DESIGN AND FABRICATE REMOTE CONTROLLED SUBMARINE WITH ON BOARD WIRELESS CAMERA

ZULKIPLE BIN JAMAL

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Faculty of Mechanical Engineering

Universiti Malaysia Pahang

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ABSTRACT

Nowadays, submarine can be use in many fields including research. For current practice, RC (radio control) submarine can be used to do underwater monitoring. Current RC submarine are expensive, and new design in this project are used to build a local RC submarine with on board wireless camera. In this project, the cost will be optimum and using an easy to obtain parts. The main things in the RC submarine are controller system and watertight. Research and comparison are done to make sure the flow of the project run smoothly. The fabrication phase started with making a control system for the submarine. A controller circuit consists of two important components; relays and radio control receiver. This will control pumps and motor. The ballast tank is made from PVC (poly vinyl chloride) pipes, sockets and round shape Perspex. To make a control system for the ballast system is the tough challenge in this project. The circuit is sensitive and easy to malfunctions. To make the tank watertight, silicon adhesive applied to avoid from water to fill the dry compartment of the ballast tank. For the result, the ballast system is finish after designing and fabricating process. Despite of that, the ballast system operated not fully functionally. The controller system had some problem and only one of the pump run.

ABSTRAK

Pada masa sekarang kapal selam telah digunakan dalam pelbagai bidang termasuk penyelidikan. Penggunaan kapal selam kawalan radio juga banyak digiatkn dalam aktiviti pemantauan di dalam air. Kapal selam kawalan radio di pasaran mahal dan dengan rekaan baru dalam projek ini telah digunakan untuk membina kapal selam kawalan radio dengan kamera tanpa wayar dipasangkan. Dalam projek ini, kos akan dioptimumkan dan menggunakan barang yang mudah didapati. Perkara utama dalam kapal selam kawalan radio adalah sistem kawalan dan tidak masuk air. Kajian dan pernbandingan dijalankan untuk memastikan projek ini berjalan lancar. Fasa pembuatan dimulakan dengan membuat sistem kawalan untuk kapal selam. Terdapat dua komponen penting dalam litar sistem kawalan; relay dan penerima isyarat radio. Litar ini yang akan mengawal pam air dan motor. Tangki untuk kapal selam ini dibuat dari paip PVC, soket dan Perspex. Untuk melengkapkan sistem kawalan bagi sistem kapal selam ini merupakan sesuatu yang mencabar dalam projek ini. Litar ini sensitif dan mudah tidak berfungsi. Untuk menjadikan tangki kapal selam ini tidak masuk air, gam silikon digunakan untuk mengelakkan air masuk ke dalam ruang kering dalam tangki. Sebagai keputusannya, sistem untuk kapal selam ini telah Berjaya disiapkan setelah proses mereka bentuk dan pembuatan dijalankan. Tetapi kapal selam ini tidak dapat berfungsi sepenuhnya. Sistem kawalan mengalami masalah dan cuma satu pam yang berfungsi.

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CHAPTER 1

INTRODUCTION

In this chapter, the project background, objectives and scopes are stated. The problem statements also included in this section.

1.1 Project Background

Nowadays, the development of submarine manufacturing are still developing in many countries such as Russia, China, America and others big nations that had the technology. The purpose of submarine manufacturing not only for military but also cover other area such as research, learning, hobby, industries and etc.

For people that can afford to have this RC submarine, usually as hobby. But in research field, it is widely used. To monitor the underwater, RC submarine are used. The submarine design and specification depends on the usage of the submarine. For deep water monitoring, the submarine can stand pressure and the control system can handle the long range under the water.

The available RC submarines now can only be ordered from other countries. No local manufacturer in this kind of business. This is because it is complicated and need a high skill team to design a fully functional nice appearance RC submarine. All of this will high in cost.

1.2 Problems Statement

1.2.1 There are some obstacles in using underwater photographing for research and industries. The cost needed to do this activity is high. The current market RC submarine, the price range is RM1000-RM1500. The current RC submarines are really expensive.

1.2.2 All of current RC submarines available by other countries manufacturers. There is no local manufacturer in this activity.

1.2.3 This project embarks on submarine project where the submarine will be controlled using remote control device and can broadcast underwater scene using on board wireless camera. This will be local made submarine. With this, the cost will try to mi minimize and using a easy to obtain parts.

