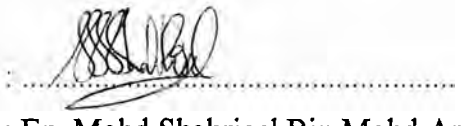
DESIGN AND DEVELOPMENT AN UNDERWATER GLIDER USING PIC

Mohd Faiz Bin Safee

Bachelor Of Mechatronic Engineering

May 2010

"I hereby declare that I have read through this report entitle "DESIGN AND DEVELOPMENT AN UNDERWATER GLIDER USING PIC" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering"

Signature : 

Supervisor's Name : En. Mohd Shahrieel Bin Mohd Aras

Date : 12/5/2010

DESIGN AND DEVELOPMENT AN UNDERWATER GLIDER USING PIC

MOHD FAIZ BIN SAFEE

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

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

May 2010

I declare that this report entitle "DESIGN AND DEVELOPMENT AN UNDERWATER GLIDER USING PIC" 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.

Signature . .....

Name : MOHD FAIZ BIN SAFEE

Date . 12/5/2010

To my beloved mother and father

ACKNOWLEDGEMENT

First of all, I want to thanks Allah S.W.T the Almighty God for the blessing so that I may complete this Final Year Project.

I wish to dedicate the most sincere thanks to my dearest supervisor, Mr. Shahrieel Bin Mohd Aras for his invaluable editorial support, encouragement, supervision and useful suggestions throughout my meaningful accomplishment of the progress report and the progress of the project. His reputable moral support and continuous guidance enabled to complete my tedious work and task successfully.

I also would like to thank the panel, Mr. Aminurrashid Bin Noordin and Mr. Ahmad Idil Bin Abdul Rahman whose give me a good comment during my presentation. I also would like to take this opportunity to express my appreciation to my family and my friends for their patients, understanding and also for their undivided support that they had gave me.

Last, but not least I also would like to thank all those helping and supporting me directly and indirectly during my Final Year Project. I am truly appreciated and grateful of what they have done.

ABSTRACT

An underwater glider is a type of autonomous underwater vehicle (AUV). Underwater Glider is a technology undergoing active and rapid development that uses small changes in its buoyancy in conjunction with wings to convert vertical motion to horizontal, and thereby propel itself forward with very low power consumption. The main objective of this project is to design and develop an underwater glider controlled by PIC. This project is categorized to three major phase which is the mechanical design concept, programming and fabrication. The design and development of the underwater glider have hydrodynamic characteristics, stability and buoyancy. The movement of the underwater glider is controlled by PIC controller using C language program. The underwater glider produced move forward autonomously.

ABSTRAK

Pesawat peluncur dalam air merupakan salah satu kenderaan dalam air. Pesawat peluncur dalam air merupakan antara teknologi yang giat dan cepat membangun yang menggunakan perubahan kecil pada daya apungan dengan bantuan sayap supaya menukarkan pergerakan mencancang kepada melintang, dan kerana itu mendorang kehadapan dengan kuasa yang rendah. Objektif utama projek ini adalah merekabentuk dan membangunkan sebuah pesawat peluncur dalam air dikawal oleh PIC. Projek ini dikategorikan kepada tiga fasa utama iaitu konsep rekabentuk mekanikal, pengaturcaraan dan fabrikasi. Rekabentuk dan pembangunan pesawat peluncur dalam air mempunyai sifat hidrodinamik, kestabilan dan keapungan. Pergerakan pesawat peluncur dalam air dikawal oleh pengatur PIC menggunakan bahasa program C. Pesawat peluncur dalam air yang dihasilkan bergerak ke hadapan secara automatik.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

FYP	Final Year Project
PIC	Peripheral Interface Controller
AUV	Autonomous Underwater Vehicle
PID	Proportional Integral Derivative
CG	Center of Gravity
CB	Center of Buoyancy
I/O	Input / Output
CAD	Computer Aided Design
GPS	Global Positioning System

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.0 Introduction

This project is titled as "Design and Development an Underwater Glider Using Peripheral Interface Controller (PIC)". An underwater glider is an Autonomous Underwater Vehicle (AUV) that utilizes a small change in its buoyancy to convert vertical motions to horizontal ones with help of wings. Thus the underwater glider can move forward with low power consumption. Therefore, the underwater glider can be a small, smart and inexpensive which has a long operational time. The difference between conventional AUVs and underwater gliders are the dynamic behavior because of propulsion mechanism.

The driving force of the underwater glider depends on hydrodynamic forces such as drag and lift, which is a function of the advance speed and the angle of attack. This underwater glider project used PIC to control the movement of the underwater glider. For this development of underwater glider, the underwater glider will have hydrodynamics characteristic, stability and dynamic buoyancy. This underwater glider propels itself by electrical motor-driven propellers. Finally, the underwater glider is produced and can move forward controlled by PIC.

