UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF 3D IMAGE FROM CAMERA FOR ROV NAVIGATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunication) with Honors.

by

MUHAMMAD IQMAL REDZA BIN MOHMAD WAHI

B071610075

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Alamat Tetap:

LOT 14992, KG JOHAN SETIA

KM8, JALAN LANGAT

41200 KLANG

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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Indusrial Electronics) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor: IR. TS. MOHAMMAD ‘AFIF BIN KASNO

ABSTRACT

This project will present the Development of 3D Image from Camera for ROV Navigation. The underwater Remotely Operated Vehicles is mounted by the camera navigation system by using 3D Laser scanner. 3D image processing also include as the monitoring system to display the 3D image view of an object scanned. The camera will captured the line laser light projecting to the object and reflected back to the camera while rotate using stepper motor. Both data from the camera and motor angle was collected and give the output to the image processing. These data will used to create 3D image processing by using Processing IDE software. The 3D image produced will show the distance between the object surrounding the ROV. The analysis of this project is to prove the image capability of the ROV when it submerge into the water for 3D scanning.

ABSTRAK

Projek ini akan membentangkan Pembangunan Imej 3D dari Kamera untuk Navigasi ROV. Kenderaan bawah laut yang dikendalikan dari jauh dipasang oleh sistem navigasi kamera dengan menggunakan pengimbas Laser 3D. Pemprosesan imej 3D juga termasuk sebagai sistem pengawasan untuk memaparkan paparan imej 3D objek yang diimbas. Kamera akan menangkap cahaya laser garisan yang menonjol ke objek dan dipantulkan kembali ke kamera semasa berputar menggunakan motor stepper. Kedua-dua data dari sudut kamera dan motor dikumpulkan dan memberikan output kepada pemprosesan imej. Data ini akan digunakan untuk membuat pemprosesan imej 3D dengan menggunakan perisian Processing IDE. Imej 3D yang dihasilkan akan menunjukkan jarak antara objek yang mengelilingi ROV. Analisis projek ini adalah untuk membuktikan keupayaan imej ROV apabila ia menenggelamkan di dalam air untuk pengimbasan 3D.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.0 Introduction

Unmanned underwater Remotely Operated Vehicles (ROV) are the most developed platforms for automated deep-sea surveillance and surveying. In sea exploration and environmental research, tracking and surveying as well as inspection, optical imaging is best suited for testing fine-scale group features over the local fields. In specific, high-resolution two-dimensional (2D) and three-dimensional (3D) mapping, preferably based on image processing are two main capacities to take advantage of the elevated data rate and optical imaging system resolution.

1.1 Background

In the latest years, in areas such as human-machine communication, mapping, and films, 3D imaging devices have improved performance. These equipment provide post-processing raw 3D information to achieve 3D data measurement. This growth is regarded as 3D recovery and is now seen as a tool for extending applications from medical diagnostics to photogrammetry, heritage reports or machine design and production. Due to the recent advances in science and technology, large ocean areas, including deep-sea regions, are becoming accessible to manned and unmanned vehicles; the recent data is available for underwater 3D restoration.

Using an underwater excavation site recording, scientists are generally prepared to obtain and communicate with appropriate 2D or 3D representations using the ordinary software system. This software enables engineers to add readings, annotations or illustrations to the design generating documents for graphics. These graphics documents assist to comprehend the web by offering an extensive and

thematic summary and interface with expert information (pilots, biologists, anthropologists, etc.) that allows proper access to a collection of heterogeneous information.

1.2 Problem Statement

Most advanced 3D sensors are intended to operate under air circumstances. Within the 3D restoration of underwater images and seafloor mapping. However, these is the primary objective. This collection of information will be carried out from a 3D camera scanner controlled by a towed body, an underwater Remotely Operated Vehicle (ROV). The 3D imaging system have some problem when it perform in underwater environment. These problem are different from conventional system such as:

1. Significant dispersion and light diffusion that confines the system's operational ranges.
2. Interfaces interrupting the screen parameter and the effectiveness of image processing algorithms between the sensor and the atmosphere via the water-glass-air [1].
3. The intensity of light can cause the camera to record in particular tasks a flawed 3D image and depth.

These problem can affect the performance of an underwater imaging system. The range, resolution and the accuracy of the parameter need to be improve to ensure the possibilities of perfection of underwater imaging system.

1.3 Objective

Based on the problem statement discussed above, the objectives of this study are:

i. To study the performance of ROV navigation by using 3D image processing.

ii. To develop a 3D image camera that can differentiate the distance between the object surrounding from ROV.

iii. To analyse the imaging capability for 3D scanning for underwater condition.

