UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A Smart Autonomous Fire Detector Which Deflects Obstacle On Pathway

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electronics Engineering Technology (Industrial Electronics) (Hons.)

by

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2016

DECLARATION

I hereby, declared this report entitled “A Smart Autonomous Fire Detector which Deflects Obstacle On Pathway” is the results of my own research except as cited in references.

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Date	:	……

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

……

(Ir. Nik Azran Bin Abdul Hadi)

ABSTRAK

Kini dalam dunia industri, komersil dan domestik, automasi memainkan peranan yang penting; ia sebenarnya susunan unsur-unsur yang berbeza dalam usaha untuk mengawal, merasa, dan mengarahkan dirinya untuk mencapai keputusan yang dikehendaki. Matlamat saya adalah untuk mencipta sebuah robot pintar dalam kehidupan seharian kita yang boleh memadam api berasaskan pelbagai sensor. Oleh itu, sebuah robot pintar yang boleh memadam api serta menghalang halangan dalam perjalanan telah dicipta dengan alat pemadam api dan beberapa komponen yang telah boleh dikawal oleh pengawal mikro. Sistem ini adalah kos efektif dan mempunyai pelbagai aplikasi yang boleh menunjukkan hasil yang baik dan berkesan apabila melaksanakannya. Ia boleh sengaja digunakan dalam perdagangan, sektor domestik dan kegunaan industri di mana keperluan tuntutan kerja automatik diperlukan. Saya mereka bentuk sistem pengesan kebakaran menggunakan sensor api yang sentiasa memerhatikan kehadiran api. Jika apa-apa kebakaran dikesan, ia akan memadamkan api menggunakan pam air yang disediakan kepadanya. Robot ini juga dapat mengelakkan halangan di laluannya dengan menukar arah pergerakannya. Kaedah ini boleh dilakukan dengan penggunaan sensor ultrasonik. Selepas pemadam api ia akan kembali untuk mencari kehadiran api yang lain. Ia mengesan dan memadamkan api secara sukarela tanpa bantuan manusia. Ini bermaksud robot melaksanakan tugas dengan situasi dunia sebenar dengan proses simulasi.

ABSTRACT

Nowadays, in industrial, commercial and domestic world, automation assumes an essential part; it is really a planning of various components so as to control, sense, regulate and instruct itself to accomplish a wanted result. My aim is to create a smart multiple sensor based fire fighting robot in our everyday life. So, "A Smart Autonomous Fire Detector which Deflects Obstacle on Pathway" created with an extinguisher and some other important elements which controlled by a microcontroller. The system is cost effective, has an extensive use, which can present effective and good outcome during execution. It can be utilized purposely in commercial, domestic sectors and industrial uses which the condition of automatic job needed. I create the fire sensing system utilizing flame sensors that constantly observe the presence of fire. If any fire detected, it will extinguish the fire using a water pump that gives to it. Fire Fighting Robot also able to avoid obstacles on its pathway by changing its direction of movement. This method is possible with the use of ultrasonic sensors. After extinguishing the fire it will move back to find another any presence of fire. It voluntarily senses and extinguishes fire without human guidance. This is mean to simulate the actual world process of robot executing a fire extinguishing task.

DEDICATIONS

To my parents,

All my lectures, especially, Mr. IR. Nik Azran Bin Abdul Hadi
All my friends and relatives

Thousands of thanks and appreciates for their supports, encouragements and understands.

ACKNOWLEDGMENTS

In the first place I want to express my thankfulness to the god concerning the blessing given which I could finish my final year project. During making this paper, I have been collaborating with several people in helping me to finish this project.

I want to express my genuine appreciation to my supervisor Mr. IR. Nik Azran Bin Abdul Hadi, to the significant guidance, primary thoughts, continuous assistance and inspiration to make sure this project achievable. I respect his reliable assistance from the earlier until the end of this project. Thanks to staff and members of Universiti Teknikal Malaysia Melaka and also all my lab mates who guide me in various perspectives throughout the project.

