SYNCHRONIZATION OF COMPASS MODULE WITH PRESSURE AND TEMPERATURE SENSOR SYSTEM

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DEGREE OF BACHELOR OF MECHATRONIC

2010

"I hereby declared that I have read through this report entitle "Synchronization of Compass Module with Pressure and Temperature Sensor System " and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronics"

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Date : 12/5/2010

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A report submitted in partial fulfillment of the requirement for the degree of Bachelor of Mechatronic

FACULTY OF ELECTRICAL ENGINEERING
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APRIL 2010

I declare that this report entitle "Synchronization of Compass Module with Pressure and Temperature Sensor System" is as a result of my own work except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

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Date : 12/5/2010

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ABSTRACT

Along with the world moving forward, part of the job requires us to control it from far away. As a simple example, a surgeon in the West can control and manage the actual surgery takes place in the operating room in the Eastern world. The same concept has been applied to this project. In general this project is the result of a combination of existing technology to produce a complete system that aims to identify the position of the Autonomous Underwater Vehicle, better known by AUV based on the degree of the AUV. This can be done with the help of compass module that can find and order the AUV is moving at a fixed angle. This created a system that aims to obtain data on pressure and temperature in the water around the AUV. Not only that, the project also aims to prove that the relationship between pressure and depth of the water and the relationship between pressure and temperature. All data gathered is capable of helping in the preparation of an AUV that can accommodate high pressure according to the depth to destination.

ABSTRAK

Seiring dengan keadaan dunia yang bergerak maju, sebahagian daripada pekerjaan memerlukan kita untuk mengawalnya dari jarak yang jauh. Sebagai satu contoh yang mudah, seorang doktor bedah yang berada di Barat dapat mengawal dan mengatur pembedahan yang sebenarnya berlaku di dalam bilik pembedahan di bahagian Timur dunia. Konsep yang sama telah diterapkan untuk projek ini. Secara amnya, projek ini adalah hasil gabungan beberapa teknologi yang telah wujud untuk menghasilkan satu sistem yang lengkap bertujuan untuk mengenal pasti kedudukan Autonomous Underwater Vehicle atau lebih dikenali dengan AUV berpandukan pada kedudukan darjah AUV tersebut. Ini boleh dilakukan dengan bantuan compass module yang mampu mengetahui kedudukan dan mengarahkan AUV itu bergerak pada suatu sudut yang ditetapkan. Sistem yang dicipta ini juga bertujuan untuk memperolehi data mengenai tekanan dan suhu dalam air di sekeliling AUV tersebut. Bukan itu sahaja, projek ini juga bertujuan untuk membuktikan bahawa hubungkait antara tekanan dan kedalaman air serta hubungkait antara tekanan dan suhu. Semua data yang diperolehi ini mampu membantu dalam menyediakan sebuah AUV yang mampu menampung tekanan yang tinggi berpandukan kepada kedalaman yang ingin ditujui.

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GPS	Global Positioning System
AUV	Autonomous Underwater Vehicle
PIC	Programmable Integrated Circuit
SLAM	Simultaneous Localization and Mapping
DGPS	Digital Global Positioning System
DC	Direct Current
BPS	Barometric Pressure Sensor
SCK	Serial Clock
SDO	Serial Data Master Out
SDI	Serial Data Master In
CSB	Chip Select
CDC	Capacitance to Digital Converter
USB	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.0 Introduction

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducer, pressure transmitter, pressure sender, pressure indicator and piezometer, manometer, among other names.

The HMC6352 integrates Honeywell's patented two-axis magnetic sensor with the required analog and digital support circuits for heading computation. For the ultimate in electronic functionality, this innovative electronic compass provides an electronic compass function using two-axis magnetic field sensing. Honeywell's digital compass combines the sensor elements and all the processing electronics in a 6.5mm square package to satisfy smaller, next generation applications. Aimed for low power battery operation on OEM printed circuit boards, the HMC6352 uses an I2C digital interface slaved to the manufacturer's microprocessor to transfer compass heading data. Heading update rates from 1 to 20Hz are selectable.

Throughout the history, navigation system formerly is a very rare system in the past few decades because of its specialty in determining location and as guidance to go anywhere but it was tremendously grown in today's world. The concept of this navigation system is drawn since the beginning of time; mankind has been trying to figure out dependable way to know where they are and to guide them from one place to another.

