REMOTE-CONTROLLED ELECTRO-PNEUMATIC ACTUATOR FOR REMOTE RESPONSE UNIT

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This report is submitted
in fulfillment of the requirement for the degree of
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DECLARATION

I declare that this project report entitled "Remote-Controlled Electro-Pneumatic Actuator for Remote Response Unit" is the result of my own work except as cited in the references

Signature : .....

Name : .....

Date : .....

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Thermal Fluid).

Signature :. .....
Name of Supervisor : .....
Date : .....

DEDICATION

To my beloved mother and father

ABSTRACT

The purpose of this study is to develop a remote operated construction robot by implementing teleoperation command and control system. Robotic technology has been used widely in industrial field that give positive feedback in terms of its accessibility, convenience and safety. Robotic technology is versatile on doing various job from simple repetitive jobs to dangerous situation. A remote-controlled robot can help human on solving problems that believe to be hazardous and need experts to be at the specific location which in this case is human. Robot have high reliability and more efficient mobility instead of conventional control system. Remote control system allowed human to carried difficult task at several distances away. The system will be developed using Arduino control system that will be used in the control of the pneumatic construction vehicle. The remote-controlled system will be controlling the movement of the mini robot. The control system will be developed using two methods for the initial method which using the Arduino programming and the SKPSW wireless transmitter. The remote controller project is developed by using PS 2 controller as a base system that will send the data from the remote control and send output data to the system. This system uses Arduino coding logarithm that has been developed in Integrated Development Environment (IDE) and uploaded to the Arduino board by USB making the Arduino as the prime controller. The Arduino system that attached with wireless receiver will receive data from the remote control and process the data to be sent to the output digital pins. The remote controller system used Arduino software and hardware as the controller that has been successfully tested by actuating cylinder that carried out operations of the mini robot when the PS2 controller button is pressed.

ABSTRAK

Tujuan kajian ini dijalankan adalah untuk menghasilkan sebuah teknologi robot menggunakan sistem teleoperasi sebagai pusat kawalan dan arahan. Teknologi robotik digunakan secara meluas dalam bidang industri dan mendapat maklum balas yang baik dari segi kebolehcapaian, kemudahan dan keselamatan. Teknologi robotik juga serba boleh dalam menjalankan tugas yang berulang dan merbahaya. Penggunaan alat kawalan robotik dapat menyelesaikan kerja yang dijalankan oleh manusia dan mudah untuk menjalankan kerja yang bahaya, serta ianya perlu dikawal oleh pakar iaitu kepakaran manusia. Teknologi robotik mempunyai kebolehpercayaan yang tinggi dan kemudahan pergerakan yang efisien yang jauh lebih baik daripada kawalan konvensional. Alat kawalan boleh digunakan oleh manusia untuk menjalankan kerja yang sukar pada jarak yang jauh. Sistem ini menggunakan Arduino sebagai asas kawalan untuk mengawal kenderaan pembinaan hidraulik. Sistem kawalan jauh ini akan digunakan untuk mengawal pergerakan robot. Sistem kawalan akan dibangunkan dengan menggunakan dua kaedah iaitu untuk kaedah awal, ia menggunakan pengaturcaraan Arduino dan pemancar tanpa wayar SKPSW. Projek untuk alat kawalan dibangunkan menggunaan alat kawalan PS2 yang akan menghantar data kepada sistem. Keseluruhan sistem ini menggunakan Arduino logaritma yang akan dihasilkan menggunakan perisian Arduino, kemudian data akan dihantar kepada papan Arduino menggunakan USB dan menjadikan Arduino sebagai kawalan utama dalam projek ini. Sistem Arduino yang dilampirkan dengan penerima tanpa wayar akan menerima data dari alat kawalan jauh dan memproses data untuk dihantar ke pin digital pengeluar. Sistem kawalan jauh menggunakan perisian Arduino dan perkakasan sebagai pengawal yang diuji oleh penggerak silinder bagi 'mini' robot apabila butang pengawal PS2 ditekan.

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LED	Light-Emitting Diode
PS2	Play Station 2
IDE	Integrated Development Arduino
V	Voltage
VCC	Positive Supply Voltage
GND	Ground
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

1.1 Backgrounds

Remote controls system is now widely used in many industry and it became essential for every human being. Nowadays, the remote-control capability built in many devices such as toys cars, video game consoles and ceiling fans. Remote controls allowed us to perform many tasks that would be difficult and dangerous. Remote control works by sending signal over a frequency through transmitter to the model that being controlled. The transmitter is the component used the send signal of the command from the board to the model.

