

PROJEK SARJANA MUDA

THE FEASIBILITY STUDY AND DESIGN IMPROVEMENT OF
FIRE FIGHTING MACHINE

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This report is submitted in accordance with requirement for the
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“I hereby declared that this thesis of
'Feasibility Study and Design Improvement of fire fighting machine'
is the result of my own effort except as cited in references”.

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ABSTRACT

Fire fighting machine is used widely in some country. These shows that the importance of the machine to use in the works of fire fighting situations. With the help and widely used of the fire fighting machine with a quite high rate of incident happened daily, a machine that most dependable is the scale to smoothens the rescue works. With the high risks of danger faced by the fireman, a high end technology machine is a fortune to them. This situations makes the some people creates the high end machine that will help the fire brigade doing their jobs efficiently and will be able to reduced the rate of accident that may faced by the victims and also to the fireman. With an ability to provide better functions, work to save life will become much smooth. In the process on improvement parts and components on the existing fire fighting machine, the applications to use the computer aided design (CAD) and computer aided engineering (CAE) will be an important needs to create and design a product in the engineering fields now on. Implementation process in creating and designing a new product is shown in details in this report.

ABSTRAK

Penggunaan meluas jentera pemadam kebakaran di setiap negara menunjukkan tentang kepentingan jentera tersebut untuk digunakan di dalam kerja-kerja pemadaman kebakaran. Dengan adanya bantuan dan penggunaan yang menyeluruh terhadap jentera penyelamat dan kadar kemalangan yang agak tinggi, jentera yang mempunyai keboleharapan yang tinggi adalah salah satu daripada pengukur bagi kelancaran proses menyelamat. Dengan tahap bahaya yang tinggi sentiasa dihadapi oleh anggota penyelamat, kecanggihan peralatan dalam aktiviti keselamatan sentiasa diperlukan oleh anggota Bomba dan penyelamat. Situasi ini mencetuskan idea untuk mencipta jentera yang dapat membantu dalam melakukan tugas-tugas menyelamat dengan lebih efisien dan dapat mengurangkan kadar kecelakaan yang mungkin akan dihadapi oleh mangsa dan juga anggota penyelamat. Dengan adanya inovasi terhadap jentera yang fokus terhadap sesuatu situasi, ini akan menjadikan kerja-kerja menyelamat akan menjadi lebih cekap dan efisien. Dalam tujuan menaiktaraf dan penambahbaikan beberapa peralatan dan komponen pada jentera, aplikasi yang betul diperlukan dalam merekacipta dan merekabentuk komponen yang ingin ditambah baiki. Penggunaan rekabentuk berbantu komputer dan kejuruteraan berbantu komputer adalah salah satu keperluan yang agak penting di dalam merekacipta sesuatu produk dalam bidang kejuruteraan masa kini. Proses merekabentuk dan analisis dengan menggunakan kaedah yang betul akan menghasilkan produk yang berkualiti. Kaedah bagi menjayakan penghasilan produk baru diterangkan dengan terperinci dalam laporan projek ini.

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ABBREVIATION

CAD	-	Computer Aided Design
CAE	-	Computer Aided Engineering
R&D	-	Research and Development
FEA	-	Finite Element Analysis
DFMA	-	Design of Manufacturing and Assembly
CAM	-	Computer Aided Manufacturing
SOP	-	Standard Operation Procedure
SF	-	Factor of Safety
WRM	-	Weighted Rating Method

CHAPTER 1

INTRODUCTION

1.1 Project Background

Focus on the feasibility study and design improvement of fire fighting machine.

1.2 Objectives

- To design and improve the existing design of the fire fighting machine for selected modules.
- To design the selected modules with better functions.
- To conduct simulations design analysis for the fire fighting machine.
- Design a product module that able to operate better.

1.3.1 Case study

The first fire brigade was found on 6 AD in Rome. A group of slaves who were hired to combat fires using bucket and pass hand in hand to the fire. In Europe, the key breakthrough in fire fighting arrived in the 17th century with the first fire engines. Manual pump rediscovered in Europe and had a very short range due to the lack of

hoses. Hans Hautsh who was an inventor from German invent a manual pump improved by creating suction and force pump, then Dutch inventor upgrade the hose that constructed of leather and coupled with brass fittings. The manual pump that pulled as a cart could deliver up to 160 gallons per minute at up to 120 feet (36m) .

The revolution keeps on going on 1853 on using a steam fire engine in USA. Then the internal combustion engine takes over the steam engine in 1907. In the meantime, many new invention and revolution have been made to improve the ability of the fire fighting machine. Even though our fire fighter are prepared with safety costumes and apparatus, the ability of a human being is very limited to compete with a several types of fire disasters either in a buildings or even for a bush fire disaster. Based on the lack of ability of a human being, the invention on providing the helpful gadget such a fire fighting machine is a needed machine to reduce rate of fireman killed while savings the victims.

This project discusses the development of a machine, capable of finding it's way through a maze of rooms, searching for a fire and extinguishing it. Though the scale of the machine is comparatively small and its ability to put out a fire. It may not be suitable in some environments but the basic idea, structure and navigation skills can be employed in real situations. There are certain situations that may be suitable and also not suitable for the machine to operate.