I acknowledge my sincere appreciation to my parents for their sacrifice, love, and dream in my life. I can't find the suitable words that may appropriately portray my gratefulness for their assistance, commitment and confidence in my capacity to accomplish my aims. Special thanks must be given to my group mates. I like to appreciate their ideas and comments that were significant for the effective accomplishment of this final year project.

The following category is the individuals who aid me to influence besides raise further in my project and constantly help me in order to finish this project. I truly welcome the information and thought given.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

A/D	-	Analog to Digital
AC	-	Alternating Current
ADC	-	Analog to Digital Converter
ARES	-	Advanced Routing and Editing Software
AVR	-	Advanced Virtual RISC
BLDC	-	Brushless DC
CCP	-	Capture/Compare/PWM
CH	-	Channel
cm	-	Centimeter
CMOS	-	Complementary Metal-Oxide Semiconductor
CO	-	Carbon Monoxide
CO2	-	Carbon Dioxide
CPU	-	Central Processing Unit
DC	-	Direct Current
ECCP	-	Enhanced CCP
Ee	-	Irradiance
ft	-	Feet
GSM	-	Global System for Mobile communications
GUI	-	Graphical User Interface
I/O	-	Input Output
IC	-	Integrated Circuit
IDE	-	Integrated Development Environment
IR	-	Infrared
KB	-	Kilobyte
L	-	Length
LD	-	Laser Diodes
LDR	-	Light Dependent Resistor
LED	-	Light Emitting Diode

Li-Po	-	Lithium polymer
m	-	Meter
MHz	-	Megahertz
MSL	-	Mars Science Laboratory
nm	-	Nanometer
PC	-	Personal Computer
PCB	-	Printed Circuit Board
PDIP	-	Plastic Dual In-line Package
PIC	-	Peripheral Interface Controller
PIR	-	Passive Infrared Sensor
PSD	-	Position Sensing Detectors
RAM	-	Random Access Memory
RISC	-	Reduced Instruction Set Computing
ROM	-	Read Only Memory
RPM	-	Revolutions per Minute
SABOT	-	Semi-Autonomous Mobile Robot
SISO	-	Single Input Single Output
SPICE	-	Simulation Program with Integrated Circuit Emphasis
V	-	Voltage
VSM	-	Virtual System Modelling
Wi-Fi	-	Wireless Fidelity

CHAPTER 1
INTRODUCTION

1.0 Introduction

These days, machinery and robotic construction turn into significant in serving human. This project support to create interest besides inventions in the robotics sector as functioning in a reasonable and possible ways to save a life and moderate damage of property. This fire fighting robot able to sense and extinguish a fire automatically. It is about assembly systems with DC motors, flame sensors, ultrasonic sensor and water pump, along with major connections. With the innovation of such a device, human and property can be rescued at a much higher rate with moderate damage brought by the fire.

This robot executes the subsequent method: environmental detection, corresponding motor control. This robot progress data from several sensors and key hardware features through the microcontroller. All types of signal got by the microcontroller will be managed and performed to achieve the mission of the robot. This robot can be stayed away from work region with obstacles in follow its mission to extinguish the fire.

The robot will observe the work region by executing undirected movements; it as an optional method utilized by humans, particularly the fire fighter to fight fire. In real life, a destructive burnt region frequently occurs without our understanding. Thus, this type of robot will need in the marketplace with high demand since it is

helpful to the human along with the environment. The entire process flow of this project appears in the figure 1.1.