1.3 Objectives

1.3.1 To design ballast system for the remote control submarine.

1.3.2 To fabricate the ballast system

1.4 Scope of Works

1.4.1 Literature review of submarine ballast system.

1.4.2 Designing the proposed ballast system.

1.4.3 Fabricating the ballast from PVC.

1.4.4 To install 12V DC (direct current) motor and water pump.

1.4.5 To test run the ballast system in water tank.

CHAPTER 2

LITERATURE REVIEW

In this chapter, it shows the literature and reference for this project and sources of ideas and guideline for the whole project. The references came from books, journals and internet sources.

2.1 Ballast System

2.1.1 Introduction

The idea of traveling underneath the ocean waters inside a contained vessel has been around for centuries. To function underwater, submarines are built a bit differently than surface ships that float on the water's surface. In order to travel underwater, submarines must function in agreement with some key laws of nature, including Archimedes' Principle and Boyles' Law [1].

Submarines as shown in Figure 2.1 are completely enclosed vessels with cylindrical shapes, narrowed ends and two hulls: the inner hull and the outer hull. The others physical parts for a submarine are sail, periscope, rudder propeller, sterns and radio antenna [5]. The ballast tanks, which control the sub's buoyancy, are located between the inner and outer hulls.

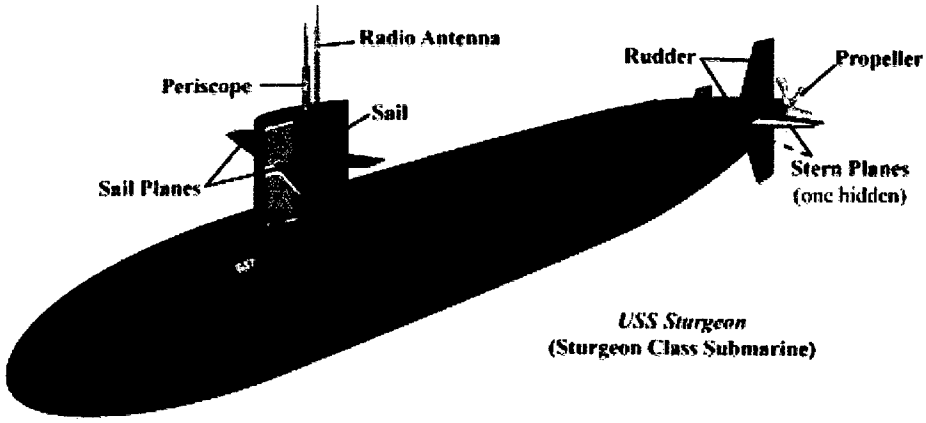

Figure 2.1: Overall view of a submarine [7]

2.1.2 Ballast Tank

Conventional submarines have two hulls. The circular inner hull is the pressure hull, where the crew lives and works. Ballast tanks outside the pressure hull form the outer hull. Bow and stern diving planes assist in submerging, using dynamic sea pressure from forward motion provided by the propulsion system [18]. But without a change in displacement, the boat could not dive. The air-filled ballast tanks make the sub lighter than the water it displaces.

A ballast tank is a compartment that holds water. A vessel may have a single ballast tank near its center or multiple ballast tanks typically on either side. Adding ballast to a vessel lowers its center of gravity, and increases the draft of the vessel. In submarines ballast tanks are used to allow the vessel to submerge, water being taken in to alter the vessels buoyancy and allow the submarine to dive [15]. When the submarine rise to the surface, water is blown out from the tanks using compressed. A submarine may have several types of ballast tank, the main ballast tanks, which are the main tanks used for diving and surfacing, and trimming tanks, which are used to adjust the submarine's attitude both on the surface and when underwater.

2.2 Product Development

Product development mans providing products features that respond to customer needs. There are other terms with similar meanings: product design, system design, product engineering. It is also activity of providing products features varies widely. Consist of applying some existing or standard design to meet customers need. Some can involve extensive research to find an appropriate response.

Some features must be considered for product development, there are: meet the needs of customers, meet our needs as suppliers, meet the competition and optimize the combined costs of our company and our customers [6].

