

MEASURING USING AUGMENTED REALITY APPLICATION

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BISMILLAHIRRAHMANIRRAHIM

Thanks to ALLAH S.W.T

To my precious family.

For their undivided love and attention.

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ABSTRACT

This project is to create an application of object distance measurement using Augmented Reality tool (ARToolkit), to improve ARToolkit tool by implementing object distance measurement technique using C++ programming in Visual Studio software and to use simple camera in order to measure object distance. The technologies nowadays are very highly develops and it may give our lives a new interface and thus make it more accurate. One of the technologies that able to do so is the Augmented Reality (AR) technology. Traditionally, we have used common measurement tools such as rulers, robots, and lasers to measure objects. The drawbacks of such measurement could led to the high maintenance cost, consuming lot of times, and human resource. Hence, it is important to have new technology such as Augmented Reality (AR) system that could help to minimize the cost and increase the accuracy of measurement.

ABSTRAK

Projek ini bertujuan untuk menghasilkan sebuah aplikasi yang boleh mengukur jarak antara objek dengan kamera dengan menggunakan ARToolkit sebagai perisian utama. Ia juga untuk menambahbaik ARToolkit bagi mengaplikasikan pengukuran jarak dengan menggunakan teknik programming C++ dalam Visual Studio. Selain itu, projek ini dihasilkan bagi menggunakan kamera yang mudah didapati dalam kehidupan seharian bagi mengukur jarak objek dan kamera. Pada mulanya, kita menggunakan alat-alat seperti pembaris, robot dan laser untuk mengukur objek. Tetapi terdapat kelemahan iaitu kos selenggaraan yang tinggi, mengambil masa yang lama dan juga menggunakan banyak tenaga untuk mengekalkan mutu dan prestasi yang jitu. Teknologi pada hari ini boleh digunakan untuk memudahkan kehidupan seharian. Oleh itu, adalah penting untuk kita menggunakan dan mencipta aplikasi melalui sistem Augmented Reality (AR) untuk memajukan diri, bangsa dan negara menuju kearah modenisasi.

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LIST OF ABBREVIATION

3D	-	3 Dimensional.
AR	-	Augmented Reality.
CGI	-	Computer Generated Images.
FPS	-	First-Person Shooter.
GPS	-	Global Positioning System.
GUI	-	Graphic Use Interface.
HMD	-	Head-Mounted Display.
HMS	-	Head-Mounted Sight.
MR	-	Mixed Reality.
PDF	-	Passive Detection Framework.
PIP	-	Personal Interaction Panel.
RCE	-	Restricted Coulomb Energy.
VE	-	Environment.
VR	-	Virtual Reality.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

With the enhancement and modern technology nowadays, comes up a new diversity of Virtual Reality (VR) known as Augmented Reality (AR). Many studies and researches had been done as it been around for the last 40 years, since 1960s. Augmented Reality (AR) is a variation of Virtual Environment (VE) or Virtual Reality (VR). In VE, the users completely immerse in an artificial world where the real world is replaced by computer-generated environment or object and it allows user to interact with it. While in AR, it allows user to see the real world as well as the computer-generated objects at the same time. It superimposes or overlays the computer-generated objects on the real world objects and creates an environment where the real and virtual objects coexist together. Thus, user can see both the computer-generated objects and the real environment simultaneously (Azuma, 1997).

As in his paper, A Survey of Augmented Reality (Azuma, 1997) stated that an AR system should have the characteristics as listed below:

1. It combines the real and the computer-generated objects in the real world environment.
2. It is interactive in real time.
3. Register the virtual objects in the real world environment.

Since the last 40 years, many researches done in order to integrate AR in humans' tasks to ease the difficulties within. It applied in different kind of fields such as medical, manufacturing, visualization, entertainment etc. It is hope that as the time pass, it will be a part of humans' daily life. With the presence of AR technology, a new exposure is given for the humans to explore new things. In this matter specially, the AR technology can help enhance our measuring technique and in the future, maybe develop a new application to measure our surroundings.

1.2 Problem Statements

The technologies nowadays are very highly develops and it may give our lives a new interface and thus make it more accurate. One of the technologies that able to do so is the Augmented Reality (AR) technology. Traditionally, we have used common measurement tools such as rulers, robots, and lasers to measure objects. The drawbacks of such measurement could led to the high maintenance cost, consuming lot of times, and human resource. Hence, it is important to have new technology such as Augmented Reality (AR) system that could help to minimize the cost and increase the accuracy of measurement.

1.3 Goal

The goal of this project is to develop an Augmented Reality version of measuring length or distance between camera and object using ARToolKit.

1.4 Objectives

The objectives of the project are to:

- i. To perform study on the Augmented Reality (AR) application for measuring distance.
- ii. To simplify everyday work on using Augmented Reality (AR) from converting object measurements to the computer screen.
- iii. To develop object distance application using ARToolKit that is capable to measure the length between camera and object.

1.5 Scopes

The scopes of the project are:

- i. To create an application of object distance measurement using Augmented Reality tool (ARToolkit)
- ii. Improving ARToolkit tool by implementing object distance measurement technique using C++ programming in Visual Studio software.
- iii. To use simple camera in order to measure object distance

1.6 Justification

Nowadays, the technology around us is expanding fast to keep up with the modern world. Everything has an upgrade or alternative to make our everyday tasks simpler and hassle free. Augmented Reality (AR) is a well-known application in today's society. It is a variation from Virtual Reality (VR) or Virtual Environment (VE) and has been developed since 1960s.