For the last few years, human tend to use remote control system for other commercial use. Remote control system in many technical machine helps people to perform security tasks, building maintenance and construction. There is some development of the robotics technology which use remote control system to operate. This technology has emerged drastically now in order to decrease the need of human power. It also helps us to perform a difficult and dangerous task. For example, the remote-controlled excavator that operate in inclined and dangerous area can be controlled by the human from long range. This will make the human to deal with any situation they may encounter autonomously. (Nathan Chandler,2011)

The function and operation of remote-controlled electro-pneumatic actuator is same with the remote-controlled robot that used widely nowadays. So, the focus of this subtopic is on the wireless remote-controlled of any devices or machine. The working tasks done by the robots is way more safe and reliable. As an example, a tele-operated service robot called ROSE (Remotely Operated Service robot) was developed to perform the human task. The operator can control the ROSE from the distance of 8 km.(Van Osch et al. 2014). This kind of robot can lead to other service robot which specialized in performing security tasks, building maintenance and construction. For

instance, the robot could be built for construction work such as lifting the heavy objects or build the building wall. This will make the human less work and safe from performing dangerous task. In chemical industry, the robot can be used to lift and move the chemical objects which hazardous for human. (" How do remote controlled toys work?",2016)

The tele-operation excavator using a human arm also was developed to perform the task like digging, material handling, demolition, general grading and mining. This resulting in positive effect for those don't have experience to operate and manipulate a mechanical excavator. They do not need a long learning process to gain skills and knowledge required in operating the overall excavator motion. Apart from that, they also do not need to operate the excavator at the dangerous place such as the inclined hill which can lead to instability of the excavator. This tele-operation excavator used the Bluetooth wireless communication as the connection between operator and excavator. In long range, the operator can simply give the command to the excavator. So, there is no potential risk of accident involved for the operator. (Kim et al. 2009)

1.2 Problem Statement

There is problem in developing the program that can control the electro-pneumatic actuator as the program provide many alternative ways to established code. The program need to be established by creating the command system for remote response unit. There is also problem in creating the command system as there is lot of coding that need to be learned to get a fully complete function of the remote response unit.

The problem with the previous remote response unit need to be resolved. This remote response unit is done by the previous student and it have some problem with the system. The problem is all LED bulb of the unit is light up when the power on. The LED should be light up when the button is pressed and the LED is turned off when the button is released. Therefore, the identification of the problem regarding with the circuit or the coding of the program need to be done.

1.3 Objective

The objectives of this project are as follows:

1. To modify electro-pneumatic actuator controller programming for the previous remote response unit.
2. To develop a new complete control system platform for the remote response unit.

1.4 Scope of Project

The scopes of this project are:

1. To program electro-pneumatic actuator controller for mini robot by using Arduino software. (objective 1)
2. To build a control panel for control system platform. (objective 2)
3. To survey and buy components to build the control panel. (objective 2)
4. To implement the failure mode and effect analysis on the project.

1.5 General Methodology

The actions that need to be carried out to achieve the objectives in this project are listed below.

1. Literature review
   Journals, articles, or any materials regarding the project will be reviewed.

2. Software study
   The Arduino software need to be practice commonly by studying the tutorials in YouTube.

3. Modify Arduino command

The coding for the remote-controlled electro-pneumatic actuator need to be established in the Arduino software in order to get the exact output.

4. Testing

   Testing will be made based on the coding input from the Arduino software to the board by testing it.

5. New panel development

   New panel of the remote response unit will be built

6. Report writing

   A report on this study will be written at the end of the project.

The methodology of this study is summarized in the flow chart as shown in Figure 1.1.

