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**DESIGN AND IMPROVEMENT OF HYDRAULIC SYSTEM FOR FIRE  
FIGHTING MACHINE**

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**This report is submitted as partial requirement for the completion of the  
Bachelor of Mechanical Engineering (Design & Innovation) Degree Program**

**Faculty of Mechanical Engineering  
Universiti Teknikal Malaysia Melaka**

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## PENGAKUAN

“Saya akui laporan ini adalah hasil kerja saya sendiri kecuali ringkasan dan petikan yang tiap-tiap satunya saya telah jelaskan sumbernya”

Tandatangan : .....

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Tarikh : .....

## DECLARATION

“I hereby, declare this thesis is result of my own research except as cited in the references”

Signature : .....

Author Name : See Thiong Zhou

Date : .....

**DEDICATION**

**To  
My Beloved Family**

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## ABSTRAK

Projek ini adalah mereka bentuk satu sistem hidraulik baru bagi mesin pemadam api. Tujuan mereka bentuk sistem hidraulik ialah untuk menambah satu penyeduk pada mesin pemadam api. Penyeduk itu hendaklah berfungsi untuk menggerakkan halangan dan rintangan semasa memadam api. Selain itu penyeduk itu juga berfungsi untuk membawa peralatan dan pelengkapan pemadam api ke tempat kejadian kebakaran dan juga membawa mangsa keluar dari tempat kejadian. Teknologi pemadam api yang sedia ada di pasaran, mesin pemadam api yang sedia ada di pasaran, dan pengetahuan- pengetahuan tentang sistem hidraulik yang akan digunakan dalam pelaksanaan projek ini dipelajari. Reka bentuk konsep akan menjelaskan proses untuk mereka bentuk sistem hidraulik. Isi-isinya mengandungi spesifikasi reka bentuk kejuruteraan, carta tata bentuk, konsep-konsep reka bentuk yang dijanakan, penilaian konsep, dan konsep yang terbaik. Lukisan CAD dibuat dengan menggunakan CATIA. Fungsi dan reka bentuk sistem penyeduk and setiap komponen dari sistem penyeduk akan diterangkan dengan terperinci. Selain itu, pengiraan untuk memilih hidraulik silinder yang betul dan tepat juga diterangkan. Seterusnya, analisis terhadap sistem penyeduk akan dilakukan dengan menggunakan SolidWork 2009 dan simulasi litar hidraulik sistem juga dijalankan dengan menggunakan FluidSim 3,6 Festo. Akhir sekali, pengiraan untuk setiap komponen, pembahagian kluster, EBOM, dan produk kos akan diterangkan dalam tajuk ini.

## ABSTRACT

The project is on design of a new hydraulic system for the fire fighting machine. The purpose of the hydraulic system is to design a shovel system attach to the fire fighting machine. The function of the shovel system is to clear the obstacles when the machine operates in the fire scene. The other functions of the shovel are to carry the fire fighting equipments to the fire scene or carry victim from the fire scene. The current existing fire fighting technologies, the current existing fire fighting machine, and the hydraulic system were studied. Firstly, the conceptual design will describes the design process of the conceptual design of the shovel. The contents include of product design specification, morphology chart, the concept designs generated, concept evaluation, and the final concept. The conceptual design is transfer to CAD drawing by using CATIA CAD software. The function and design of the shovel and each of the components of the shovel system will be described in detail. Besides, calculations on how to select the proper hydraulic cylinder also stated. Then the shovel system will be analysed using SolidWork 2009 and the hydraulic circuit for new hydraulic system is being simulated using FluidSim 3.6 Festo. Finally, the numbering part to each of the part, division of the shovel system to separate cluster, engineering bill of material (EBOM), and product costing will be described in detail.



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**LIST OF SYMBOLS**

$x$	=	distance
$V$	=	volume
$A$	=	area
$F$	=	force
$A$	=	area
$P_{hyd}$	=	hydraulic power
$P$	=	pressure
$N$	=	rotational speed
$Q$	=	flow
$T$	=	torque
$\Delta P$	=	pressure drop across motor
$V_m$	=	displacement

## LIST OF ABBREVIATIONS

CAD	=	Computer-Aided Design
PDS	=	Product Design Specification
EBOM	=	Engineering Bill of Material

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## **CHAPTER I**

### **INTRODUCTION**

This chapter explains the background of the project, problem statement, objective, and scope of this project.

#### **1.1 Background**

Firefighters are rescuers to put out hazardous fires that threaten civilian populations and property, to rescue people from collapsed and burning buildings, car accidents, and other such situation. Collapsing buildings, explosions and poisonous fumes all pose a serious threat to the lives and limbs of fire crews. Currently, there are many technologies that assist firefighters to fight against fire such as fire fighting vehicle, fire extinguisher, mobile water supply, and fire fighting machine.

The gap between fire fighting and machines has finally bridge by technology. Fire fighting machine and fire fighting robot allow for a more efficient and effective method of firefighting. Robots and machines designed to extinguish a fire, before it rages out of control, could work with firefighters greatly reducing the risk of injury to victims. In the other words, using machine or robot to put out fires will eliminate the risk of injury or death of the fire fighter.

Fire fighting machine is a fuel or electric powered machine controlled from a panel or remote-controller that can be situated outside the danger area with no line-

of-sight necessary. The fire fighting machine usually equipped with variable pattern fire-fighting nozzle, cameras, and local cooling system, contained in a stainless steel insulated body. The control of the leveling, declining, elevating, and rotating of the fire monitor can adjust the spraying point of fall of the fire extinguishing media. The hydraulic system is usually used is the control system of the fire monitor.

The use of hydraulics as a means of power transmission in industries has been a significant increase in the past. Hydraulic systems are now extensively used in machine tools, material handling devices, transport and other mobile equipment, in aviation systems, etc. Hydraulic system is a power transmission system using oil to carry the power. All systems require an input and an output. The output force is almost always multiplied in the process. Hydraulics is mechanically safe, compact, and is adaptable to other forms of power and can be easily controlled. The basic components of the hydraulic system are pump, strainer, oil reservoir, filter, pressure gauge, pressure relief valve, direction control valve, actuator (cylinder or motor), etc.

## **1.2 Problem Statement**

The current fire fighting machine developed by University Teknikal Malaysia Melaka (UTeM) is powered by battery and controlled by remote-controller. The fire fighting machine is mounted with a hydraulic control arm with a nozzle which is connected to the water supply. The main function of this fire fighting machine is to reach the fire source (by using remote-control) in road, basements or other enclosed building compartments, especially factories. The fire fighting machine will reduce the high ambient temperature and the fire intensity or even extinguish the fire by using water spray, thus allow fire fighting and rescue teams to approach safely. With the control of hydraulic system, the nozzle can be adjusted to the spraying point of the water stream at different angle.

There are some weaknesses present in the current UTeM's fire fighting machine such as mobility of this machine is narrow. This machine cannot go through a path if the path is being blocked by obstacles.