REMOTE CONTROLLED CONSTRUCTION SYSTEM FOR EMERGENCY AFTERMATH

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Report
Projek Sarjana Muda II

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DECLARATION

I have checked this report and the report can now be submitted to JK-PSM to be delivered back to supervisor and to the second examiner.

Signature : Yogesh

Name : YOGESWARAN A/L GNANASEGARAN

Date : 22/6/2017.

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	:.................................

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to all those who helped me to complete this final year project and report writing. First of all I would like to express my special gratitude to my supervisor, Dr.Ahmad Anas Bin Yusof who gave me this opportunity to do this project with the title of the Remote Controlled Construction Vehicle For Emergency Aftermath. Through his guide and advice, I managed to complete my final year project without any conflict and problem. His guide and skills enhanced my knowledge and technical skills in completing the task assigned.

Besides that, I would like to express my gratitude towards Master student under Dr.Ahmad Anas Bin Yusof for monitoring my progress and sharing his experience as well as knowledge about this project. Furthermore, appreciation goes to the technician and staff of thermal fluid laboratory for giving their cooperation to provide the equipment and components. I would like to appreciate their guidance for teaching me about the usage of the equipment

Last but not least, I would like to thank my family and colleagues for their invaluable support, suggestion and encouragement throughout this project.

ABSTRACT

The purpose of this research is to examine and analysis the Remote Controlled Construction Vehicle for Emergency Aftermath. It is one of the requirements needed to be fulfilled by the students in order for them to graduate. Student is given the opportunity to choose the title of the Final Year Project given by the university to fulfill the requirement to do this project.

In this project, Tele-Operated Electro Hydraulic Actuator (T-EHA) system is the one familiar system that we used to do as working mechanism such as remote control system, the tele-operation system which can control the distance of the length. It is commonly associated with robotics and mobile robots but can be applied to a whole range of circumstances in which a device or machine is operated by the person from a distance. The task is assigned to carry out simulation and experimental result based on the cylinder stroke, pressure, flow rate and pressure fluctuation between T-EHA and the excavator

ABSTRAK

Tujuan kajian ini adalah untuk mengkaji dan analisis Kenderaan Pembinaan kawalan jauh Untuk Kecemasan Aftermath. Ia adalah salah satu keperluan yang perlu dipenuhi oleh pelajar bagi membolehkan mereka untuk bergraduat. Pelajar diberi peluang untuk memilih tajuk Projek Tahun Akhir yang diberikan oleh universiti untuk memenuhi keperluan untuk melakukan projek ini.

Dalam projek ini, Tele-Operated Electro hidraulik penggerak (T-EHA) sistem adalah satu sistem yang biasa yang telah kami lakukan sebagai mekanisme kerja seperti sistem kawalan jauh, sistem tele-operasi yang boleh mengawal jarak panjang. Ia biasanya dikaitkan dengan robotik dan robot mudah alih tetapi boleh digunakan untuk pelbagai jenis keadaan di mana alat atau mesin dikendalikan oleh orang yang dari jauh. Tugas ini diberikan untuk menjalankan simulasi dan Hasil eksperimen berdasarkan strok silinder, tekanan, kadar aliran dan tekanan turun naik antara T-EHA dan penggali

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IDE	Integrated development environment
T-EHA	Tele-operated Electro Hydraulic Actuator
PSM	Projek Sarjana Muda
Kw	kilowatt
Hz	Hertz
RPM	Revolution per minute
3D	Three dimensional
CAD	Computer Aided Diagram
mm	Millimeter
LED	Light emitting diode
PS2	Play station 2
V	Volt
MIG	Metal Inert Gas
DCV	Directional Control Valve
RCV	Remote-controlled Construction Vehicle

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CHAPTER 1

INTRODUCTION

1.1 Background

In this new era of technology, robot is one of the greatest inventions of human kind. Research and development of robot is growing rapidly from time to time. One of the good advantages of robot is it is able to perform difficult tasks that can be performed by human. Examples of the dangerous task that cannot be perform by human but can be perform by robot are volcanic disaster response, earthquake, explosive disposal, underwater operation and others. Robot technology and capability to control robot enables human to perform dangerous operation more safely and reduce the risk of injury or loss of life. Besides that, the technology of robot is also apply in manufacturing field such as producing electronic equipment, manufacturing vehicle components, food production and others. Thus, give a lot of benefits to the manufacturer due to the reduction of production cost, increment of productivity at low cost and others. Other application of robot which can contribute to human life is in medical field. One of the applications of robot in medical part is replacing missing part of body such as missing hands, legs or joint. These parts which were produced to replace the missing part of body are called prosthesis. This application can help those disabilities to have a better life.

