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Development of sonar sensor system for autonomous underwater vehicles (AUV) application / Nurul Syahirah Khalid.

DEVELOPMENT OF SONAR SENSOR SYSTEM FOR AUTONOMOUS UNDERWATER VEHICLES (AUV) APPLICATION

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DEGREE OF BACHELOR IN ELECTRICAL ENGINEERING (MECHATRONICS)

2010

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DEVELOPMENT OF SONAR SENSOR SYSTEM FOR AUTONOMOUS UNDERWATER VEHICLES (AUV) APPLICATION

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May 2010

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DEVELOPMENT OF SONAR SENSOR SYETEM FOR AUTONOMOUS UNDERWATER VEHICLES (AUV) APPLICATION.

NURUL SYAHIRAH BT KHALID

A report submitted in partial fulfillment of the requirements for the degree

of Bachelor in Electrical Engineering

(Mechatronics)

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2010

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I declare that this report entitle "Development of Sonar Sensor System for Autonomous Underwater Vehicles (AUV) Application" is the result of my own research 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.

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To my dearly loved father and mother

To all my teachers and friend

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ABSTRACT

This project is about the development of sonar sensor in purpose for Autonomous Underwater Vehicles (AUV) application. The concept of this project is using the ultrasonic sensor as a main device to transmit and receive the signal from the obstacle. The ultrasonic sensor will be combined to the ultrasonic circuit. Usually, the ultrasonic sensor is often used in robots for obstacle avoidance, map building and especially in navigation. Ultrasonic range sensor is works by emitting a short burst of 40 kHz sound also known as a "ping" sound ultrasonic sound from ultrasonic sensor. In addition, a small amount of sound energy is reflected by objects in front the device and returned to the detector or the receiver. The receiver sends this reflected signal known as echoes to the microcontroller to determine how far away the objects. However, to know how far away the objects it is using the speed of sound and time it took for the signal to be reflected. Unfortunately, echoes are not completely a product of distance. There are many other factors that can alter readings. Different the medium will give the different speed and different result.

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ABSTRAK

Projek ini menceritakan mengenai penderia sonar untuk kenderaan dalam air. Konsep projek ini adalah menggunakan penderia ultrasonik sebagai alat untuk menghantar dan menerima signal daripada objek. Penderia ultrasonik akan digabungkan bersama litar ultrasonik. Pada kebiasaannya, penderia ultrasonik digunakan untuk robot bagi tujuan mengelak halangan dan terutamanya untuk teknik pemetaan dalam pelayaran. Penderia ultrasonik bekerja dengan menghasilkan frekuensi tinggi sebanyak 40 kHz atau dikenali sebagai bunyi 'ping' yang terhasil dari penderia ultrasonik. Sebagai tambahan, tenaga bunyi yang dipantul dari objek atau halangan akan kembali kepada pengesan atau penerima. Penerima akan menghantar signal atau dikenali sebagai gema untuk mengetahui jarak sebenar objek tersebut. Walaubagaimanapun, untuk mengetahui jarak objek kelajuan dalam air dan masa yang diambil untuk signal dipantul perlulah juga dikenali. Malangnya, gema tidak menghasilkan sepenuhnya hasil jarak. Pelbagai faktor yang mempengeruhi perubahan bacaan. Medium yang berbeza akan menghasilkan kelajuan yang berbeza dan keputusan yang berbeza.

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LIST OF ABBREVIATIONS

AUV	-	Autonomous Underwater Vehicles
mm-	-	milimeter
cm	-	centimeter
m	-	meter
TXR	-	transceiver
SOLS	-	Small Object Locating Sonar
INSS	-	Integrated Navigation and Sonar Sensor
CPU	-	central processing unit
ROM	-	read-only memory
EEPROM	-	electrically erasable programmable read-only memory
I/O	-	input/output
Hz	-	Hertz
PIC	-	Peripheral Interface Controller
MCU	-	Microcontroller Unit
LCD	-	Liquid Crystal Display

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CHAPTER 1

INTRODUCTION

1.1 Background

A sonar sensor is actually a device that used to transmit and to receive a signal from the obstacle. In other words, sonar is a short term that taken from the 'Sound Navigation and Ranging'. A sonar sensor is essentially an inexpensive device. Nowadays, the sonar sensor are widely use in over the world for the specific purpose. Many project and research are building up based for the purpose of the Autonomous Underwater Vehicles (AUV). This is because, sonar sensor has its own special characteristic and waterproof that can penetrate in any type of water. However, the microcontroller will do the job by giving a command to the sonar sensor to work. The suitable programs should be creating based on the objective of the project.

This chapter consists of introduction of project such as a problem statement, objective and scope of the project. Methodology of the project also discussed in this chapter. Methodology of the project is very important part to make the project successful.

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1.2 Problem Statement

As we know, we faced some problem to detect the obstacle in underwater. This situation is happened especially for the underwater vehicle such as for the navigation and monitoring navigation application. Accident in underwater is always happened to the underwater vehicle. This is because, the vehicle cannot detect an obstacle in underwater and make the vehicle colliding with an obstacle. To solve this problem, the sonar sensor system is developing for that purpose in Autonomous Underwater Vehicle (AUV) application.

1.3 Objective of project

The objective of this project is to develop of sonar sensor system in Autonomous Underwater Vehicle (AUV) application.

1.4 Scope of Project

Scopes of the project are listed:

- Research for information and study about the problem in AUV especially for obstacle avoidances.
- Study the theory of operation and circuit connection of ultrasonic sensor for underwater application.
- Study the work of ultrasonic sensor for underwater.
- Study and familiarize with C language.
- Design by using SolidWork software and build a simple prototype of AUV.

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1.5 Methodology

Before start the project, the methodology is the most important thing. This is to make sure that the project can be developing with well planning. In this project, the whole process will shown in Figure 1.1.

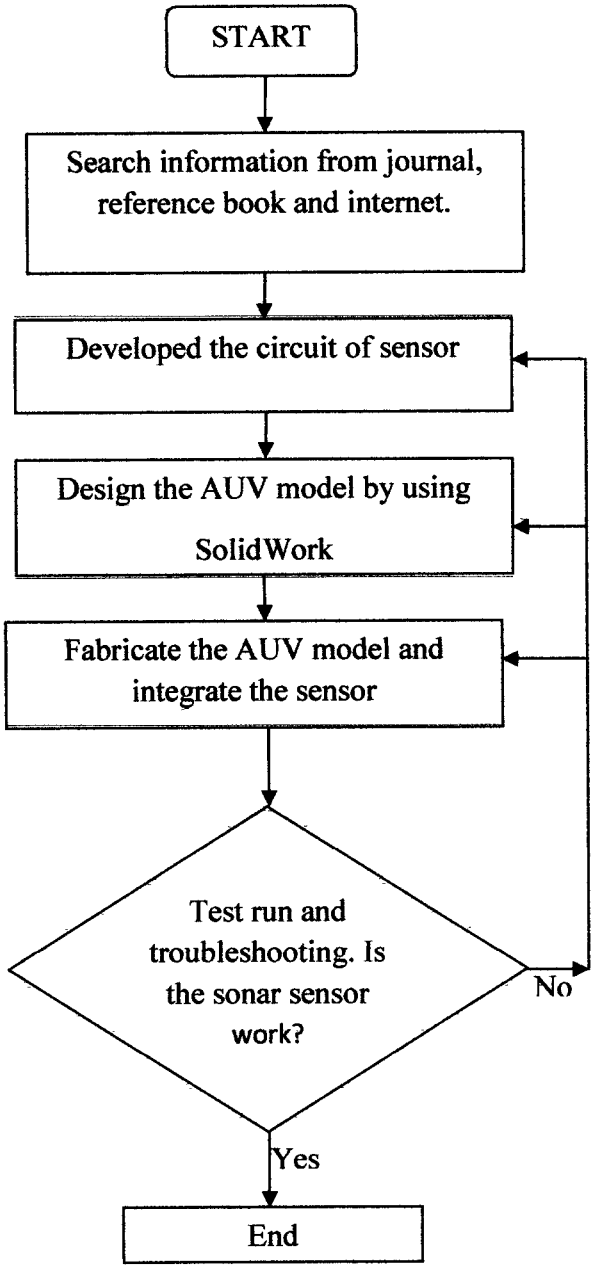

Figure 1.1: Flow Chart Methodology.

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1.6 Summary

In this chapter is, well planning is very important to make this project success. Every planning that is planned should be follow to make the project finished on the dateline or earlier before the dateline. Besides that, the projects that are developed are based on the problem statements that are state in this chapter. The objective of the project is also important to make the project successfully and as aim of the project. In addition, the scope of the project needs to recognize before start the project.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a summary of previous research on a topic. The purpose of a literature review is to convey what knowledge and ideas have been established on a topic and what are the strengths and weaknesses. Literature review has been conducted prior to undertaking this project to obtain the information on the technology available and the methodologies that used by the other researchers on the same topic around the world. This chapter provides the summary of literature reviews on key topics related to the sonar sensor application for Autonomous Underwater Vehicles (AUV).

Nowadays, there are so many types of project that related to the application of sonar sensor are developed. These types of project appeared with much kind of features and character, but with the same objective. This part will discuss about the development of sonar sensor system for that exist in the world, their specifications and how it functions

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2.2 Diver-Based Integrated Navigation or Sonar Sensor

Diver-Based Integrated Navigation or Sonar Sensor consists of two diver based system, the Small Object Locating Sonar (SOLS) and the Integrated Navigation and Sonar Sensor (INSS). They are small and easy to use systems that allow a diver to:

- Detect underwater objects
- Classify underwater objects
- Identify underwater objects
- Render large sector visual images
- Map and reacquire diver location
- Analyze diver path
- Analyze a target location

The hardware consists of:

- Unique, simple, single beam high resolution sonar
- An acoustic navigation systems
- An electronic depth gauge
- Compass
- GPS and RF interfaces

Results that showed are very positive. These showing significantly greater capabilities than current diver held systems [10]. For example, the detection ranges are increased over existing systems and the system allows the divers to classify mines at a significant standoff range. Figure 2.1 shows the result of using diver-based integrated navigation or sonar sensor.

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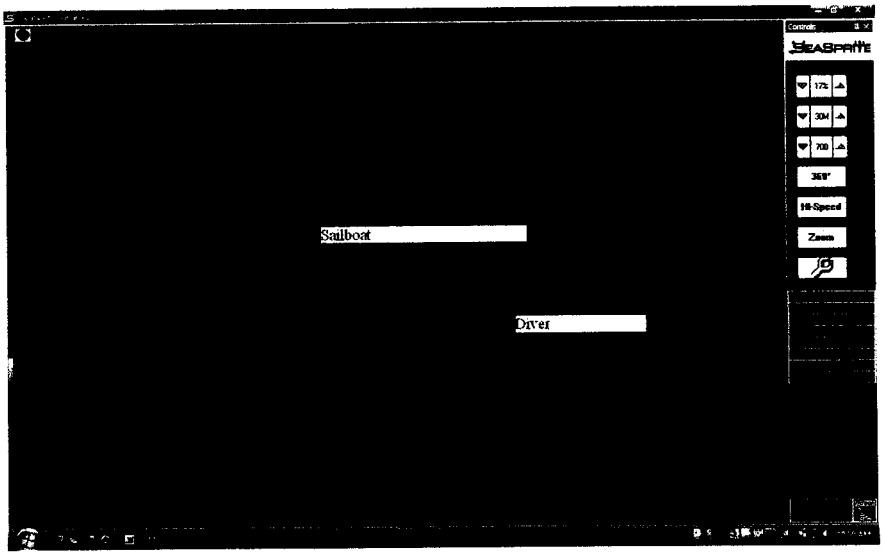

Figure 2.1: The Result of Using Diver-Based Integrated Navigation or Sonar Sensor

2.3 Sonar Sensor Use in Fishery Technology

In fishery technology in Malaysia, sonar sensor is used to detect and to know the location of a group of fish around the boat area [8]. This technology is also known as underwater radar. It does also can avoid the barrier or obstacle when the boat is at the sea. The main purpose of this sonar sensor system is:

- To detect the condition of the sea either is good or not.
- To detect the fish for cord operation.
- To know the distance between fish and boat.
- Help in navigation for the boat safety.

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