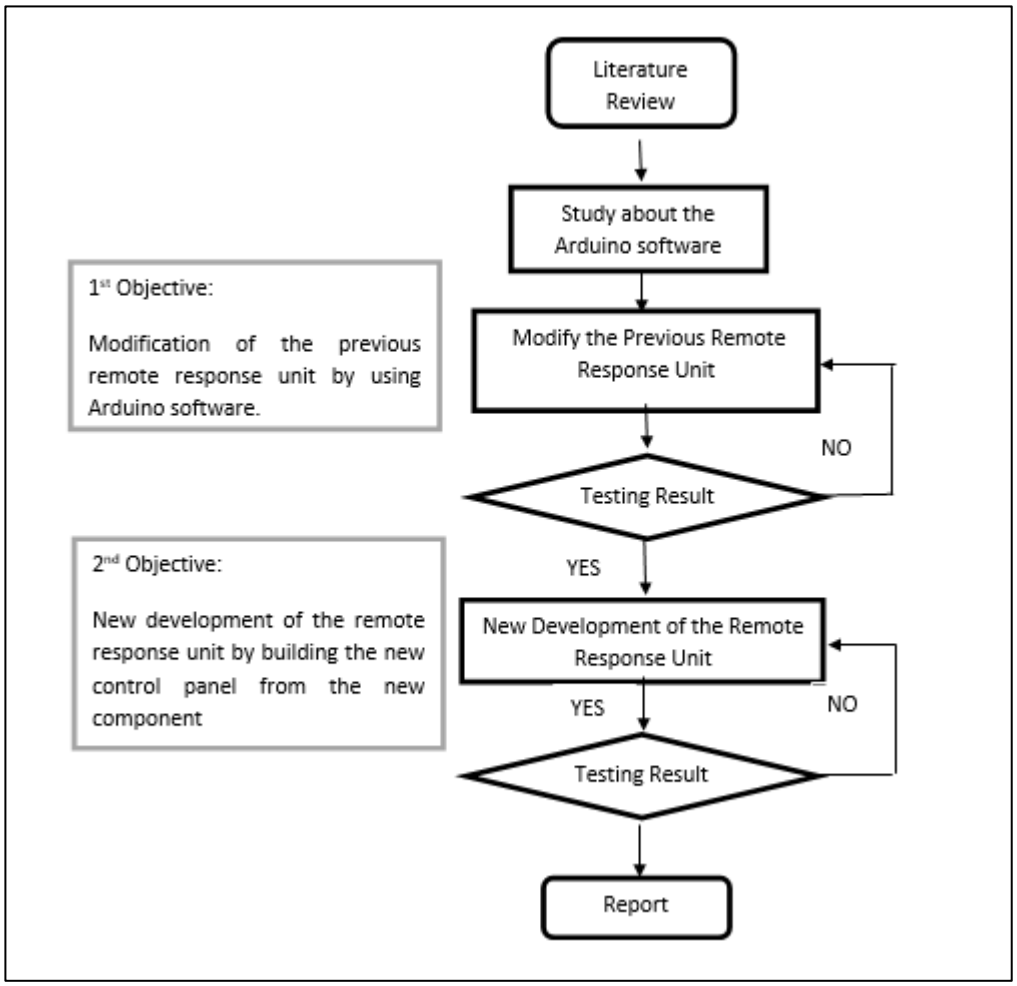
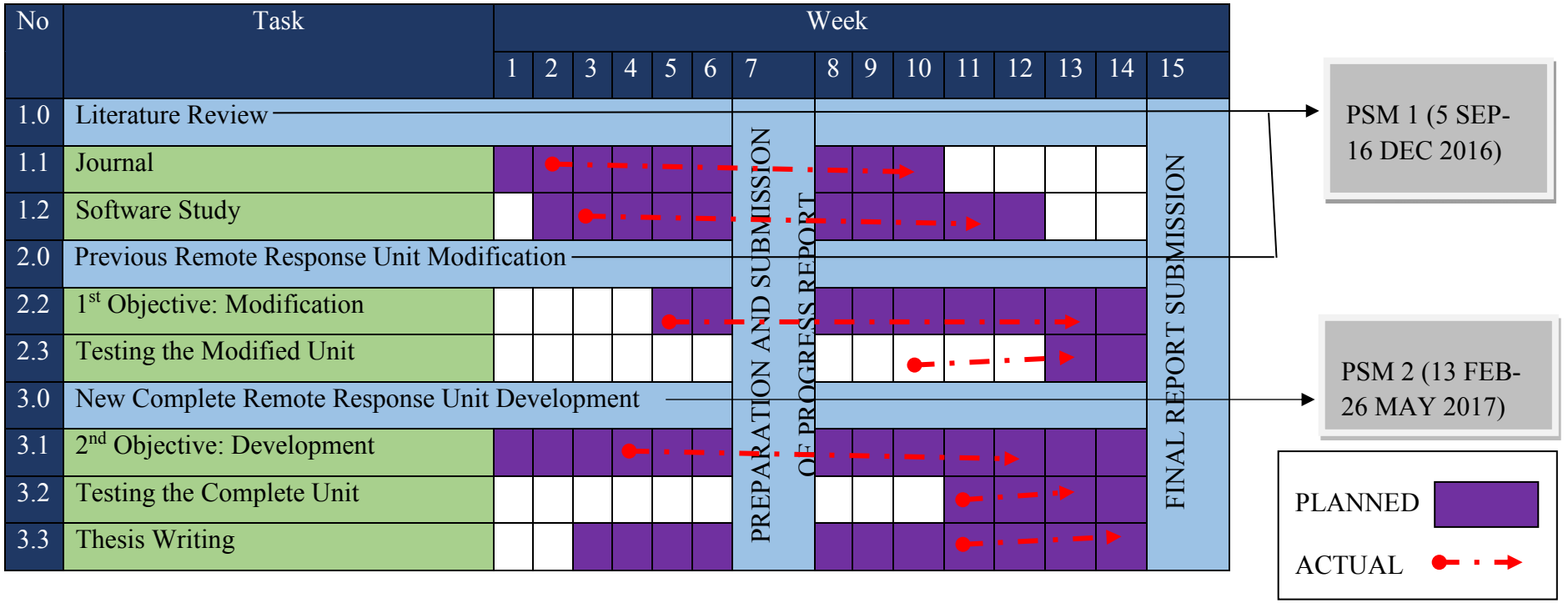