Remote control system is one of the good methods to link human with the robot. Remote control system gives user ability to operate the robot. User can link the remote control unit with the robot using several ways such as bluetooth, infrared or wi-fi. Most of the remote control system for robot is applied to perform task such as volcanic disaster response, explosion, rescue mission in deep sea and military purpose without the presence of human on that dangerous location. These robots which were remotely-controlled can be categorized into three type of categories which are unmanned ground vehicle (UGVs), Unmanned Aerial Vehicle (UAVs), Unmanned Surface Vehicle (USVs) and Unmanned Underwater Vehicle (UUVs) (ADASI., 2014).

Nowadays, master-slave system is the most popular system utilized by many researchers to control the robot. Remote control acts as a master which is controlled by user or operator while the vehicle that carrying out the task serves as the slave of the system. Usually, these vehicles are equipped with sensors. The presence of sensors will enhance the control and communication process between the user and the robot vehicle at the working site. The example of robot which utilized master-slave system is excavator tele-operation system using human arm. The human arm serves as the master of the system and the slave part is the backhoe of the excavator. The movement of human arm presents the movement of the actuator of the boom, arm and bucket of the excavator. There are few sensors used to execute the movement of the boom, bucket and arm. These sensors are orientation sensor, rotary encoder and inclinometer. The function of the orientation sensor is to orientate the hand of the user while the encoder is to determine the angle between palm and the finger meanwhile for inclinometer its target is orientation of upper arm and for the movement of excavator arm. Based on the example given, tele-operation system allow human to perform dangerous tasks without the presence of the operator at the site.

This system is beneficial in performing tasks that exposes human to dangerous situation such as earthquake rescue mission, mine clearance, radiation and others.

1.2 Problem Statement

In this day and age, excavator is one of the modern construction vehicles that use for earth work or do specific tasks such as rescue work or recovery mission. However, it requires a well-trained operator to operate the tele-operated excavator. For manned constructions, it is necessary for an operator to handle the excavator at the working site to perform the specific task. Thus, the operator is exposed to a dangerous and risky environment such as hazardous material or any disaster that might happen again.

1.3 Objectives

The objectives of this project are as follows:

A) To simulate the operation between the Tele-operated Electro-Hydraulic Actuator (T-EHA) and its effect on mini excavator boom movement.

B) To test the operation of Tele-operated Electro-Hydraulic Actuator (T-EHA) and it influences on mini excavator boom movement.

1.4 Scope of Project

The scopes of this project are:

1. Simulate the T-EHA and boom movement using FluidSim software.

2. Simulate T-EHA and boom movement using MATLAB software; SimScape. Both simulations will be conducted based on pressure, flow rate, spool movement and cylinder stroke of T-EHA and the mini excavator boom.
3. To conduct experiment on T-EHA and mini excavator test rig. The experiment will be based on pressure, flow rate, spool movement and cylinder stroke of TEHA and the mini excavator boom. A comparison between simulation and experiment data will be conducted to evaluate the data.

1.5 General Methodology

Simulation and experimental process were carried out to achieve the objectives and the scopes in this project. The purpose of these simulations is to give a better understanding on how the mini-excavator operates based on the simulation software.

First of all, FluidSim software is one of the comprehensive software for the creation, simulation, instruction and study of electro pneumatic, electrohydraulic and digital circuits. FluidSim is capable of simulating a vast numbers of different cylinders and valves. The combination of all part designs and functional types would lead to display thousands of symbols. FluidSim includes basic knowledge of designing, testing and simulating fluid power circuits. Delegates will learn about creating standard compliant drawings with an ease and confidence that other simulation and drawing programs have not previously achieved. By adjusting cylinder sizes, operating pressure and flow control, FluidSim able to simulate the behaviour of the system quite accurate.

Modelling a circuit of the hydraulic system of an excavator circuit using SimScape enable us to create a new hydraulic system that do not exist in the Foundation library or in any of the add-on products. The SimScape software eases the modelling process of the physical systems. It defines custom components as textual files, complete with parameterization, physical connections, and equations represented as a causal implicit differential algebraic equation (DAEs). The components created can reuse the physical domain definitions provided with SimScape to ensure that the components are compatible with the standard SimScape components.

Finally, experiment will be conducted based on the relation between mini excavator boom with T-EHA. The results that need to be obtained are the pressure, flow rate, spool movement and cylinder stroke of T-EHA and the boom. The experiment includes the setup of T-EHA, pressure gauge, flow sensor and data logger. A data logger is an electronic device that records data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery-powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer, and use software to activate the data logger and view the recorded data and analyse the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.

