book. A leap Motion Controller is essential as a peripheral input device for the user to interact with the system. The application of Leap Motion Controller in this project further enhance the interactivity with different hand gestures such as thumbs up, pinching and pointing finger direction. This project is greatly potential because it is not just for educational purpose, but also applicable in business, architecture and medical field. This project successfully implemented an Interactive Augmented Reality Playbook that can be interact with the Augmented Reality Headset.

ABSTRAK

Realiti Augmented adalah teknologi baru untuk menggabungkan maklumat yang dijana oleh komputer digital seperti audio, teks, video, animasi dan model 3D dengan lancar ke persekitaran dunia sebenar. Teknologi ini dipercayai akan mengubah cara orang membayangkan, melihat dan belajar di masa hadapan. Projek ini bertujuan untuk merekabentuk dan membangun objek interaktif untuk realiti diperkukuhkan dengan mengintegrasikan Oculus Rift, Leap Motion dan Kamera Web. Peranti Paparan Video Realiti Augmented akan direka untuk berfungsi Bersama dengan buku Realiti Augmented. Peranti Leap Motion adalah penting sebagai peranti input periferi bagi pengguna untuk berinteraksi dengan sistem. Penerapan Peranti Leap Motion dalam projek ini secara lansung dapat meningkatkan interaktiviti dengan gerak-geri tangan yang berbeza seperti ibu jari, mencubit dan menunjuk arah jari. Projek ini sangat berpotensi kerana ia bukan hanya untuk tujuan pendidikan, tetapi juga berkaitan dalam bidang perniagaan, seni bina dan bidang perubatan. Projek ini berjaya melaksanakan Buku Interaktif Realiti Augmented yang boleh berinteraksi dengan Peranti Realiti Augmented.

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LIST OF SYMBOLS AND ABBREVIATIONS

AR	:	Augmented Reality
VR	:	Virtual Reality
SDK	:	Software Development Kit
3D	:	Three-dimension
C#	:	C Sharp
MR	:	Mixed Reality
IDE	:	Integrated Development Environment
DOF	:	Degree of Freedom
DK	:	Development Kit
DVI	:	Digital Visual Interface
USB	:	Universal Serial Bus
HDMI	:	High-Definition Multimedia Interface
IR	:	Infrared
CMOS	:	Complementary Metal-Oxide Semiconductor
OLED	:	Organic Light-Emitting Diode
API	:	Application Programming Interface
QR	:	Quick Response
XML	:	Extensible Markup Language

HTML	:	Hyper Text Markup Language
IOS	:	iPhone Operating System
CSS	:	Cascading Style Sheets
RGB	:	Red-Green-Blue
YUV	:	Luminance (Y) Chrominance (U, V)
LED	:	Light-Emitting Diode
RAM	:	Random Access Memory
AMD	:	Advanced Micro Devices

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CHAPTER 1

INTRODUCTION

Augmented Reality (AR) is an emerging form of experience in which the real world is enhanced by computer-generated content. AR supplements reality augmenting one's immediate surroundings with electronic data or information and digital assets such as audio and video files, textual information, and even old factory or tactile information can be incorporated into users' perceptions of the real world.

Augmented reality uses technology to make such a layer of information accessible to people to blend one's perception of the actual world with digital content about it generated by computer software. This technology comes in a myriad of forms: from wearables and smart glasses that use retinal projection to put a display in the wearer's eyeball (e.g., Google Glass was a very noticeable AR Headset, the Vaunt by Intel is much less conspicuous) to the more commonly used smartphones.

1.1 Project Background

This project will be separated into 3 stages which are Hardware Integration, Software Development, and Test Run for further improvement. The Hardware Integration is to design and implement an Augmented Reality display device by integrating Oculus Rift DK2, C310 Logitech Webcam, and Leap Motion Controller. After that, Augmented Reality Playbook is designed which each marker will be assigned for specific functions. Next, for the Software Development this project will be using Vuforia and Unity3D as platforms to run the Augmented Reality Program. These programs will be used to mark the markers for the location of Augmented Reality objects to appear on the screen. The AR playbook will be tested with the Augmented Reality device. User will have to interact with the virtual objects according to the program. Lastly, the interaction of the user and virtual objects will be analyzed for the further improvement.

1.2 Problem Statement

Oculus Rift Virtual Reality Goggles are not fully utilized. It is only limited to immersive learning in virtual environment. Virtual Reality has its own limitation and one of them is user will be isolated in the VR world. User will be 'teleported' to another world which only the user can experience it. The interaction is restricted to the real environment because user can only engage with objects inside the VR world. The attached webcam on the Oculus Rift will enhance its feature by enabling immersive learning in Augmented Reality environment, with the Oculus Rift itself to be a display screen for the user. In addition, the performance of the Oculus Rift is improved by adding the function of leap motion controller. Now users can interact with the virtual objects using specific hand gestures.

1.3 Objectives of the Research

The aim of this project is to develop an interactive Augmented Reality playbook that can be useful for modern technologies. The following objectives of this project as following:

i. To design and develop Augmented Reality device by integrating Oculus Rift, C310 Logitech webcam, and Leap Motion Controller.
ii. To develop a hand gesture for interactive Augmented Reality playbook that compatible with the Augmented Reality device.
iii. To analyze the interaction performance of Augmented Reality Headset with the AR playbook.

1.4 Scope of Work

This project will be conducted mostly in the Research Lab 3. This project focused mainly on implementing Augmented Reality playbook for Oculus Rift with Leap Motion Controller. For the first stage, design and develop an Augmented Reality display device by integrating Oculus Rift and webcam. The functionality of Leap Motion Controller is add-on to improve the interactivity system of the project. Next, design Marker Based Augmented Reality will be programmed in Unity 3D. Lastly, the implementation of hand gestures interaction such as pinch to grab and stretch to zoom in/out.

1.5 Report Structure

The thesis is organized and arranged into 5 chapters. In Chapter 1, the development of Augmented Reality device and its overview is discussed in the project background. In addition, the problem statement, objective and scope of work will be outlined clearly in this chapter. In Chapter 2, the past studies related to Augmented Reality and reviewed and analyzed. The theory of Augmented Reality will be included in this chapter. In Chapter 3, all methods and techniques that are related to the development of AR playbook will be used and discussed the outcomes. The methods will be explained in block diagrams and flowcharts accordingly. For Chapter 4, the performance of the project will be analyzed and recorded during the test run. The obtained results and data will be determined the project strengths and weaknesses. By this result, the project will be improved to achieve the objectives. In the last chapter, a conclusion will be drawn from the project. In addition, the recommendation for future implementation for this project will be in this section.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the background studies from the related journals and papers on the theoretical background of Augmented Reality. The differences between Augmented Reality and Virtual Reality is analyzed in this chapter. The background and introduction of Oculus Rift and Leap Motion Controller also will be explained in this section.

2.1 First Development of Augmented Reality

A Harvard professor and computer scientist named Ivan Sutherland invented what he called the Sword of Damocles in 1968. With his student, Bob Sproull, he invented this first kind of augmented reality device. Damocles ' Sword featured a head-mounted