DESIGN AND DEVELOPMENT OF GPS NAVIGATION GUIDELINE SYSTEM FOR AUTONOMOUS UNDERWATER VEHICLE

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DESIGN AND DEVELOPMENT OF GPS NAVIGATION GUIDELINE SYSTEM FOR AUTONOMOUS UNDERWATER VEHICLE

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To my beloved mother and father

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Finally, this work is reliant on those mentioned in the references and upon the people mentioned above. Without these giants, this work would be mere supposition and I thank them for the solidity their shoulders have granted me. Thank You.

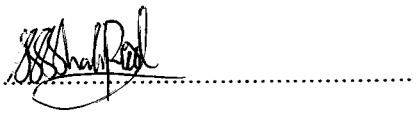
ABSTRACT

The goal of this project is to design and develop of Global Positioning System (GPS) navigation guidance system for AUV. The GPS is a satellite based on navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides with information. Using GPS technology you can determine location, velocity and time, 24 hours a day in any weather condition anywhere in the world for free. The device was designed to interface with any GPS receiver capable of outputting NMEA v3.01 RMC, sentences via FT232R UART and USB connection. This project is using Smart GPS Receiver model EB-85A and GPS Engine Board model EB-230. The GPS Locator Utility version 2.61 and GPSTrace version 2.61 is an application program used to enable EB-85A to do the configuration on the unit. This design could easily be expanded and made portable for use in automobiles or other vehicles. This project was intended to demonstrate some ideas that could be used to create a commercially available GPS for AUV. The scientific community uses GPS for its precision timing capability and position information. This device is used in military, aviation, marine and consumer product applications. At sea, GPS is also typically used for navigation by recreational boaters, commercial fishermen, and professional mariners.

ABSTRAK

Tujuan utama projek ini adalah untuk mereka dan membangunkan sistem pembantu dan pemanduan arah Sistem Posisi Sedunia (GPS)untuk kegunaan kenderaan dalam air (AUV). GPS ialah satelit yang berdasarkan kepada sistem pandu arah atau petunjuk tempat yang menghantar dan menerima isyarat-isyarat radio dalam bentuk gelombang. Penerima isyarat GPS memperolehi isyarat – isyarat itu dan menyediakan maklumat yang diperlukan. Dengan menggunakan teknologi GPS ini, ia dapat memberikan maklumat serta menentukan lokasi tempat kita berada, kelajuan kita bergerak dan juga waktu tempat pada masa itu. Ia dapat memberikan maklumat pada bila – bila masa yang diperlukan, tidak mengendahkan keadaan dan cuaca di sekeliling tanpa pembayaran. Alat ini direka bentuk untuk menghubungkan dengan penerima GPS yang mampu mengeluarkan protokol NMEA v3.01 RMC melalui FT232R UART dan USB sebagai penyambung. Projek ini menggunakan Smart GPS Receiver model EB-85A dan GPS Engine Board model EB-230. GPS Locator Utility versi 2.61 dan GPSTrace versi 2061 adalah satu program penggunaan yang digunakan bagi membolehkan EB-85A melakukan susunan dan program ke atas unit itu. Reka bentuk ini dengan mudahnya boleh berkembang dan kemudahan untuk penggunaan dalam kereta dan kenderaan lain. Projek ini bertujuan untuk menunjukkan beberapa idea yang boleh digunakan bagi mencipta satu GPS yang secara komersial boleh didapati untuk kegunaan kenderaan dalam air. Alat-alat ini biasanya digunakan dalam ketenteraan, penerbangan, perkapalan dan pengguna yang lain. Di laut, GPS biasanya digunakan untuk pengemudian oleh pemandu bot, nelayan-nelayan perdagangan, dan kelasi profesional.

" I hereby declare that I have read through this report entitle "Design and Development of GPS Navigation Guidance System for AUV Application" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)"

Signature : 

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

Date : 12th May 2010

I declare that this report entitle "*Design and Development of GPS Navigation Guidance System for 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.

Signature : 

Name : Mahirah Mohamad

Date : 12th May 2010

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Global Positioning System (GPS) is a satellite based on navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides with information of the location, velocity and time. GPS satellites also called NAVSTAR stand for Navigation Satellite Timing and Ranging named by the official U.S. Department of Defense for GPS. The first GPS satellite was launched in 1987 and full constellation of 24 satellites was achieved in 1994. The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us.

They are constantly moving, making two complete orbits in less than 24 hours. These satellites are travelling at speeds of roughly 7,000 miles an hour. Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit. A GPS satellite weighs approximately 2,000 pounds and is about 17 feet across with the solar panels extended. Transmitter power is only 50 watts or less. The GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path.