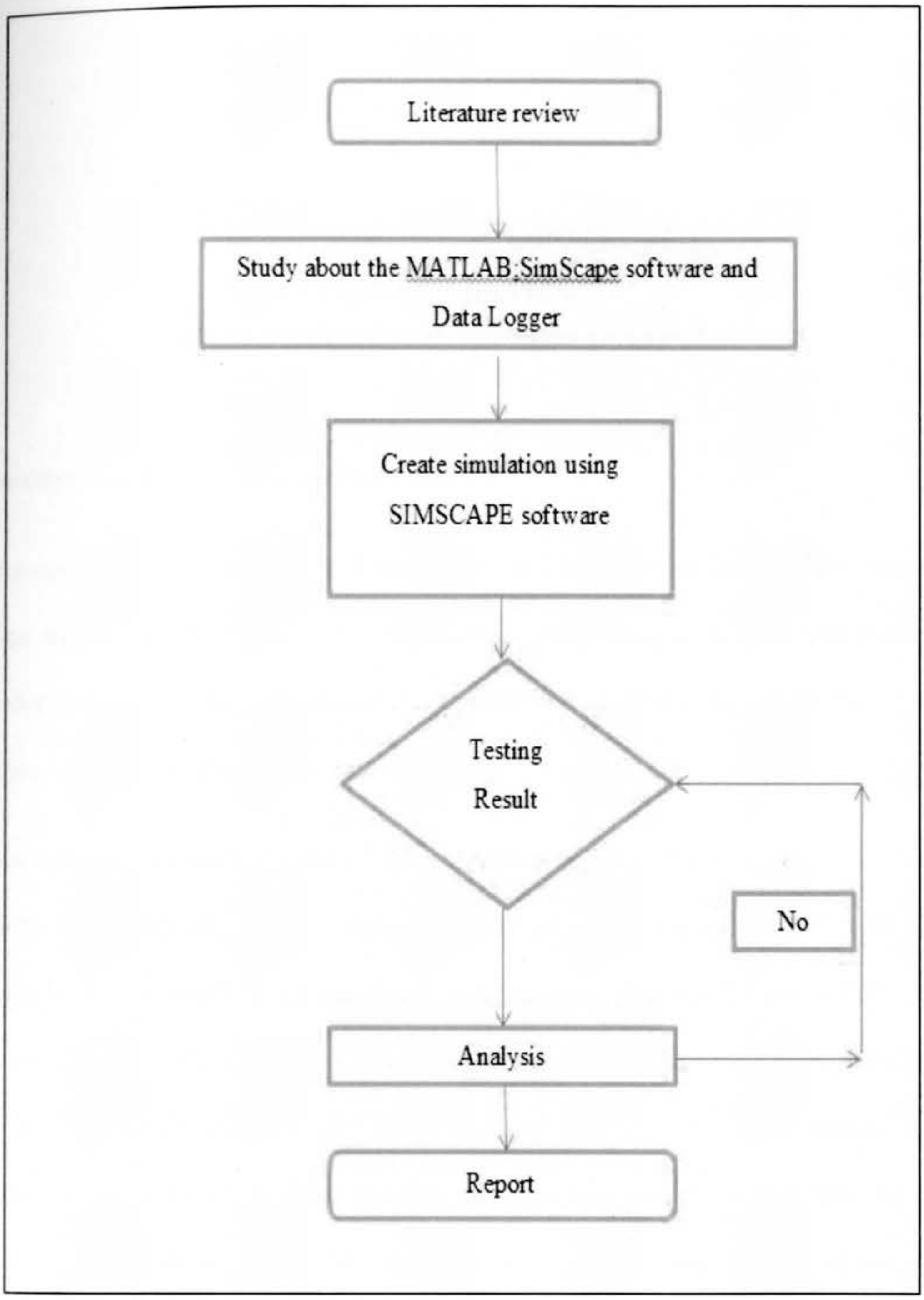

Figure 1.1: Flow chart for Remote-Control Construction vehicle for emergency aftermath

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction To Tele-Operated System

Tele-operation has enjoyed a rich history and has led both to many practical applications and to a broad vision of interaction with environments far removed from the user. In order to understand tele-operation clearly, we first provide some of the basic terms and concepts, which appear related to tele-operation.

Tele-operator is a machine that enables a human operator to move about, sense and mechanically manipulate objects at a distance. Most generally any tool, which extends a person's mechanical action beyond her reach, is a tele-operation (Q. Zhang, 2000). Tele-robot is a subclass of a tele-operator. It is a robot that accepts instructions from a distance, generally from a human operator and performs live actions at a distant environment through the use of sensors or other control mechanisms. Usually it has sensors and effectors for manipulation and/or mobility, plus a means for the human operator to communicate with both. Tele-operation is a means to operate a robot using human intelligence, which requires the availability of adequate human-machine interface. A tele-operation system usually consists of two robot manipulators that are connected in such a way as to allow the human operator control one of the manipulators, which is called the master arm, to generate commands that map to the remote manipulator, which is called the slave arm. (T.Wang, 2000).

