Faculty of Cognitive Sciences and Human Development

AUGMENTED REALITY: INTEGRATED FINGER TRACKING METHOD INTO REAL TIME

Tay Chia Huey

Bachelor of Science with Honours
(Cognitive Science)
2008

Lampiran B

BORANG PENGESAHAN STATUS TESIS

Gred:

JUDUL : AUGMENTED REALITY : INTEGRATED FINGER TRACKING METHOD INTO REAL TIME

SESI PENGAJIAN : 2007/2008

Saya TAY CHIA HUEY
(HURUF BESAR)

mengaku membenarkan tesis * ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sarawak
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja
3. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat pendigitan untuk membangunkan Pangkalan Data Kandungan Tempatan
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi
5. ** sila tandakan (√)

☐	SULIT	(mengandungi maklumat yang berdarjah keselamatan atau kepentingan seperti termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat Terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:

Tarikh : 15 Mei 2008

Tarikh: 8 May 2008

Catatan: * Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda
*Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai TERHAD.

AUGMENTED REALITY: INTEGRATED FINGER TRACKING METHOD INTO REAL TIME

TAY CHIA HUEY

This project is submitted in partial fulfillment of the requirement for a
Bachelor of Science with Honours
(Cognitive Science)

Faculty of Cognitive Sciences and Human Development
UNIVERSITI MALAYSIA SARAWAK
2008

This project entitled 'Augmented Reality: Integrated Finger Tracking Method into Real Time' was prepared by Tay Chia Huey and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Science).

Received for examination by:

(Dr. Ng Giap Weng)

Date:

8 May 2009

ACKNOWLEDGEMENT

First of all, I would like to express my thanks to my family for their love and care. Special thanks to my supervisor, Dr. Ng Giap Weng for his supervision and encouragement throughout the study. His support and continuous guidance has kept me on the right track. Lastly, thanks to my fellow friends for their physical and spiritual support.

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

AUGMENTED REALITY: INTEGRATED FINGER TRACKING METHOD INTO REAL TIME

TAY CHIA HUEY

"Augmented Reality" (AR) is the evolution of the computer science field which deals with the combination of real-world and computer-generated data. In past, mouse and keyboard are used as input devices to interact with the computer. AR with finger tracking allows human interact with computer by using human natural sensory. Fingertip is used as a pointing device in this project. Finger tracking method is integrated into real time in this project. Skin colour segmentation and template marching process are used in the finger tracking algorithm. This system works in dynamic environment and recognizes dynamic object in real time. Virtual object will be popping out by using finger tracking algorithm developed in real time.

ABSTRAK

AUGMENTED REALITY: INTEGRATED FINGER TRACKING METHOD INTO REAL TIME

TAY CHIA HUEY

"Augmented Reality" (AR) merupakan evolusi sains komputer yang menggabungkan dunia sebenar dengan data yang dihasilkan oleh komputer. Pada masa yang lepas, tetikus dan papan kekunci digunakan sebagai alat masukan untuk berinteraksi dengan komputer. AR dengan cirri "finger tracking" membenarkan manusia menggunakan sensori semula jadi manusia berinteraksi dengan komputer. Jari manusia telah dijadikan sebagai alat petunjuk dalam projek ini. Dalam project ini, "finger tracking" telah diintegrasikan ke dalam situasi langsung. "Skin colour segmentation" dan "template matching" telah digunakan di dalam algoritma "finger tracking". Sistem ini beroperasi secara dinamik dan dapat mengenal pasti sesuatu objek dalam situasi langsung. Objek maya akan dihasilkan dalam situasi langsung dengan menggunakan algoritma "finger tracking" yang telah dibina.

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter discussed the background, problem statements, research objectives and project scope of this study. The significance of the study and structure of the project are also included in this chapter.

1.1 Background of the Study

Nowadays, computers are becoming less and less visible in our lives, getting smaller, smarter and easy to use (Thomas Brown & Richard C Thoams, n.d.). Some advanced technology has introduced to improve the interaction between human and computer. Augmented Reality (AR) technology has been introduced to interact with computer effectively.

AR system is the system which mixes the physical surrounding with the virtual object to enhance the perception of surrounding. There are some characteristics of AR which are:

- combines the real environment with virtual objects
- interactive in real time

- registered in three dimensional (Vallino, 2002)

Besides that, AR also provides interaction between the users and the AR system. It allows users to decide when, where and how to be augmented. For a long time, there are a lot of methods to interact with the computer such as mouse, keyboard, tablet, joystick, trackball, pen input and touch screen (Hardenberg, 2001b). However, it is not in two-ways interaction.