This system is designed and built and is operated instead of maintained by the United State Department of Defense under its NAVSTAR satellite program in 1973. In 1978, the system is firstly used in US military to carry the Polaris nuclear missile by six satellites. By mid 1990's the system is fully operated with up to 24 satellites. Since it became fully operational on April 27, 1995, navigation system has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, tracking and surveillance, and hobbies such as geocaching. Also, the precise time reference is used in many applications including the scientific study of earthquakes and as a required time synchronization method for cellular network protocols such as the IS-95 standard for CDMA.

From the benefits of this very sophisticated technology, a navigation system can be developed in order to have the clearer along the desired path. Normally in navigation system, it involves a reference point which calls the waypoints. These waypoints are set by the diver or the person who needs to know her or his direction and then, the navigation process is taking the part to navigate the person to the set waypoints. From its definition, navigation is the process of planning, reading and controlling the movement of a craft or vehicle from one place to another. This former Latin word use is also give the meaning as "to move" or "to direct". Thus, with some research and development also with the use of other device, navigation system can be used as a medium to navigate a craft or vehicle for a wide variety especially in navigation system.

1.1 Problem Statement

Besides all the sophisticated technologies in the system, it still has a major lack which is land navigation cannot be applied directly for underwater navigation even the satellite being used since the terrain under the water is not as on land. The fact is underwater cannot transmit any compass module signal and thus, some modification need to be done to navigate the Autonomous Underwater Vehicle (AUV). The underwater vehicle such as submarine also needs the navigation so that its location can be known. As we know, it is very hard to know the location of the vehicle when it is under the water, thus in such instances, if there is any emergency cases, the vehicle cannot be tracked and will not be able to get some help from people outside. This project is to reconcile this problem by addition of the barometric pressure sensor to synchronize with the compass module to be able to detect the location of the AUV when the AUV is above the sea level.

For the time being, our world is already have Predator ETA that is used in military section to get a clear view what is happening in some country. For example, film Transformer used this tiny airship to determine what happen in Qatar before sending reinforcement to support their man. In this project, the objectives are to develop an Autonomous Underwater Vehicle with a navigation system to help in military section to do an investigation underwater as same as Predator ETA that being used as an airship spy.

1.2 Project Objectives

As important as the other part, the project objective must be clearly defined so that the directions of the project always keep on track. After clearly understand the problem statements, the purpose of this project is restricted to one major and general objective that hopefully can be achieved throughout project completion. The project objective is focused to:

1) To develop a barometric pressure sensor system and temperature sensor system of the Autonomous Underwater Vehicle (AUV) with synchronizing the compass module and to implement a program to

synchronize the compass module with the pressure and temperature sensor.

1.3 Scope of Project

In pursuit of the objective, this project has several scopes that will be covered both in technical report and also in system technologies combination process. Other than that, this project also will cover the setting of the barometric pressure sensor that will be control by the main board that already being developed before. This project will only cover the pressure in the water about 1 to 2 meters depth. Besides that, the implementation of a barometric pressure sensor needs guidance from the PIC board by creating a simple program to switch on and off the pressure sensor. Last but not least, after the program being applied another source of medium needs to implement to make sure the pressure sensor make contact with LCD display by synchronized it with a simple program.

1.4 Methodology

In order to complete the project with the organized task schedule, a methodology is planned starting from the researching of the project until the project handover and demonstration. In between the start and finish part, the research of the project is done to gain a general knowledge of what the project is all about. In this prophase, the project brainstorming is actually conducted indirectly. Many articles from internet, journals and also from the references related to this project give a lot of ideas and suggestions which is very helpful to know the basic operation of this project. The research part will always continue as long as the project still developing because everything learned throughout this project as part of research process. After having the project research, that equipment that will be used is being listed out and continues with buying all the equipments. For this intelligent pressure system for AUV project, an evaluation board such as PIC microcontroller start up kit, barometric pressure sensor and compass module from Cytron Technologies is recognized.