Since it became fully operational on April 27, 1995, GPS 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 and way marking. Also, the precise time reference is used in many applications including the scientific study of earthquakes and as a time synchronization source for cellular network protocols.GPS has a variety of applications on land, at sea and in the air. Basically, GPS is usable everywhere except where it's impossible to receive the signal such as inside most buildings, in caves and other subterranean locations, and underwater.

The scientific community uses GPS for its precision timing capability and position information. Surveyors use GPS for an increasing portion of their work. GPS offers cost savings by drastically reducing setup time at the survey site and providing incredible accuracy. Basic survey units, costing thousands of dollars, can offer accuracies down to one meter. More expensive systems are available that can provide accuracies to within a centimeter. Recreational uses of GPS are almost as varied as the number of recreational sports available. GPS is popular among hikers, hunters, snowmobilers, mountain bikers, and cross-country skiers, just to name a few.

GPS is now commonplace in automobiles as well. An autonomous underwater vehicle (AUV) is a robot which travels underwater. In military applications, AUVs are also known as unmanned undersea vehicles (UUVs). AUVs constitute part of a larger group of undersea systems known as unmanned underwater vehicles, a classification that includes non-autonomous remotely operated underwater vehicles (ROVs) that is controlled and powered from the surface by an operator or pilot via an umbilical. AUVs can navigate using an underwater acoustic positioning system. When operating within a net of sea floor deployed baseline transponders; this is known as (LBL) navigation. When a surface reference such as a support ship is available, ultra-short baseline (USBL) or short-baseline (SBL) positioning is used to calculate where the subsea vehicle is relative to the known GPS position of the surface craft by means of acoustic range and bearing measurements. When it is operating completely autonomously, the AUV will surface and take its own GPS fix.

Inertial Navigation System (INS) measures the motion or acceleration of the AUV in three axes that's are up and down, left and right, and forward and backward. An INS provides the AUV with precise, short-term navigation and some can even sense the rotation

of the earth. Although INS has been used widely in aviation and surface ship communities for many years, only recently has the system been miniaturized for AUV use. INS on aircraft and boats relies on position inputs from Global Positioning System (GPS) satellites in orbit. However, just as GPS signals are lost when a car enters a tunnel AUVs lose GPS reception as soon as their antennae submerge. Therefore, GPS is only available to help with the Inertial Navigation System when the AUV is on the surface.

1.1 Problem Statement

GPS has a variety of applications on land, at sea and in the air. The most common airborne applications are for navigation by general aviation and commercial aircraft. At sea, GPS is also typically used for navigation by recreational boaters, commercial fishermen, and professional mariners. Land-based applications are more diverse. The scientific community uses GPS for its precision timing capability and position information. It is important information that AUV need to know because with this information, other people can find and help them if they were in trouble.

Basically, GPS is usable everywhere except where it's impossible to receive the signal such as inside most buildings, in caves and other subterranean locations, and underwater. This project is design to guide the users especially the AUV's because we know that GPS receiver cannot detect the signal when it placed under the water. So, this design is proposed to guide the users of AUV. This GPS is placed on top of the AUV so that, when the AUV hit upon the water surface, this device clearly at the airspace. Then it can work successfully.

1.2 Project Objectives

Based on the problem statement, this project clearly designs according to the problem of AUV. The main objective of this project is to design and develop of GPS Navigation Guidance System for AUV

1.3 Project Scope

Scope of this project is interface with desktop or personal computer or notebook and interface with GPS Module or GPS Receiver. The device was designed to interface with any GPS receiver capable of outputting NMEA v3.01 RMC, sentences via FT232R UART and USB connection. This project is using Smart GPS Receiver model EB-85A and GPS Engine Board model EB-230. The GPSTrace version 2.61 and GPS Locator Utility version 2.61 is an application program used to enable EB-85A to do the configuration on the unit. In order to follow AUV specification, the Wireless cannot apply to interface with desktop because wireless signals very weak or maybe lost under the water surface. Figure 1.0 shows project overview.

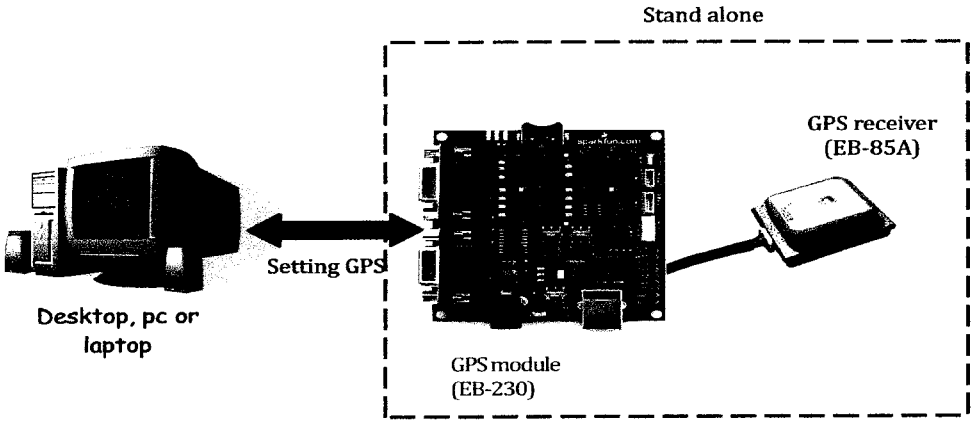

Figure 1.0: Project Overview

1.4 Organization of Report

There are six chapters in this report. Basically, Chapter 1 is an outline of the report that includes the introduction part of the project chosen, problems statements, and project objectives, scope of project and Methodology of the project. Besides, elaboration on the project objectives and project scope will be explained in details so that a better view of the project can be obtained.