1.4 Scope

The scope of this research work are established on the objectives that mentioned. In this project, the 3D laser scanner is mount to the underwater Remotely Operated Vehicles (ROV) as the camera navigation. The 3D laser scanner consist of camera and line laser module are the equipment to differentiate the distance and depth between two object. Lastly, a glass dome will use as the protection for 3D scanner when underwater condition and the process will test during low light place.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

In this chapter, the purpose of this literature review is to analysis previous projects and research that done by other researcher on 3D image processing operates and integrated with the ROV. Meanwhile, the legitimacy of past research will be discussed and determine. Similitude, literature that was explored incorporated the algorithm, image processing, programming, PID tuning etc. Methods and results in past papers will be contrasted and assess all together with creating great philosophies for the fruition of this project.

2.2 Background History

The first 3D technology was invented by David Brewster in 1844. The invention was the beginning of photography is 3D photographic images taken by the stereoscope. By using the improvised technology, in 1851 Louis Jules Duboscq was taken the image of Queen Victoria at the Great Exhibition. The stereoscopic cameras became famous throughout the world [2].

Because of the enhancement of 3D technology throughout the years, a stereo the animation camera called Kinematoscope was invented and anaglyph's first movie was produced in 1915 using the same technology. The first 3D colour film was created in 1935. In the 1960s, a new technology called Space-Vision 3D was created. This technology replaced the usage of 2 camera to show 3D movies. Stereovision created a new 3D technique using a unique anamorphic lens to enlarge the image using a set of polaroid filters in 1970.

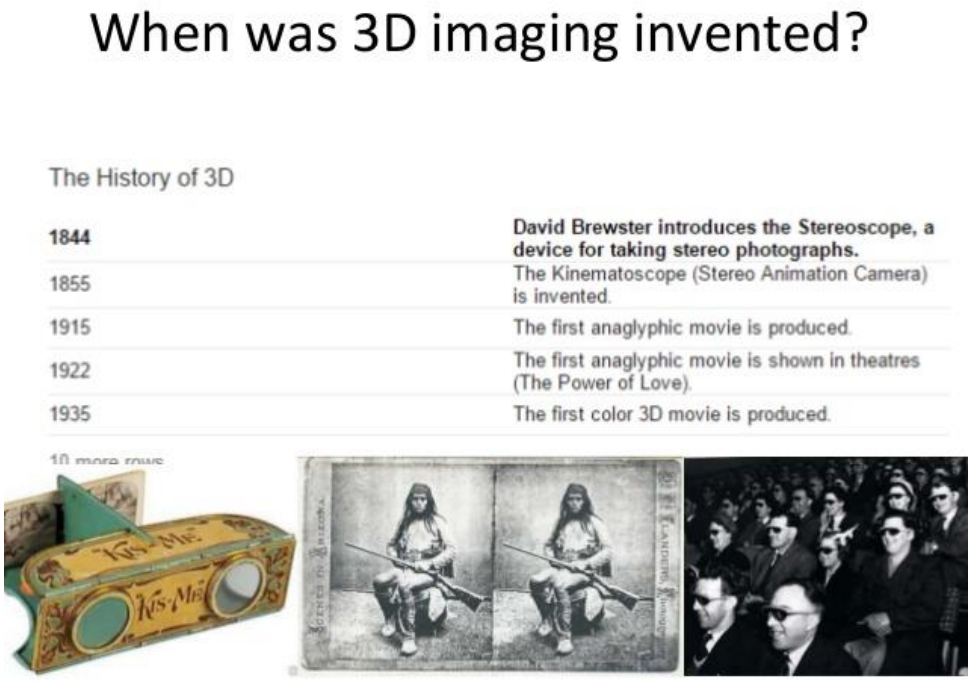

Figure 2.2.1: History of 3D imaging

With revolutionary motion management experiences, the new 3D technology already provides nice hints of things to come within the entertainment and gaming world. Extremely rich information visualization, explored interactively in 3D area, with the new 3D technology, following generation movement control experiences are already here [3]. There is no denying that perfection is still needed for the new 3D technology. Thus, the people realize the pitfalls, for example, using the 3D lenses can cause the image to dim obviously. Simply tilting your head can also create image ghosting and colour changes. Several individuals might experience headaches and sickness while viewing 3D for a substantial amount of time. But these issues have been overcome by the incredible latest 3D technology and it is the next big thing in home entertainment.