Other than that, the compass module is also one of the main hardware being used for this project. The project methodology then continues by assembling the PIC board with the barometric pressure sensor and compass module as the main controller for detecting pressure surrounding. Since this project is about combining the existed technologies, the assemble process is a very important part so that the objective will be achieve. After the assembling process being done, one main procedure must be done before move to the next procedure is by testing the barometric pressure sensor by place it into container and immerse it deep into water. This procedure must be done to make sure the pressure sensor make contact with the PIC.

The second phase is creating a source code in order to make sure there is a contact between barometric pressure sensors along with the LCD display. After that, all hardware is being assembled by combining the PIC board with barometric pressure sensor, capacitive sensor and compass module. Then, all the settings have been done and troubleshooting process takes place. The results from troubleshooting process then analyzed whether it works as desired or not. If the troubleshooting results yield as an expected result, then the project come to ending phase but if there is still any problem come from the hardware or setting procedures, the process will loop back to the equipments assemble and troubleshooting process until the desired result is achieved. The methodology explained is illustrated in Figure 1.0.

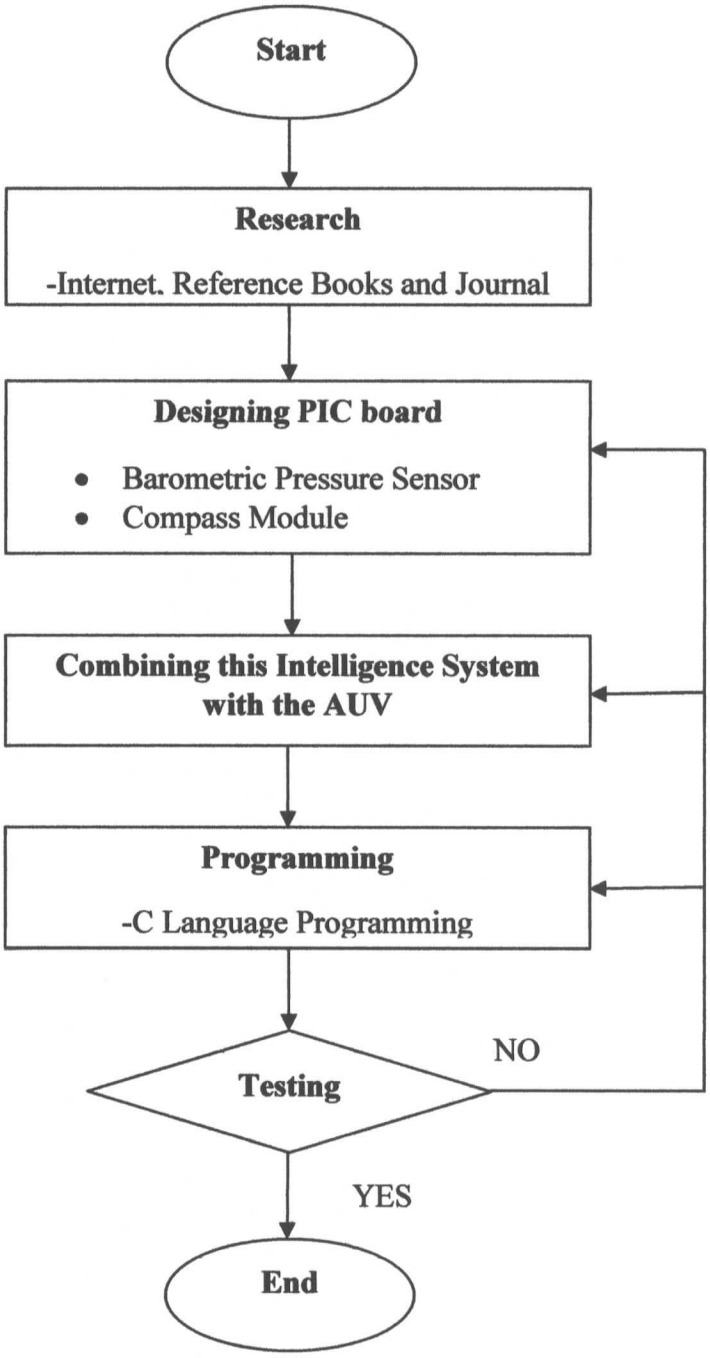

Figure 1.0: Methodology Flow Chart

1.5 Organization of Report

The chapter 1 of this report is an outline of the project introduction which includes the project background, objectives and methodology. This is followed by Chapter 2 that contains literature review from the other studies which are related to this project. Chapter 3 discuss about the project background which is theoretical and fundamental aspects of the project itself. Chapter 4 presents the design procedure that contains all the procedures taken in completing this project. The result derived from the analysis is tabulated in Chapter 5. After all, the conclusion is stated in Chapter 6.