Figure 1.1: Flow chart of the methodology

Table 1.1 below shows the project schedule of PSM 1 and PSM 2 in the form of Gantt Chart.

Table 1.1: The Gantt Chart for PSM 1 and PSM 2



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of Teleoperation System Control

Machine that enables a human operator to move about, sense and mechanically manipulate objects at a distance is called tele-operator. Most generally any machine which can perform a person's mechanical action beyond her reach is called tele-operator. One of the subclass of the tele-operator is tele-robot. It is a robot which can receive a command from a human operator at specific distance. The transmission of command input through the installed sensors or other control mechanisms can make the robot to perform live actions at a distant environment. The transmission process take place in between sensors and effectors with the support of the human operator to communicate with both. Whereas, teleoperation is a mechanism in which operation of robot take place using human intelligence. This operation need a suitable adequate human-machine interface that can be easy to handle. Figure 2.1 below shows the schematic diagram of the command flow in the tele-operation system (Cui et al. 2003).

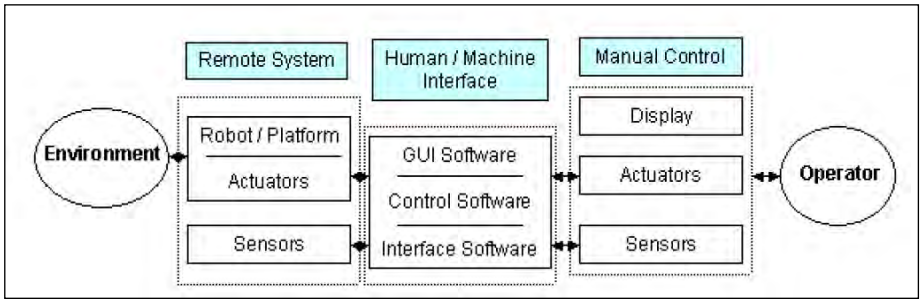


Figure 2.1: The Schematic Diagram of the Command Flow in the Tele-Operation System (Cui et al. 2003)

Mobile robots can be considered as an example of teleoperation system because they can be remotely controlled by human to accomplish certain tasks (Muhammad Hafiz, 2016). Nowadays, remote-controlled based robot technology is developed rapidly in order to take place of human in performing the task especially the repetitive task. Robot can be used in two general sector which are industrial and

service. Based on the International Federation of Robotics (IFR), service robot is defined as a robot which operates on semi or fully automatic to perform services useful to the well-being of humans and equipment (Yusoff et al. 2012).Hence, the main function of the teleoperation system is to help human to perform and accomplish complex or difficult tasks in hazardous and less structured environments, such as space, nuclear plants, battlefield, surveillance, and underwater operations. Figure 2.2 below shows the remote-controlled arm robot (Computing 2013).