The long history of 3D technology still continues. In the coming years, as expected 3D technology can be more advanced and expand throughout the entire world.

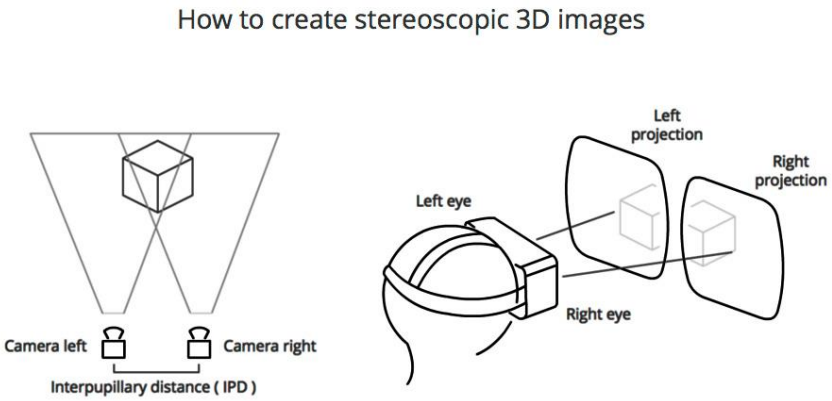

Figure 2.2.2: Stereoscopic 3D images

2.3 Related Work

2.3.1 Study and Development of 3D Monitoring System for ROV by Using Arduino with IMU Sensor

Based on the report, this project is about developing the 3D processing image and parameter for underwater Remotely Operated Vehicle (ROV). The system that had been developed will displayed 3D image and data about heading, pitch, roll and yaw by using accelerometer with the help of magnetometer. The gyroscope sensor were added for the angular rate of the ROV. The sensors connect to the Arduino Uno and then combine with the MultiWii and Processing IDE to display the information. The project were successfully develop and collaborate with the Bumi Subsea (M) Sdn Bhd.

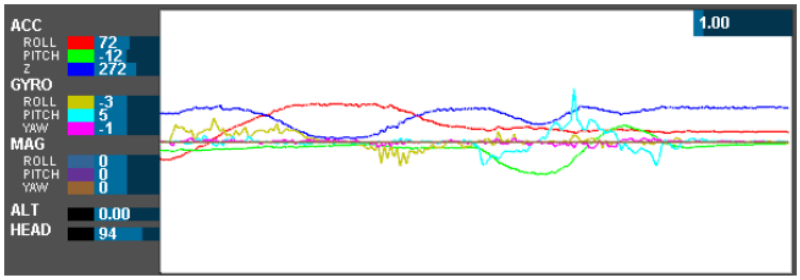

Figure 2.3.1.1: The Reading of Roll, Pitch, and Yaw in Multiwii

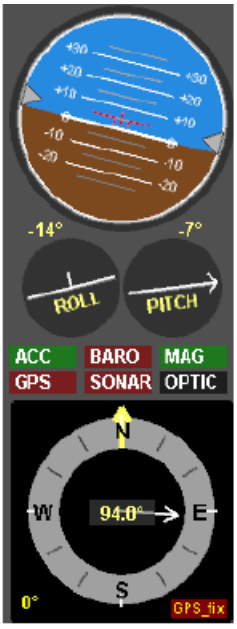

Figure 2.3.1.2: The GUI of Roll, Pitch, and Yaw in Multiwii

To achieve the aim of this project, the developer use multiple hardware integration such as the interfacing between Arduino UNO and IMU sensor to sending a RAW data of X-axis, Y-axis, and Z-axis from IMU sensor to display on the Serial Monitor in Arduino IDE. The collected data will be used to make the algorithm of noise filter and creating in 3D image processing. Next step is to develop 3D image processing by using data from the Arduino IDE Serial Monitor. Since the Processing IDE can interface with Arduino, the output data will be the source of input data in the Processing IDE. The 3D image needed the X, Y, and Z axis coordinates and the shape of 3D image to build a code. This project was using Multiwii software by

synchronizing the IMU sensor via Arduino to show the parameter of Heading, Pitch, Role, and Yaw. In order to integrate with Arduino, Multiwii Firmware were modified to include several libraries in the Arduino. These libraries will enabling the function of Accelerometer, Gyroscope, and Magnetometer of the IMU sensor. The main focus for the developer is to see the behaviour of IMU sensor interfacing with Multiwii via Arduino [4].

Figure 2.3.1.3: 3D Image Processing in Processing IDE