2.3 Sheet Poly (methyl methacrylate)

2.3.1 Introduction

Sheet poly (methyl methacrylate) became prominent during World War II for aircraft glazing, a use predicted by Hill in his early patents and since then other applications field are using it. Example of commercial poly (methyl methacrylate) sheet are Perxpex (ICI), Oroglas and Plexiglas (Atoglas), Poly (methyl methacrylate) moulding powders include Diakon (ICI), Acry-ace (Fudow Chemical Co. Japan), Lucite (Du Pont) and Vedril (Montecatini) [4].

2.3.2 General Properties of Poly (methyl methacrylate)

Poly (methyl methacrylate) is hard, rigid, transparent and have extremely good weathering resistance compared with other thermoplastics. As might be expected from somewhat that similar to thermoplastic material, mechanical,

electrical and other properties are strongly dependent on temperature, testing 'rate' and humidity [4]. Poly (methyl methacrylate) is recognized to be somewhat tougher than polystyrene but less tough than cellulose acetate or the ABS (Acrylonitrile butadiene styrene) polymers. Although it is harder than other thermoplastics, the scratch resistance does leave something to be desired. Shallow scratches may be removed by polishing.

2.4 Proposed Design

Based on current RC submarine that available at market, the proposed came out. The basic concepts and components for the submarine still the same such as DC motor, servos, valves, water pump, radio control and camera.

For this project RC submarine, several adjustments had been made that are the submarine will equipped with wireless camera. This is the parts for the submarine so we can monitor underwater with this submarine.

2.4.1 Direct Current (DC) Motor

DC motor as shown in Figure 2.2 is proportional to the voltage applied to it, and the torque is proportional to the current. Speed control can be done by variable battery tappings, variable supply voltage, resistors or electronic controls. The direction of a wound field DC motor can be changed by reversing either the field or armature connections but not both.

Figure 2.2: DC Motor [10]

The mechanism of DC motor:

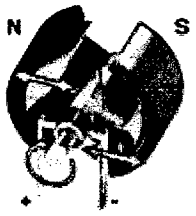

Figure 2.3 [10]

(i). The rotation of DC motor started with when the coil is powered, a magnetic field is generated around the armature. The left side of the armature is pushed away from the left magnet and drawn toward the right, causing rotation.

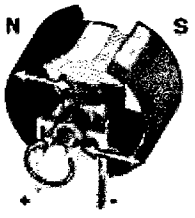

Figure 2.4 [10]

(ii). The armature continues to rotate because of inertia.

Figure 2.5 [10]

(iii). When the armature becomes horizontally aligned, the commutator reverses the direction of current through the coil, reversing the magnetic field. The process then repeats.

2.4.2 Inverter

An inverter as show in Figure 2.6 is an electronic circuit that converts direct current (DC) to alternating current (AC). Inverters are used in a wide range of applications, from small switching power supplies in computers, to large electric utility applications that transport bulk power. The inverter is so named because it performs the opposite function of a rectifier.

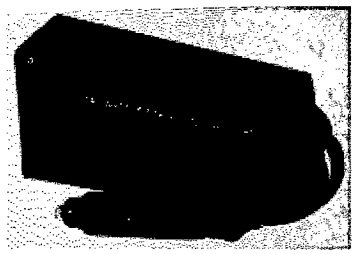

Figure 2.6: 12V DC – 230V AC inverter [19]

2.4.3 Polyvinyl chloride (PVC)

Polyvinyl chloride, (IUPAC Polychloroethene) commonly abbreviated PVC, is a widely used thermoplastic polymer. In terms of revenue generated, it is one of the most valuable products of the chemical industry. Globally, over 50% of PVC manufactured is used in construction. As a building material, PVC is cheap, durable, and easy to assemble [21]. In recent years, PVC has been replacing traditional building materials such as wood, concrete and clay in many areas. Despite claims that PVC production negatively affects the natural environment and human health, it is still widely used.

There are many uses for PVC. As a hard plastic, it is used as vinyl siding, magnetic stripe cards, window profiles, gramophone records (which is the source of the term vinyl records), pipe, plumbing and conduit fixtures. The material is often used in Plastic Pressure Pipe Systems for pipelines in the water and sewer industries

because of its inexpensive nature and flexibility. PVC pipe as in Figure 2.7 is typically white, as opposed to ABS, which is commonly available in grey as well as white.