1.6 Summary

The idea of the project is derived by determining the problem statement first. By doing so, the problem can be solved throughout project completion soon. Overall, this project is barometric pressure sensor, temperature sensor and compass module based project that executed to solve the problem in tracking or navigating the underwater vehicle. Thus, the methodology is planned to have the projected steps from the first step until the completion of the project.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Under navigation system based underwater vehicle navigation; there are many applications or projects done by some inventors whereby the uses of very accurate and modern equipments are implemented. These kinds of surveys done as one of the tools to have some ideas how this project works based on others achievement and also to think about the advantages of the proposed solution. This may help in problem solving skills and options required for own project soon.

2.1 Behaviour-Based Control for Autonomous Underwater Exploration

2.1.1 Project Abstract

This paper surveys by Julian Rossenblatt, Stefan William and Hugh Durrant-White present a system for behavior-based control of an autonomous underwater vehicle for the purpose of inspection of coral reefs, a task currently performed by divers holding a video camera while following a rope. Using sonar and vision-based approaches, behaviors have been developed for guiding the robot along its intended course, for maintaining a constant height above the sea floor, and for avoiding obstacles. A task-level controller selects which behaviors should be active according to user-defined plans and in response to system failures. Behavior arbitration has been implemented using both fuzzy logic and utility fusion. Initial

experiments have been conducted in a natural coastal inlet, and the system is to be soon demonstrated in the coral reef environment.

2.1.2 Project Result

This section presents some preliminary results from deployment of the vehicle in a natural terrain environment along Sydney's coastline. The first behavior developed was Maintain Altitude, which keeps the vehicle at a fixed standoff distance from the ocean floor. In the experimental results shown in Figure 2.0, the desired altitude was 1.5m, which was maintained within a standard deviation of 0.2m, as can be seen in the first plot if altitude vs. time. This is despite a rapidly changing bottom profile, as can be seen in the second plot of depth vs. time.

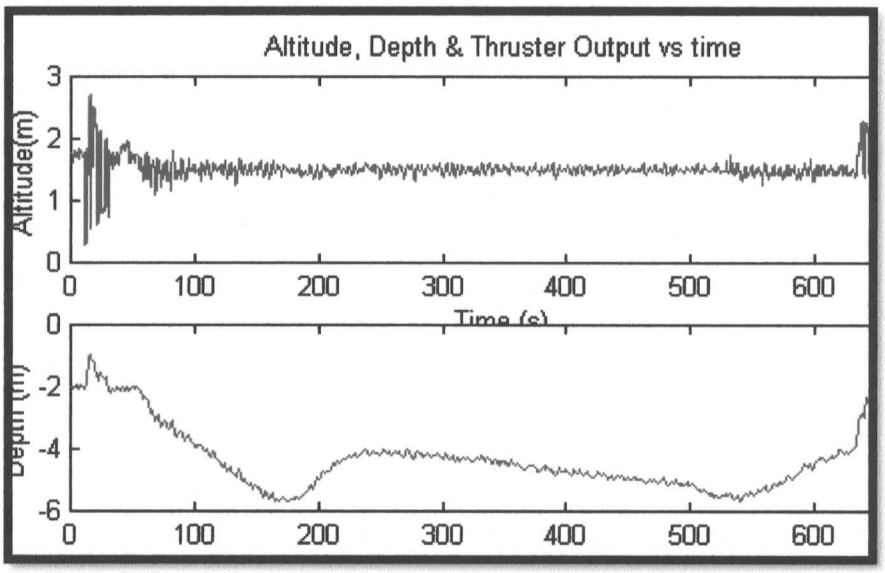

Figure 2.0: Results from Maintain Altitude behavior: a) plot of altitude vs. time shows that the desired altitude of 1.5m was maintained within 0.2m; b) Plot of depth vs. time shows that the vehicle was continuously changing depth to match the profile of the sea floor.