Since human is able to sense and interact with environment by using their natural sensory such as ears and eyes, therefore the interaction between human and computer has been improved by using human natural sensory. The interaction between human and computer has been improved effectively by using human natural sensory. Human natural sensory provides direct interaction between human and computer. Human natural sensory as input device of system does not involve any device and very easy to use (Hardenberg, 2001b). Theoretically, nowadays there are computers and machines which can mimic human abilities and perform some of the human tasks such as calculation (Lim, 2005).

The purpose of this study is to integrate the finger tracking into real time. User's fingertip will be used as the input device of the AR system. Mostly, the finger tracking applied in AR system is aimed to replace the mouse function such as clicking and pointing in real time (Hardenberg, 2001b).

1.2 Problem Statements

Currently, most of the virtual objects are developed using the ARToolkit except for developing the system that popping out the virtual object when interacting with the object in real environment. Beside that, most of the AR research was on one-way communication (Kaufmann, 2004). This type of interaction is not very effective since the interaction of human and computer does not work effectively.

On the other hand, the use of expensive devices like wired device, gloves and infrared camera in other research is a big problem to society (Kaufmann, 2004). It is

because not all level of society can purchase the device since the cost is expensive. Therefore, it is not widely introduced and used in the society. In addition, the use of those devices such as wire device and gloves might cause users to feel uncomfortable. Such feeling might cause the users reluctant to use the devices and the application or technologies which need those devices for functioning.

In this study, finger tracking will be integrated to the real time. The system developed is able to detect dynamic shape in real time and replace the mouse and keyboard by using user's fingertip to improve interaction between human and computer. The virtual object will appear as long as the camera is detecting fingertip that is pointing on the rectangular or rectangle object in real time.

1.3 Research Objectives

Therefore, the objectives of this study are as below:

i) To integrate the finger tracking method in real time

ii) To pop out the three dimensional object using finger tracking algorithm developed in real time

1.4 Scope of the Project

The scope of this project is to detect a dynamic object which is in rectangle or rectangular shape in real time. Other shapes such as triangle or sphere are not considered in this study. The function will only work well in certain background and lighting condition.

In addition, the study only uses a single fingertip as input device. The system will detect the fingertip and recognizes it as pointing device. The system is able to detect the fingertip without any marker or device attached to the finger.

1.5 Significance of the Study

This study is a new approach to pop out the virtual object by detecting the shape of the object in real time. By using the algorithm developed, the virtual objects will not appear without detecting the fingertip pointing on the rectangle or rectangular object during real time. Therefore, the virtual object will not pop out right after the system is executed. In future the use of keyboard and mouse might be ignored and replaced by human natural sensory such as fingertip in more research.

1.6 Structure of the Project

This project consists of five chapters, which are introduction, literature review, research methodology, system development, discussion and conclusion of the study. For Chapter 1, the background of the background, problem statements, research objectives, project scope, value of study, significant of study and structure of the project would be included.

In Chapter 2, some literature reviews related to the study are discussed. Some previous works done by researchers around the world were also included in this chapter. The research methodology used in this study is included in Chapter 3. The conceptual design, system architecture, system flow, system specifications and evaluation were included.

Chapter 4 consists of the screen shots of the system interface and the system development of this study. Some functions implemented in this study were explained in this chapter. Chapter 5 will focal point at the discussion and conclusion of the study. Strengths and weaknesses of this study, contributions and recommendations for future researchers were also included in this chapter.

1.7 Conclusion

This chapter is the introduction of the research. In this chapter, the background, problem statements, research objectives, scope of project, significance and the structure of the project are included. The following chapter will discuss the literature review related to this study.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will discuss literatures related to this study. This chapter consists of introduction to Augmented Reality, Augmented Reality system, previous works, edge detection and image segmentation.

2.1 Introduction to Augmented Reality

Augmented Reality (AR) is a variation of Virtual Reality (VR) (Kaufmann, 2004). AR system is the system which mixes the physical surrounding with the virtual object to enhance the perception of surrounding. There are some characteristics of AR which are combined the real environment with virtual objects, interactive in real time and registered in 3D (Vallino, 2002). Besides that, AR also provides interaction between users and AR system. It allows the user to decide when, where and how to be augmented.

Milgram had come out with an idea known as "Reality-Virtuality Continuum" (Vallino, 2002). Figure 2.1 shows the Milgram's Reality-Virtuality Continuum.

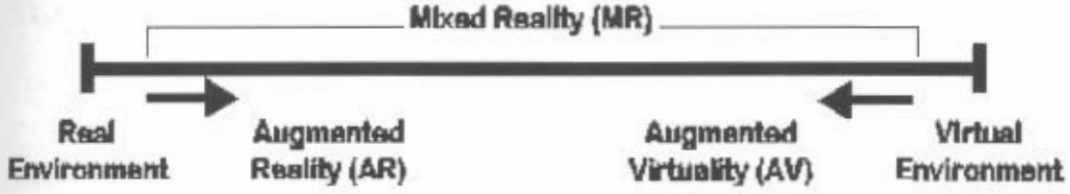

Figure 2.1 – Milgram's Reality-Virtuality Continuum (Vallino, 2002)

According to the Figure 2.1, the real environment and the virtual environment are at the two ends of this continuum respectively. The middle region between the real environment and virtual environment is called Mixed Reality (MR). The MR consists of Augmented Reality (AR) and Augmented Virtuality (AV). AR is close to the real environment end while the AV is near to the virtual environment. In AR environment, the whole environment is real and there is only an object is in three dimensional while an AV environment is three dimensional and only an object is real.

There are some differences between AR and VR. The main difference is in terms of the immersiveness of the system. Users who use the VR technology will be completely immerse in the virtual environment. At the same time, the real environment is blocked by the Head Mounted Display (HMD) worn by users during the immersion (Kaufmann, 2004). On the other hand, AR allows users to see the virtual objects in the real world but is not replace the real environment with the virtual environment (Kaufmann, 2004). Therefore, we can say that AR technology allows users to focus on the interest which is the virtual object in the real world.

The AR technology has been applied in many different fields such as education, training, assembly, repair and maintenance, manufacturing, medicine, military and so on. For example, the Boeing Company has developed an AR system which can be used to guide the technician with the assembly of the aircraft (Curtis, Mizell, Gruenbaum & Janin, 1998). The technician can repair the machine by using the instruction available and therefore he does not need manual book to guide him. In addition, the doctor can perform a surgery by the help of the AR technology. The AR technology provides the surgeon with the ability to visualize the insides of a patient (Schwald, Seibert & Weller, 2002).

2.1.1 AR System

An AR system could be considered as the ultimate immersive system. The users cannot become more immersed in the real world. According to Milgram (1994), the AR system can be divided into two classes which are monitor based and see-through AR system.

The common components that are always presented in the AR system are as below:

I. Display
II. Tracking system
III. Devices for interaction
IV. Graphic system such as computer

Figure 2.2 shows the components of an AR system (Vallino, 2002). A video camera is used as an imaging device to analyze the real scene image. Then the video camera will change the real scene image from three dimensional forms into two dimensional forms. The image on the image plane is fully dependent on the intrinsic and extrinsic parameter of the imaging device. The virtual image will be combined with the real scene image to form AR image through a standard computer graphics system (Vallino, 2002).

An AR system must be simple to use and can provide users with clear information. The system must have the ability to let the user to key in the information easily and provide transparent but complex procedures to the users. Furthermore, an AR system must provide interaction between each other, easy to install and in cheaper cost (AREL, 2006).