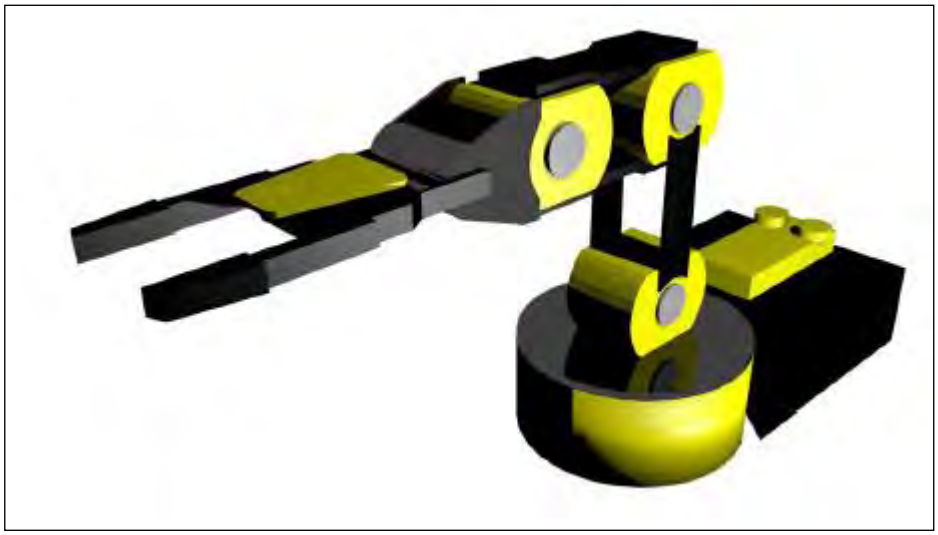


Figure 2.2: The Remote-Controlled Arm Robot (Computing 2013)

2.2 Teleoperation Application

The application of teleoperation increasing rapidly because of the easy access to the Internet and other related technologies. Nowadays, almost all sector provides dangerous task to the human. This force human to use other equipment especially the tele-operated machine to perform this kind of task. Teleoperation system is a kind of task which need a continuous interaction between the human operators, tele-operator system and the environment in order to make the system run properly.

2.2.1 Undersea Application

Teleoperation system is developed for the operation in the undersea which is very difficult and dangerous task for the human. Some of the task in this sector limit

the human to accomplish the task completely without the help advanced technology like tele-operated machine. Teleoperation used in the undersea application mainly for inspection to know the real situation happening beneath the sea. Figure 2.3 below shows the undersea vehicle Jason which is used to locate the Titanic ship that sink under the sea. This vehicle developed by the Argo-Jason, so the vehicle is named after him (Cui et al. 2003).

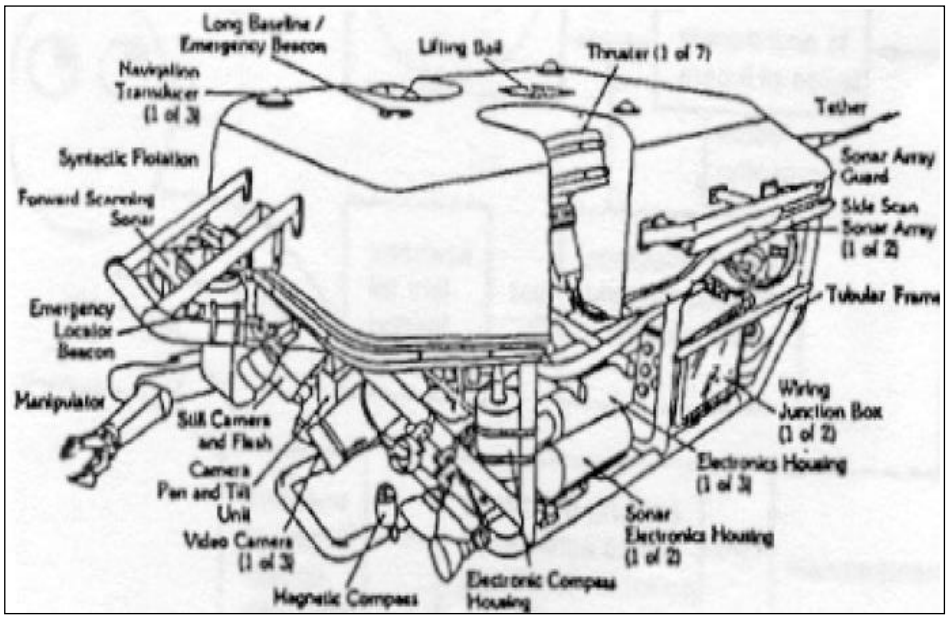


Figure 2.3: The Undersea Vehicle Jason (Cui et al. 2003)

2.2.2 Space Application

Space also used teleoperation system in some case mostly to deal with the space environment which is not suitable for human. Most of the deep space probes use teleoperation system which can interact with the human in long distance. It has some features using simple control such as take pictures, travel in the space and ability to be reprogrammed. In 1993, the first space tele-robot called 'Rotex' was successfully built by the German. This discovery proved the ability to control the tele-robot in space in a distance. (Cui et al. 2003)