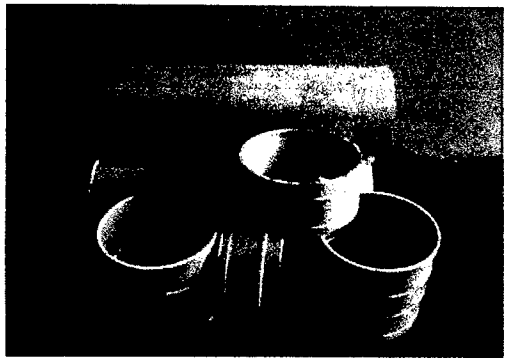

Figure 2.7: PVC pipes and sockets

2.4.4 Water Pump

The earliest pump was described by Archimedes in the 3rd century BC and is known as the Archimedes screw pump. Pumps work by using mechanical forces to push the material, either by physically lifting, or by the force of compression. A pump is a device used to move liquids, or slurries. A pump moves liquids from lower pressure to higher pressure, and overcomes this difference in pressure by adding energy to the system (such as a water system) [11].

For this project, the water pump is placed in the second department of the ballast system. The pump is used to transfer the water into the ballast tank when the submarine wants to dive and to transfer the water out the ballast tank for the submarine to rise.

2.4.5 Radio Control

Radio control (R/C) is the use of radio signals to remotely control another device. The term is used frequently to refer to the control of model cars, boats, airplanes, and helicopters from a user-held control box (radio) [14]. Industrial, military, and scientific research organizations make use of radio-controlled vehicles as well.

For this project, a 35MHz radio control is used. It from a remote control car and some modification on the circuit are done to suit the projects.

2.4.6 Wireless

The term wireless is normally used to refer to any type of electrical or electronic operation which is accomplished without the use of a hard wired connection. Some of these operations may also be accomplished with the use of wires if desired, while others, such as long range communications, are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g., radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g., radio frequency (RF), infrared light, laser light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances [13].

2.4.7 Camera

A camera is a device used to capture images, as still photographs or as sequences of moving images (movies or videos). Cameras may work with the light of the visible spectrum or with other portions of the electromagnetic spectrum. A camera consists of some kind of enclosed hollow, with an opening or aperture at one end for light to enter, and a recording or viewing surface for capturing the light at the other end [9]. Most cameras have a lens positioned in front of the camera's opening to gather the incoming light and to focus the image, or part of the image, on the recording surface. The diameter of the aperture is often controlled by a diaphragm mechanism, but some cameras have a fixed-size aperture.

Video cameras are used primarily in two modes. The first, characteristic of much early television, is what might be called a live broadcast, where the camera feeds real time images directly to a screen for immediate observation; in addition to live television production, such usage is characteristic of security, military/tactical, and industrial operations where surreptitious or remote viewing is required. The second is to have the images recorded to a storage device for archiving or further processing; videotape is traditional for this purpose, but optical disc media, hard disk, and flash memory are all used as well. Recorded video is used not only in television and film production, but also surveillance and monitoring tasks where unattended recording of a situation is required for later analysis.

2.4.8 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts [18]. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of an electrical amplifier.

In this project, relay as shown in **Figure 2.8** are used. It has 8 pins and operated in 12V DC.

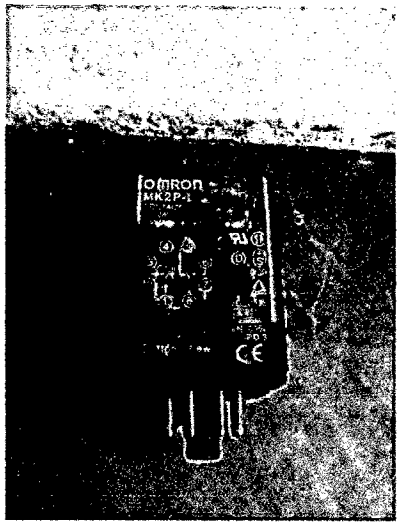

Figure 2.8: 8 pins 12V DC Relay.

CHAPTER 3

METHODOLOGY

In this chapter, all of the flow of the whole project will briefly explain from start to the end.

3.1 Flow chart of the project

Figure 3.1 shows that the overall flow of the project. This includes all the process required from the start, literature review to final report submission. These are steps for the project to finish successfully.