1.4 Scope

This report will be focused on optimizing and create a better design and use ability based on the machine that's innovates by UTeM. The target of this project is to make an optimization of certain compartment and component that may seems to be hard to operates, handle, unsuitable parts or even for a backup features to the end user. For

this report, the parts that are detects that may need an optimizations is for the battery compartments and also for the resting arm port.

1.4.1 Job Scope

- To study on the overall fire behavior
- To study the causes that effect from fire disaster
- To make a research about the existing fire fighting machine
- To study the new machine inventions and paten
- To make a design improvement of the machine modules
- To upgrade the battery compartments and also for the resting arm port module design.
- To conduct analysis simulations for the product design.

1.5 Problems Statement

As we know, fire disaster can cause a big lost in a human community. Properties, money, farm and also life can be a victim to this terribly fire disaster. As a focus on those lost, human life is the most important among others. Many people, organizations, government sectors and private sectors try and make a lot of research and development regarding to the fire disaster. For prevention, fire brigade equipment, clothes, accessories, machine and even for a safety precaution system are invented. As we all know, some of those fire can be prevent but some of them are caused by a mother nature or technical failure. Most fireman always faced the critical situations while doing their rescuing work especially when it is connects to the fire disaster. With an inventions and technology applied to some of fire fighting machine, this will reduce the degree of danger to the fireman. As UTeM has create a machine to use for the fire

fighting purpose, some of the module from this machine needs some improvement for a better handling and functions.

1.5.1 Problem Statement Highlight

- To reduce the shock
- Determine the degree of danger that firemen will face before they can enter to the infected places
- Explore the unreachable danger place
- Rapid rescue operation

CHAPTER II

LITERATURE REVIEW

2.1 Fire

Fire is the rapid oxidation of a combustible material releasing heat, light, and various reaction products such as carbon dioxide and water. If hot enough, the gases may become ionized to produce plasma. Depending on the substances alight, and any impurities outside, the color of the flame and the fire's intensity might vary. Fire in its most common form can result in conflagration, which has the potential to cause physical damage through burning.

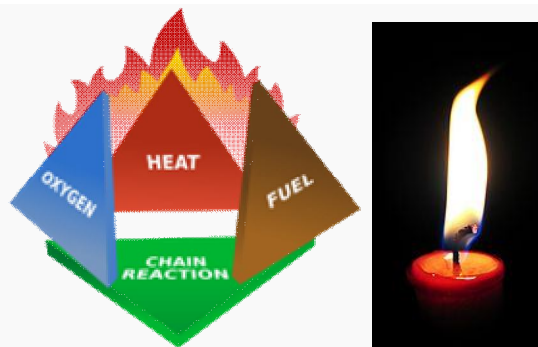


Figure2.1: Elements Combinations that generate fire.

2.1.1 The Fire Tetrahedron

Fires start when a flammable and/or a combustible material with an adequate supply of oxygen or another oxidizer is subjected to enough heat and is able to sustain a chain reaction. This is commonly called the fire tetrahedron. Fire cannot exist without all of these elements being in place (though as previously stated, another strong oxidizer can replace oxygen). Once ignited, a chain reaction must take place whereby fires can sustain their own heat by the further release of heat energy in the process of combustion and may propagate, provided there is a continuous supply of an oxidizer and fuel.(internet source; www.burnerfire.com, 2008)

Fire can be extinguished by removing any one of the elements of the fire tetrahedron. Fire extinguishing by the application of water acts by removing heat from the fuel faster than combustion generates it. Application of carbon dioxide is intended primarily to starve the fire of oxygen. A forest fire may be fought by starting smaller fires in advance of the main blaze, to deprive it of fuel. Other gaseous fire suppression agents, such as halon or HFC-227, interfere with the chemical reaction itself.(Swain, A. 1973).

2.2 Fire disaster categories.

Fire has been a source of comfort and also got a bad side for human race. Fire is believed to be based on three element that present fuel, heat and oxidizer. All the fire incident can be divided into many types depends on the cause of fire but broadly there are two types of fire that classified in:

- Manmade

- Natural fire disaster.

Fire can be occurs on the ground, below the ground and also above the ground. Firestorms can be natural or even human generated. Natural firestorm usually causes for a forest fires that can burn thousand miles of forest and also can killed thousands of people that stays around there. All industrial and chemical fires are due to explosion or fire made by human or even due to technical failure.

2.2.1 Natural

The fire and explosion risk associated with an earthquake is a very complex issue. Fires which are considered as natural are basically

- earthquake
- volcanic eruption
- lightning - generated fires

2.2.2 Manmade

Any confined fire could be due to many reasons like, cooking fire confined to container, chimney or fuel fire confined to chimney, incinerator overload or malfunction, fuel burner/boiler malfunction, and trash fire. Fire caused by human/machine errors are considered as manmade fires, e.g.

- industrial or chemical fire disasters
- Electrical short circuit fires
- accidental fire and kitchen-fires