1.1 Problem Statement

The exploration on underwater is very dangerous for human life. The uses of glider simplify the movement from one point to one another. For application in oceanography, observing the coastal environment that involved human being brings a lot of disadvantages. One of the great difficulties in oceanography is collecting science data in the ocean. Sciences data such as temperature, conductivity and current are the great importance to understanding the ocean and it's dynamic. Collection of scientific data at any one point in space and time is of much less scientific use than collection of data over large regions. Underwater glider offers a flexible and elegant platform to meet this need. In the military application, operation that involved soldier in reconnaissance and surveillance are very dangerous. Operation that involves glider loitering in an area of interest for long periods, transiting undetected between areas, or waiting on the bottom for long periods before beginning a mission bring a lot of disadvantages. The attractive feature in glider is used because quieter vehicles are more difficult to detect. In this case, human life can be excluded from the risk of facing danger by developing the underwater glider.

1.2 Project Objective

As important as the other part, the project objective must be clearly defined so that the direction of the project always keeps in track. After clearly understand the problem statements, the purpose of this project is restricted to one major objective that hopefully can be achieved throughout project completion. The main objective of this underwater glider project is:

i. To design and develop an underwater glider controlled by PIC.

1.3 Scope Of Project

In pursuit of the objective, this project has several scopes that help in design and develop the underwater glider. To design the underwater glider, Solidworks software is used so that the designing process of the underwater glider will be having hydrodynamic characteristics. Other than that, this project covers the development of programming part which focuses on the forward movement of the underwater glider. Lastly, the fabrication and assemble all the subsystem of the underwater glider which is included the mechanical, software and electronic parts.

1.4 Methodology

In order to complete the project with the organized task schedule, a methodology is planned starting from 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 knowledge of what the project is all about. In this phase the project, brainstorming is actually conducted indirectly. Many articles from internet, journals and also from same reference book related to the underwater glider give a lot of ideas on how the project is. The research part will continues as the project is going through since everything learnt throughout the project is also as the research process. For design the underwater glider, the SolidWorks software is used because this software is easy to implement and use. The project methodology then continues with programming stage. At this stage, the movement of the dc motor is controlled by PIC. C language program is used to process the data. C compiler will execute the hex file which needed to be downloaded into the PIC chip. Then, the next stage is the fabrication process. In this task, all the subsystems are assembling so that the objective will be achieved. The project methodology continues to testing/troubleshooting stage. In this task, the result from this troubleshooting process then is analyzed whether it works or not. If the troubleshooting results

yield as the expected result, then the process comes to terminating stage but if there still any problem come from hardware or fabrication process, the process will loop back until the desired result is achieved. The overall flows methodology explained is illustrated in Figure 1.0.