With this project, we are aiming to minimize the time and energy that is used to measure equipment using Augmented Reality (AR). Instead of using the traditional ways of

measuring, this method can replace the modern ways of living. In the future, this method maybe can be used to measure buildings and help architecture to plan their work precisely.

1.7 Report Organization

The following briefly explains the matters concerning what will be discussed in the few next chapters:

Chapter 1

This chapter discussed about the introduction to the project such as the common fact related to Augmented Reality (AR), determining the focal point of the project and the benefits or the justification of the project.

Chapter 2

Literature Review of the project will be discussed in this chapter. Few things have been discussed here are common history about AR, the fields that used AR technology, researches and study been done around AR beforehand. Besides that, the toolkit or software is also explained in this chapter.

Chapter 3

This chapter explains the methodology of this project. It mentions about the research approach, the development and few other things. In simple word, this chapter states the steps that need to be followed along the development process so that the project will meet the expectation.

Chapter 4

Discuss the development of the project systematically and also, the result for the project.

Chapter 5

Future work that can help improve this project. Conclusion of the entire project discusses here in this final chapter. It discusses thoroughly for all in previous chapter before it has been conclude.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature review is the background study of the project that carried out before we develop our proposed system. It enlightens few things related to Augmented Reality (AR) and ARToolKit in order to get the picture of the whole thing before we proceed further. In this chapter, first it discusses about Augmented Reality's history, fields that had applied it and the display equipment for it. The last part explains about the ARToolKit

2.2 Introduction to Augmented Reality

Augmented Reality (AR) is one of the computer researches that concerns about the combination of the real world with the computer-generated imagery. For example, an AR user might wear a translucent goggle where through it; he could see the computer-generated images imposed on the real-world environment. Augmented Reality (AR) is a technology that superimposes real-time

computer-generated information with the physical surrounding of an individual. It also defined as referring to cases in which the real environment is augmented by means of virtual objects (Milgram and Kishino, 1994). The ultimate goal of AR is to blends all the parts: real or virtual objects seamlessly together that it convinces that the whole environment is a real one.

One of the main differences of AR and VR is the environment. In Virtual Reality (VR), the computer generates the environments fully. The user completely immerses in a synthetic environment. While in AR, the user can see both the real world and the virtual objects at the same time as the virtual objects are composited into the real world. The AR considered as supplements of reality, rather than completely replace it (Azuma, 1997). Both VR and AR make up the Mixed Reality. Mixed Reality (MR) refers to the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real-time.

In 1994, Paul Milgram and Fumio Kishino defined MR as "*...anywhere between the extrema of the **virtuality continuum.***", where the Virtuality Continuum extends from the completely real through to the completely virtual environment with augmented reality and augmented virtuality ranging between.

Through the figure, the left end is the real environment while at the other end is the environment that immersed the user in virtual world. Moreover, as it stated, AR placed more closely to real environment as it hold some virtual objects that overlap with the actual environment. The inverse case where real world contained contributes to synthetic surroundings called augmented virtuality (Milgram and Kishino, 1994).

AR also defined as the middle ground between VR (completely synthetic) and telepresence (completely real) by Milgram (1994a) (1994b). While Azuma (1997) also mentioned that, three (3) characteristics make up an AR system, which are:

- i. Combines real and virtual.
- ii. Interactive in real time.
- iii. Registered in 3D.

2.2.1 History of Augmented Reality

Richard Wagner introduced the idea of immersive in a different environment in 1849. His idea was to place the audience in a darkened theatre and surround them in imagery and sound. This idea later has been applied in the Mixed Reality (MR). Then in 1948, came cybernetics; a technology that can transmit messages between man and machine by Norbert Wiener. In 1962, Morton Heilig who was a cinematographer, applied the idea of Richard Wagner and creates Sensorama. It incorporates visual, sound, vibration and smell to a motorcycle simulator. The major change was in 1966 as Ivan Sutherland invented the head-mounted display and he suggested that it was a window into a virtual world. Nine (9) years later in 1975, Myron Krueger created VideoPlace that allows users to interact with virtual objects. It creates an artificial reality that surrounded the users and responded to their movements and actions. The phrase Virtual Reality has been coined by Jaron Lanier, the founder of VPL Research in 1989 and thus creates the first commercial business around virtual worlds. A year later, in 1990 Tom Caudell comes up with the phrase “Augmented Reality” while helping the workers assembling cables into an aircraft.

As the new millennium started, great numbers of AR game emerged. In 2000, Professor Bruce H. Thomas makes a prototype of ARQuake, an AR version of Quake. Later, it has being improved by Dr. Wayne Piekarski. Then come, the Invisible Train by Daniel Wagner of StudierStube in 2004. Through 2005 to 2006, a group of Upper Austria University’s students developed a multi-user AR racing game named The Neon Racer. Another latest prototype of AR technology is EyeToy by Sony. It a responsive virtual game that responds to every movement made captured by the camera. It has different way of play from the conventional game that use console.