The main function of the tele-operation system is to assist the operator to perform and accomplish complex, uncertain tasks in hazardous and less structured environments, such as space, nuclear plants, battlefield, surveillance, and underwater operations (S.Thrun, 2000). Tele-manipulation is a scheme in which a slave robot arm, which is usually in a remote or dangerous environment, tracks the motion of a master manipulator. In general, tele-manipulation is divided into two strongly coupled processes: the interaction between the operator and the master device; and the interaction between the remote slave device and its environment (A. Weber, H. Breitwieser, and J. Benner,2002). Tele-presence. In 1987 Sheridan described tele-presence as the "ideal of sensing sufficient information, and communicating this to the human in a sufficiently natural way that she feels herself to be physically present at the remote site." Sheridan also called tele-presence a "compelling illusion" and "a subjective sensation". Many research has been carry out to develop this Tele-operation system. Several studies were done to adapt and apply the concept of Tele-operation system. This development allow human to be able to operate a difficult task at remote area or hazardous environment without the presence of operator at site. This task can be done with continuous interaction between the operators, the systems and the environment itself. Tele-operation construction robot system with virtual reality was discussed (Tang, X. and Yamada,H., 2011). Self-controlled robot for military purpose also been described in (sathiyanarayanan,M Et al., 2014). Study of Tele- operation system using human arm also described in (Dongmok,.K Et al., 2009).

Human skill and intelligence can be applied in Tele-operation system to enhance the safety and quality of robotic system. In presence of human intelligence and skill, a certain problem or decision making can be solve efficiently and quick compared to robot that operate based on the program. To design a friendly and intuitive human-robot interaction is one important aspect to make the control process easier (Farkhatdinov, I. and Ryu, J.H.,2008). In the field of robotics, tele-presence generally refers to a remotely controlled system that combines the use of computer vision, computer graphics and virtual reality.(P. Batsomboon,2000). Tele-presence systems are usually viewed as composed of three parts: A capture system to record and represent the information from the remote site; a network transmission system and a display system to make the local user feel as if she were somehow present in the remote scene.(W. Wu D. Liu, J. Liu and J. Wu,1996).

In this research, Tele-operation system is applied to control the operation of mini excavator. These mini excavators usually do the tasks that have tight space where the big heavy machine cannot do. To operate this mini excavator, a person needs presence at the controlling platform to control the lever. The lever is use to move the excavator part such as boom, arm, bucket, crawler and boom swing.

2.2 Mechanism of Tele-Operated System

Master-slave control is very useful to dangerous and difficult task such as for restoration of damage, rescue mission and extreme environment at seabed, volcano eruption, underwater task and others. Recent research has make initiative to develop the human machine interaction is almost the same as the operator operates the machine directly at work place. With the development of technologies, more advanced equipment was installed in a master-slave system in ensuring a smooth and continuous communication. This also can enhance the level of safety of the operation. In Tele-operation, the task can be classified into cooperative and independence Tele-operation. The independence Tele-operation is operation that based on absolute operation and position. For the cooperative Tele-operation task is characterize by the relative control position, orientation and the contact force of the effector and the manipulator (Zhijun et al,2015). The framework system framework can be class into two types which is bilateral system and multilateral system. The multilateral system is the extend system from bilateral system. Besides that, there is new system that has been developed, which is bilateral operation system.

2.3 Bilateral Tele-Operation System

Bilateral operation is one of the new developments of system in tele operated system. This system consists of master site which is this site is driven by the operator with master manipulator as shown in figure 2.1. At another site is remote slave site. At this site, it contact with environment. With the advancement of technologies, bilateral Tele- operation systems can communicate through internet. For the typical bilateral system, the operator remains at the master site and the slave remain contact with the environment. These two sites communicate through force and position feedback and the feedback is shown in screen at the master site. This information is transmitted through wire. The type of transmission can be electrically wire, wire network or wireless human machine interaction is almost the same as the operator operates the machine directly at work place. With the development of technologies, more advanced equipment was installed in a master-slave system in ensuring a smooth and continuous communication. This also can enhance the level of safety of the operation. In Tele-operation, the task can be classified into cooperative and independence Tele-operation. The independence Tele-operation is operation that based on absolute operation and position. For the cooperative Tele-operation task is characterize by the relative control position, orientation and the contact force of the effector and the manipulator (Zhijun et al,2015). The framework system framework can be class into two types which is bilateral system and multilateral system. The multilateral system is the extend system from bilateral system. Besides that, there is new system that has been developed, which is bilateral operation system.

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