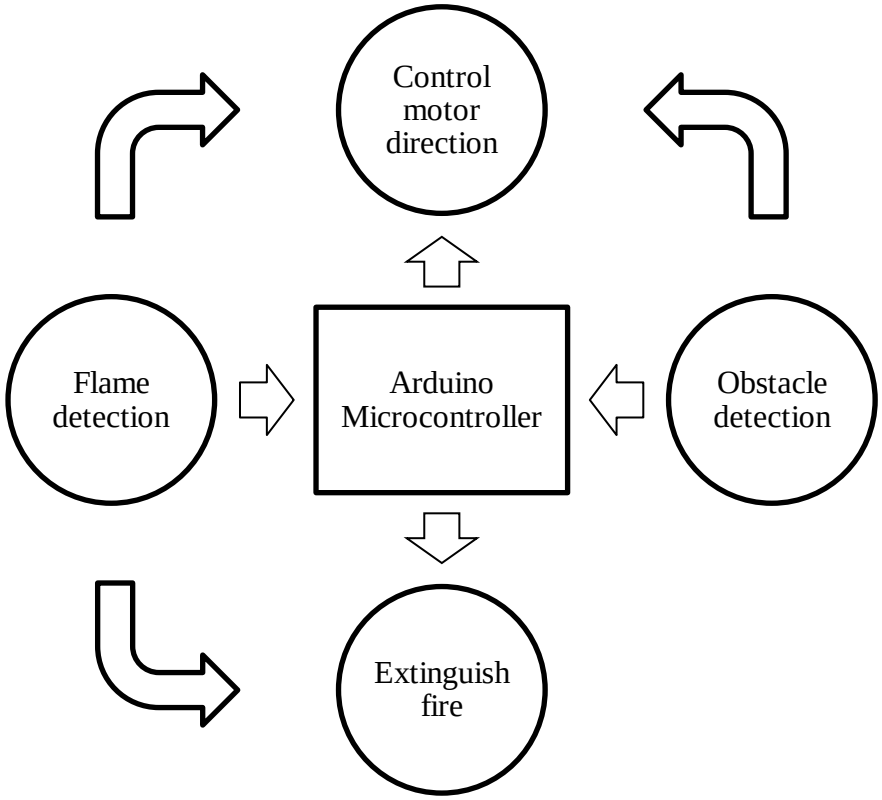

Figure 1.1: Block diagram of process flow

1.1 Problem Statement

Fire fighting robot is particularly created for help humans, especially for fire fighter who deal with fire in extinguishing fire situation. This robot can be used at home or residential based on what way its setup. It can be utilized by fire fighters or individuals, the objective is one and only to protect life when facing the fire.

Fire fighters are more unsafe to death over their everyday routine in fire fighting. The utilization of robots is one of the options for decreasing fire fighter losses and improving fire fighter abilities. Not like humans, the robot has a more ability to aware, not tired and ready to operate 24 hours based on the program of work given to the robot.

Sometimes a problem for help could occur from the assigned fire department. Details over a phone call require certain time to decide the area of the fire incident. Furthermore, the vehicle that fire fighter used was large and hard to go through the traffic jam. By creation of fire fighting robot, the time can decrease by situating the robot in a high-risk location of a fire.

Having water sprays in each fire system for every building has its own disadvantages such as it may damage furniture, gadgets and documents in the buildings. However, by utilizing the robot, it can extinguish the fire at the targeted spot only. Other than that, the robot can created with high sensitivity sensors that can sense the existence of fire, smoke and heat which unable to sense by human's sensitivity.

Fire that happened in nature is above the human prediction. Chemical oil and gas may create an explosion and risk to human life. The reason for building this fire fighter robot is to extinguish the fire once detected by the sensors, to avoid and/or decrease the losses and cost, helps the job of fire fighter as they reach and to protect fire fighter's life by against some critical cases which they can't manage.

1.2 Objective

The objectives of the project are:

i. To create a robot that reduces the human factor from unsafe work.
ii. To reduce or avoid the losses and cost due to fire.
iii. To utilize as a primary solution to extinguish the fire before fire fighters arrives.