Chapter 2 provides the literature reviews where similar project and researches are reviewed, discussed and analyzed. This chapter also explains about the theoretical and project background. It includes the information and guideline to choose the part of the equipment needs to this project in detailed.

Chapter 3 discuses about the methodology of completing this project. The methodology is including the hardware and software use in this project. Here, all aspects such as literature review, software component involving GPS Locator Utility development, hardware consists of EB-85A module, the evaluation board module are explained. Some analysis on how to setting the GPS receiver is included in this chapter.

Chapter 4 shows the result gets from this project. The results contain the information of the device such as location, time and sped.

Chapter 5 is about the data and analysis of the project result. This chapter analyzes the strength of the GPS as a navigation device.

Lastly, in Chapter 6, based on the result obtained in previous chapter, the overall measurement and performance of the project is concluded. Last but not the least, possible improvement for future work is also outlined.

1.5 Summary

This chapter shows the overview of this project. This chapter includes the description of the objective of the project, scope, problem statement, methodology and the organization of this project.

CHAPTER 2

LITERATURE REVIEW / THEORETICAL BACKGROUND

2.0 Introduction

This chapter presents the fundamental GPS technology and some existing application about the background, application technology relates to this project. There are many applications or projects done by some inventors whereby the uses of very accurate and modern equipments are implemented. By having some literature reviews, this may help to improve the skill while completing this project.

2.1 AmeriMap - GPS (Global Positioning System) Device [1]

This project was done by Nitin Gupta and Chris Pelosi presents the GPS device that capable of outputting directions via interstates to any major city in the continental United State. The device was designed to interface with any GPS receiver capable of outputting NMEA v0183 RMC sentences via RS232 connection. The device was to create an expandable design capable of using a larger database of cities and connecting roads by using a GPS receiver. This design could easily be expanded and made portable for use in automobiles or other vehicles. This project was intended to demonstrate some ideas that could be used to create a commercially available Global Positioning Device.

2.1.0 Project Result

Device was first tested in Manual mode and all of the features worked as expected. In order to test the device in NMEA mode, GPS receiver needed to capable of outputting NMEA sentences through an RS232 connection. In place of a GPS receiver, GPS simulator software obtained that outputted configurable NMEA sentences through the COM port of a PC. As a result, the PC is able to connect to the device and features were tested under a variety of circumstances, such as constantly changing position. The device is compatible with any commercially available GPS receiver capable of producing output to the specification given. One issue encountered while developing the device was memory limitations. The memory available for implementing the device was limited, due to the large amount of information stored in the database. There was a point at which ran out of RAM due to the information needed to store. To rectify this, the memory usage is reorganized so that available flash memory could utilize. Flash memory turned out to be an issue and also as implemented more and more features. Since the instructions are stored in flash and there are lots of conditions to handle, some of the features had to eliminate, originally intended so program could fit on the chip.

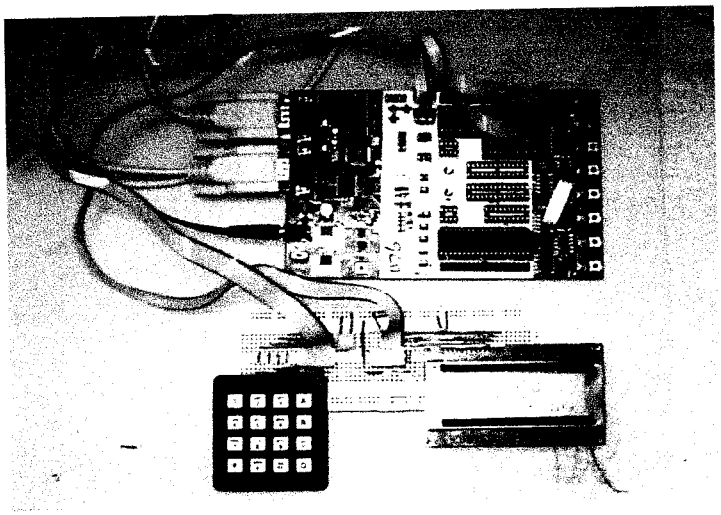

Figure 2.0: AmeriMap device configuration