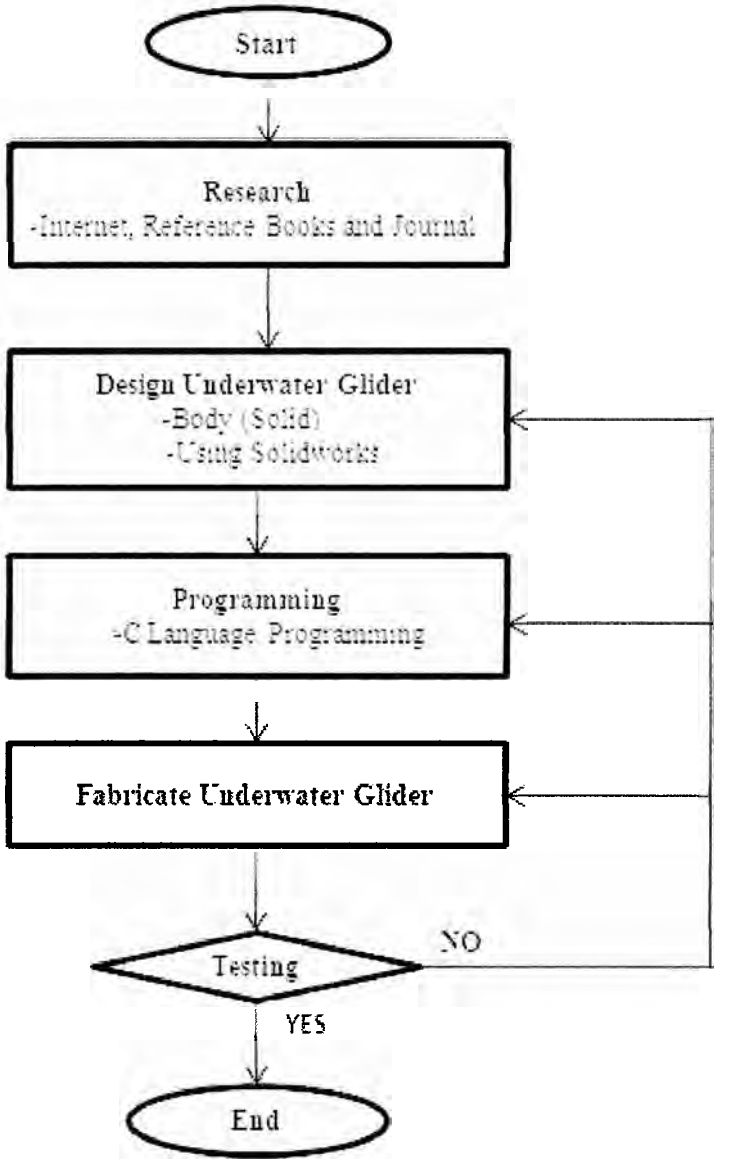


Figure 1.0: Flow Chart of Overall Methodology

1.5 Organization Report

The first chapter of this report is an outline of the project introduction which includes the introduction, problem statement, objective, scope and the methodology. This is follow by Chapter 2 that contain the literature review from the other studies which are related to this project. Chapter 3 discuss about the theory underwater glider and the project background of underwater glider. Chapter 4 presents the methodology and project development that contains all the procedure taken in completing this project. Chapter 5 contains the result and discussion about the development of the underwater glider project. Finally, the conclusion and recommendation is stated in Chapter 6.

1.6 Summary

At the end of this project, the objective will be accomplished. An underwater glider will be produced and can move forward controlled by PIC.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, a review of previous research project that are related of this project will be discussed. This kind of surveys done as one of the tools to have some ideas on how this project works based on other achievement and also to think about the advantages of proposed solution. This may help in problem solving skills and options required for design and develop the underwater glider.

The concept for underwater gliders grew from the need for oceanographic sampling and work on oceanographic floats. The need to track currents and bodies of water in the ocean, and later to provide distributed and economical collection of such data, was first filled with oceanographic floats. Work on profiling floats played a role in the development of the Slocum glider concept, which leads to work on the three existing oceanographic gliders: Slocum, Spray and Seaglider. Table 2.0 shown some dates of interest in the development of oceanographic gliders:

Table 2.0: Oceanographic Glider Development

1989	"The Slocum Mission" appears in Oceanography [2].
1990	Office of Naval Technology (ONT) awards WRC contract for Slocum prototype.
1991	Tests of Slocum prototype and thermal engine, Wakulla Springs FL and Lake Seneca, NY.
1992	First deployment of the ALBAC glider, a shuttle type glider developed at the University of Tokyo in the lab of Tamaki Ura. The ALBAC design uses a drop weight to drive the glider in a single dive cycle between deployment and recovery from ship. It uses a moving internal mass to control pitch and roll [3].
1993	Autonomous Oceanographic Sampling Networks paper appears in Oceanography [4].
1999	Slocum gliders tested at LEO-15 Observatory, NJ. Slocum glider continues to be used there for ocean sampling through 2005.
1999	Autonomous Ocean Sampling Network (AOSN) I conducted in Monterey Bay, CA Gliders are used to make oceanographic surveys. A prototype Spray operates for 11 days. Three Seagliders were also deployed in the bay. [5, 6]
2000	By this time all three glider programs, Spray, Slocum and Seaglider, have completed 10 day missions.
2001	Spray glider makes 280 km section from San Diego [5, 7].
2002	Seaglider travels 1000+ km off Washington Coast. Another Seaglider is deployed for month in storms off shelf near Seward Alaska.
2003	January. Deployments of three Slocum Gliders in the Bahamas by WHOI.

	Trials of prototype thermal Slocum conducted by WRC on same cruise.
2003	February. SPAWAR and the Canadian Navy conduct tests in the Gulf of Mexico of three Slocum Electric gliders equipped with acoustic modems.
2003	August -September. AOSN II conducted in Monterey Bay, CA. Gliders are used to make extensive oceanographic surveys over a six week period. Twelve Slocum and five Spray gliders are deployed during the experiment, to date the most gliders deployed for one project.
2004	September - November. A Spray glider travels across the Gulf Stream, beginning about 100 miles south of Nantucket, MA and arriving near Bermuda about one month later [8]. The glider travels 600 miles, at a speed of about .5 miles per hour or 12 miles per day. Spray is the first AUV to cross the Gulf Stream underwater.

2.1 Slocum Glider

There are two types of Slocum Gliders, electrically powered gliders operating to 200 meter depths using a syringe type ballast pump, and thermally powered Slocums operating to depths of 1500 m. As of 2003, the Thermal Slocum design is still in prototype testing, while Electric Slocums are a working vehicle. More than 21 Electric Slocums have been manufactured and sold to groups including WHOI, SPAWAR, the Canadian Navy, Rutgers University, and Scientific Fisheries. The Slocum Electric Glider is shown in the Figure 2.0: