

**FIRE FIGHTING ROBOT**

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BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II

Tajuk Projek : FIRE FIGHTING ROBOT  
Sesi Pengajian : 

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For my beloved mom and dad

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## **ABSTRACT**

This project report is related to Fire Fighting Robot that works automatically by examining aspects of the specification, design and also in terms of consumerism needs. Fire emanating from sources that cannot be identified potentially endanger human life and cause a loss of property. Therefore, the resulting robot project should have sensitivity to heat and to avoid obstacles in the surrounding work area. This programmable robot using PIC is able to find fire, next extinguish fire automatically by doing random motion in a flat work area.

## ABSTRAK

Laporan projek ini adalah berkaitan dengan Robot Pemadam Kebakaran yang berfungsi secara automatik dengan meneliti aspek spesifikasi, rekabentuk dan juga dari segi keperluan kepenggunaan. Kebakaran yang berpunca daripada sumber yang tidak dikenal pasti berpotensi membahayakan nyawa manusia sekaligus menyebabkan kehilangan harta. Oleh itu, projek robot yang dihasilkan perlu mempunyai kepekaan terhadap api dan dapat mengelak halangan yang terdapat di sekitar kawasan kerja. Robot yang diprogramkan menggunakan PIC ini mampu mencari api, seterusnya memadam api secara automatik dengan melakukan pergerakan rawak sekitar permukaan rata kawasan kerja.



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## LIST OF ABBREVIATION

PIC	-	Peripheral Interface Controller
GND	-	Ground
HEX	-	Hexadecimal
ICSP	-	In-circuit Serial Programming
DC	-	Direct Current
AC	-	Alternate Current
INOTEK	-	Innovation and Technology Competition
V	-	Voltage
A/D	-	Analog-to-Digital Converter

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## **CHAPTER I**

### **INTRODUCTION**

#### **1.1 Introduction**

This project is referring to the design of robot that capable to move and extinguish fire automatically. Implementation of this robot is tested with high fire temperature to evaluate the sensitivity of detecting, after that expunges the fire by using water mechanism. Work area with barriers can be avoided by this robot, in pursuing its ability to extinguish fire. The movement and behavior of this robot is fully controlled by the programmable PIC. All forms of signal received by the PIC will be processed and executed to accomplish the mission of the robot. Robot will monitor the work area by performing random movements; it as an alternative medium used by humans, especially the fireman to fight fire. The whole processes of this project are shown in the figure 1.

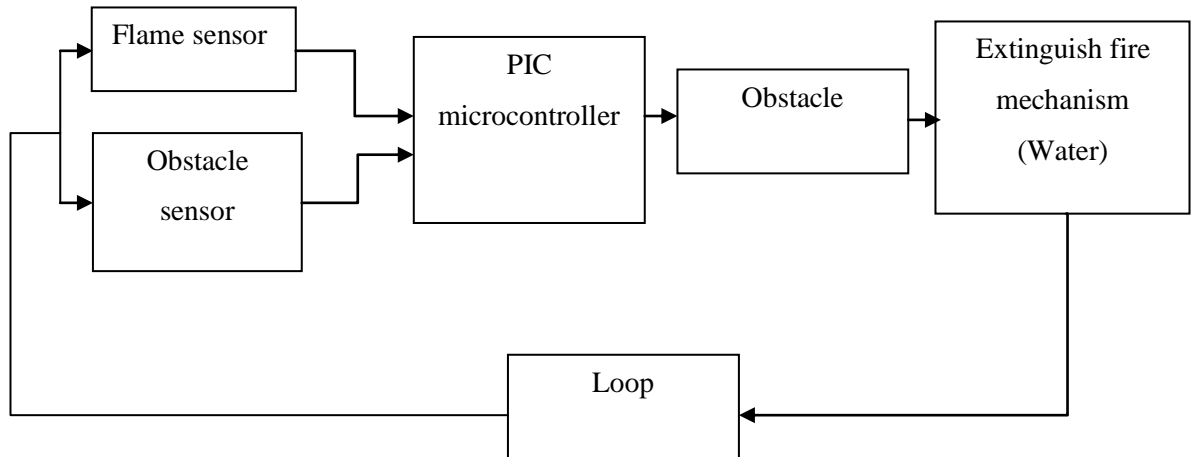


Figure 1.1: The whole processes for Fire Fighting Robot flow

## 1.2 Objectives

The purpose of this project is to develop and design a Fire Fighting Robot guided by these following objectives:

- a) To determine the use of multiple sensors for various sensing on the robot.
- b) To develop a program to implement all the movement and behavior of the robot by using the PIC as the main control system design.
- c) To design a robot that is able to avoid obstacles, detect fire next extinguish fire.

## 1.3 Problem Statement

Fire Fighting Robot is specifically designed for help humans, especially for firemen in the face of extinguishing fire situation. This robot uses can be applied at home or residential depending on how its operation. No matter it is used by firemen or individuals, the goal is only one which is to save lives when against the fire.

National Fire Protection Association has issued statistics on the number of firemen at the normal age suffering from line-duty deaths are due to heart attack by 25 percent, 21 percent die trapped by fire, 18 percent died after falling from a high

place and the rest suffer from cancer as a result of direct contact with chemicals and poisonous [1]. Firemen are more vulnerable to death in the course of their daily routine firefighting. The use of robots is one of the alternative medium for reducing firemen casualties and enhancing fireman capabilities.

Small fires from short circuits, gas stoves or other factors in the residence cannot be detected by human's sensitivity while robot design equipped with high sensitivity sensors can detect the presence of heat, smoke and fire. Unlike humans, the robot has a maximum capacity as alert, not tired and is able to perform 24 hours depending on the program of work specified in the robot [2].

The time factor is a problem in a fire situation. Small fire took just a few minutes before they become large, which may spread to other areas. Information through a phone call about a fire that was reported to firemen need time to determine the location of fire. The information of burning location must be recorded before the firemen go to that place. Moreover, the vehicle they are driving, large and difficult to pass through the traffic jam [3]. Through the production of fire fighting robot, the time can be reduced by placing the robot in a high-risk area of a fire.

Fire that occurred in nature is beyond human expectations. Fire caused by gas leak and chemical oil could cause an explosion, so dangerous to human life. Additionally degrees temperature level heat generated from the fire is beyond the capabilities of the human senses temperature [4]. The robot is capable doing its job in the area that is exposed to danger and able to perform the tasks at a high temperature.

#### **1.4 Scope of Work**

The potential of Fire Fighting Robot acts during extinguish flame, including:

- a) Detection of fire
- b) Wall avoidance
- c) Extinguish fire

Robot detects the presence of fire through the sensor within a range of 20cm to 100cm in designated areas. Sensitivity of sensing the fire is determined by calculating the distance from the robot to fire then the distance will be included in the PIC program.

Robot will avoid barriers if there have any obstacles that occur during the process of detecting fire. The distance between the robot and the obstacle is determined through calculations included in the PIC program.

The next step is it will act to go to that place (fire) that have been detected by the sensor after move randomly and extinguish the fire with water. Focus on robot movement is based on flat surface work area.

All robot behavior is controlled by the Programmable Interface Controllers (PIC) as the main control system. PIC will control and give commands to the robot to sense the fire and obstacles. Assembly language is used as the language interface to be programmed in the PIC.

Robot has four wheels which consist of two servo wheels, and 2 castor balls driven by the DC geared motor (mounting with servo wheels). The use of these wheels is to facilitate the movement of the robot to move forward, backward and even to move in  $120^{\circ}$  rotation in order to detect the flame and avoid obstacles.

Ultrasonic sensor is used as a sense of sight for Fire Fighting Robot. It is a sensor that will indicate obstacles in the path of movement. Ultrasonic sensor consists of a transmitter and receiver, transmitting to detect obstacles and receive signals through the receiver. Receiver will inform the PIC if there are obstacles in front of the robot. PIC will command the robot to change the direction of movement to avoid collisions with objects.

In detecting flame, the robot is equipped with flame sensor mounted on a robot body. This sensor will respond to the presence of fire around 20cm to 100cm and give an interrupt to the PIC, next giving instructions to the robot moves towards the flame. When the sensor has detected flame, the PIC will activate the washer

pump and pump water out of the tank. Water will then be channeled to the spray nozzle through a rubber pipe. Robot will act by extinguishing flame using water, until erased and return to the task of sensing a flame.

## **1.5 Report Layout**

This thesis basically discussed about the design and development of Fire Fighting Robot. There will be five chapters that will describe and explain further about this project

Chapter I will describe about project introduction. This topic describes the introduction of the Fire Fighting Robot and the main objectives of the project. Overall topics include scope of the project; project methodology and the problem statement are included in this topic.

Chapter II will discuss Literature review topic. This topic focuses on the theory of every part of the robot design. Resources obtained from textbooks, journals, thesis and website containing all the information related to the project.

Chapter III will explain the methodology of project. This topic presents the steps to implement the project from the initial design to completion. Strategy and time planning are shows in this topic.

Chapter IV will inform the analysis and project result. This chapter describes the analysis and the development that was done in order to get better result to the project.

Chapter V will describe the conclusions of the topic I to topic IV. The conclusion and recommendation will be concluded in this topic.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Fire Fighting Robot has the ability and capability to avoid obstacles, detect the presence of fire and extinguish the fire using water mechanism [5]. To avoid the obstacle, the robot requires an ultrasonic sensor that is placed in front of the robot. Flame sensor is also used in the robot to detect the presence of fire. Robot movement was driven by a DC geared motor with encoder. All behavior is controlled by the PIC which is the brain of robot that process information and give instructions to the output to act. Studies performed on existing robot also carried out in this chapter to assess the characteristics of a Fire Fighting Robot and to be taken as a reference.

## 2.2 Thermite Fire Fighting Robot

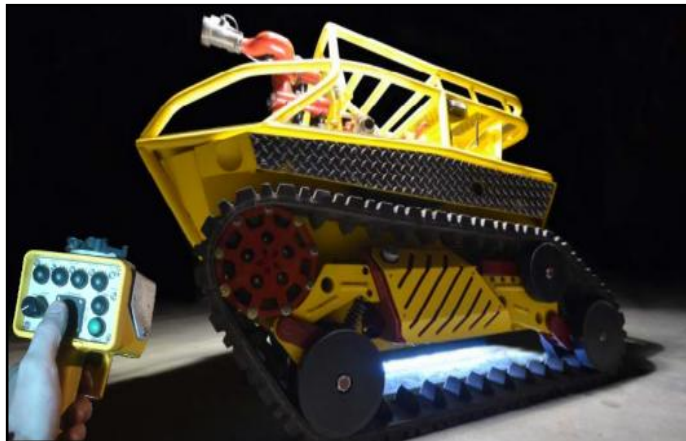


Figure 2.1: Fire Fighting Robot made by Howe and Howe technologies [6].

Thermite is a Fire Fighting Robot that uses a remote control and can operate as far as 400m. This robot size 74 inches (187.96 cm) x 35 inches (88.9 cm) x 55 inches (139.7 cm). Referring to the figure 2.1, weight capacity for Thermite is 1.640 pounds (743.89 kg). Size is not too big and it is probable that Thermite can be carried anywhere. This robot powered up to 25 bhp (18.64 kW) by using diesel engine. Consumption aircraft aluminum grade manufacturing durable makes this robot easily across the extreme area. The main components in the design of this robot are multi-directional nozzle that is backed by a pump that can deliver 600 gallons per minute (2271.25 l/min).

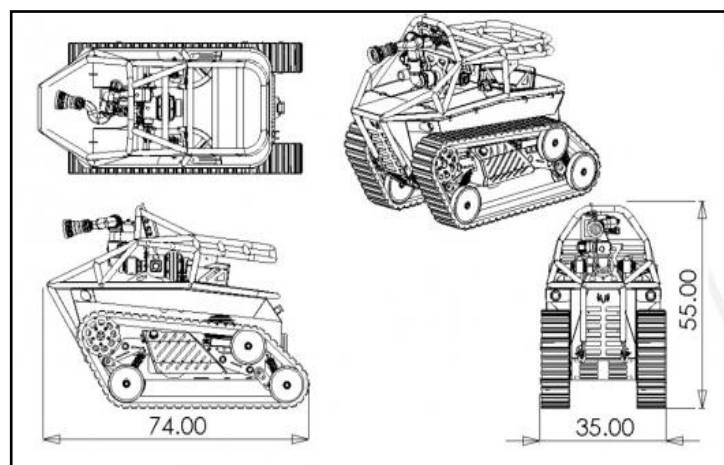


Figure 2.2: Thermite scale and sketch drawing [6].

The Thermite is designed to be used in areas of extreme hazard, such as aircraft fires, refineries, chemical plants or nuclear reactors. Not only is it preferable to risk a robot instead of a person, the Thermite is also immune to smoke, fumes and fatigue. This robot is priced at U.S. \$ 98.500 which is equivalent to RM302, 395 per unit.

### 2.3 Fire Fighting Robot Contest #1



Figure 2.3: Fire Fighting Robot made by Mikron123 [7].

Referring to the figure 2.3, this Fire Fighting Robot is used to compete in robot competitions. The function of this robot is to find a candle that contains the fire, and then extinguish the fire. This robot can also function to save victim in the competition. The work area cover by this robot is in most rooms, stairs and sometimes can avoid obstacles.

This robot used aluminum to develop chassis. Designs are more focused on the round shape of the robot body. This robot used three DC servo motors (1 for turret). Robot movement operated by 2 wheels do major motion robot and one wheel for balance. This robot brain is ATmega microcontroller and has two main sensors. Ping ultrasonic ranging sensor is used to avoid obstacles and UVTron flame sensor as the sensor detects the presence of heat and fire. This robot is equipped with