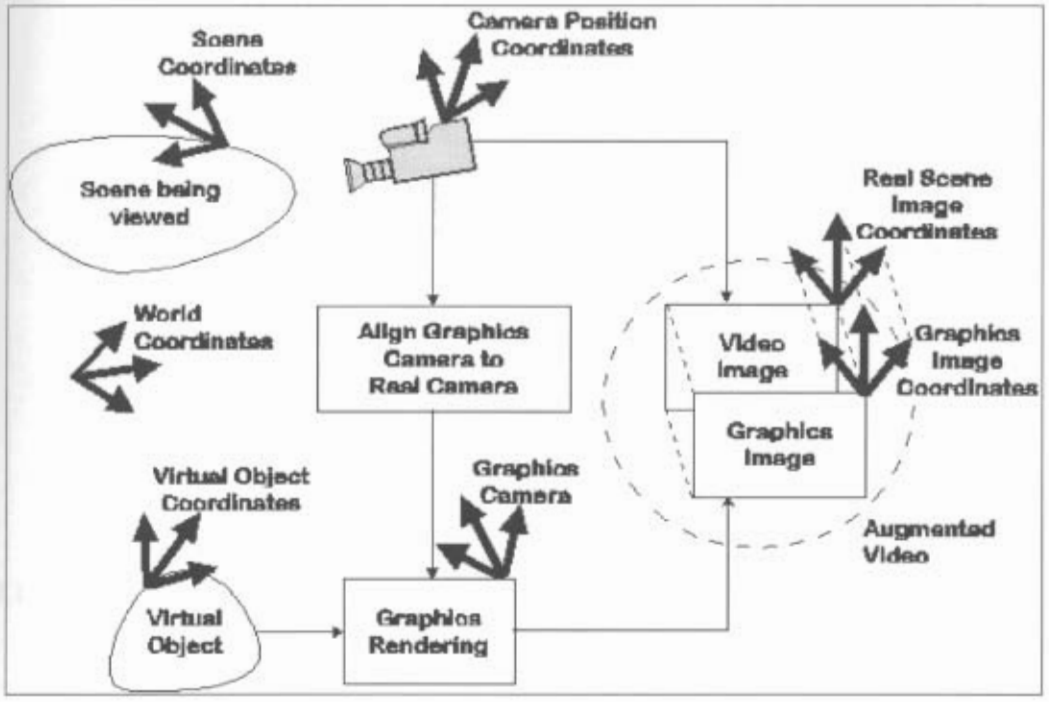

Figure 2.2 - Components of an AR System (Vallino, 2001)

2.1.1.1 Monitor-Based AR System

According to Milgram (1994), monitor-based AR system is also known as "window-on-the-window" (WoW). The users observe the augmented environment through a window such as the computer monitor. In addition, users view the virtual object and the real environment without wearing special glasses (Dipl, 2002). That means this AR system can eliminate the HMD problem. The real environment will be recorded and combined with the graphic images and then displayed on the monitor. This AR system is always used for telepresence application. The Figure 2.3 shows the Monitor-Based AR conceptual diagram:

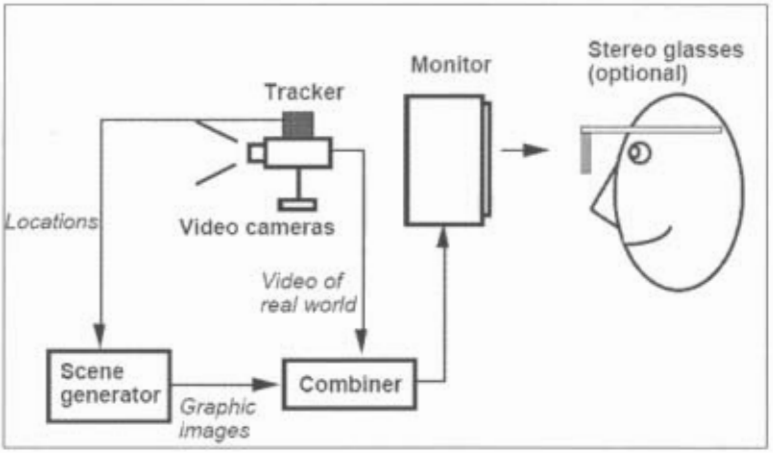

Figure 2.3 - Monitor-Based AR conceptual diagram (Azuma, 1997)

2.1.1.2 See-Through AR System

The see-through AR systems are more complex as compared to monitor-based AR system. This AR system provides users with whole surrounding of the environment so that the users can reach maximal perception of the real world (Dipl, 2002). HMDs are used to allow the users interact with the virtual environment directly over the real environment.

There are two types of see-through AR systems which are optical see-through and the video see-through (Azuma, 1997). Both of the AR systems differ in the way the resulting image is composed. The video see-through AR system is similar to the monitor-based AR system. The real environment will be recorded and combined with the graphic images and then displayed on the monitor. Optical see-through AR system is worked by putting optical combiner in front of the user's eyes. The users can see the real environment directly from the combiners since those combiners are partially transmissive (Azuma, 1997). Usually the optical see-through AR system is used in military aircraft. Figure 2.4 represents the Optical see-through HMD conceptual diagram and Figure 2.5 represents the Video see-through HMD conceptual diagram.