1.3 Scope of Work

Made a smart autonomous fire fighting robot which is normally safe and steady. It can give more efficiency to sense the flame and it would be extinguish fire ahead it goes strong and risk to human life. Therefore, this robot can play an important role. The fire fighting robot will have characteristic such as:

a) Fire detection

The robot can identify the existence of fire within a particular range over the flame sensor. Sensitivity of detecting the fire is decided by calculating the distance from the robot to the fire, and after that the distance will be added in the program.

b) Obstacle avoidance

The robot will stay away from the obstacle utilizing ultrasonic sensor throughout the fire sensing process. The distance from the robot to the obstacle also decided from calculations and will add in the program. The robot will turn its position of movement to stay away from a clash with objects.

c) Extinguish fire

After exploring randomly, once the fire has been identified it will extinguish the fire automatically by using water. Robot movement and concentration depending on horizontal work region.

1.4 Report Layout

This thesis generally talked about the design and improvement of fire fighting robot. There will be five chapters that will explain more about this project.

Chapter 1 explain about the introduction of the fire fighting robot and the important objectives of the project. Besides that, the problem statement and scope of the project are added on this topic.

Chapter 2 compiles the literature review, generally on the existing projects and components that used in this project. This part concentrates on the theory of all aspects of the robot plan. Sources from journals, books, thesis and website that covering all the information connected to the project are included.

Chapter 3 describes the methodology of the project on the design and simulation part. This part concentrates on the procedure to execute the project from the primary design until the end. Strategy and time management are presented in this part. The project's ghant chart for this semester also added here.

Chapter 4 gives some prior results and discussion of the current work. This part talks about few findings and issue that being noticed during the simulation method.

Chapter 5 draws the conclusions of chapter 1 to chapter 5. The conclusion and recommendation will be concluded here.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

A Smart Autonomous Fire Detector Robot has the ability and capability to run automatically, avoiding obstacles and at the same time find and detect flame and extinguish them using water mechanism. An ultrasonic sensor used to avoid the obstacle while flame sensor used for initial detection of the flame. Robot movement was driven by a DC geared motor with encoder. Using an Arduino microcontroller this robot process information from several sensors and main hardware portion. This section basically guides for preparing the entire report content, including the graphical illustrations. 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.

2.1 Types of Robot

These days, robots do a variety of tasks in multiple fields and the total of jobs assign to robots is growing consistently. One of the most ideal ways to separate robots into types is categorize them with their application. The following portions show some of the robots.

2.1.1 Redundant Robots

Redundant robots are those that own more degrees of freedom than those needed to perform a given task (Zhou, Wu & Liu, 2014). As of late extraordinary consideration has been given to the investigation of redundant manipulators, and this redundancy has been considered as an important characteristic in the execution of tasks that require skill equivalent to that of the human arm, such as, for example, in the space mission called the Mars Science Laboratory (MSL), better known as Curiosity.

Although most redundant manipulators don't have an adequate number of degrees of freedom to carry out their primary responsibilities, e.g., following the location and/or the direction, It is realized that its limited manipulability results in a decrease of the work area because of the mechanical restrictions of the links and in the existence of obstacles in that area. This has driven research worker to analyze the performance of the manipulators when more degrees of freedom are included (kinematic termination), letting them to satisfy extra responsibilities determined by the user.

Those responsibilities can be symbolized as kinematic actions, containing not just the elements of kinematics that mirror some desirable properties of the manipulator's performance, for example, the qualities of the joints and the avoidance of obstacles, however, can also be extended to include measurements of the dynamic performance over the meaning of tasks in the robot's dynamic model, e.g., effect strength, control of inertia, and all. (Boschetti, Rosa & Trevisani, 2013). The robotized manipulator studied incorporates two extra degrees of freedom, providing it termination in its turning motion, in its motion on the x–y plane, and in addition in its prismatic motion along the z axis, as appeared in Figure 2.1 (Urrea & Kern, 2016).

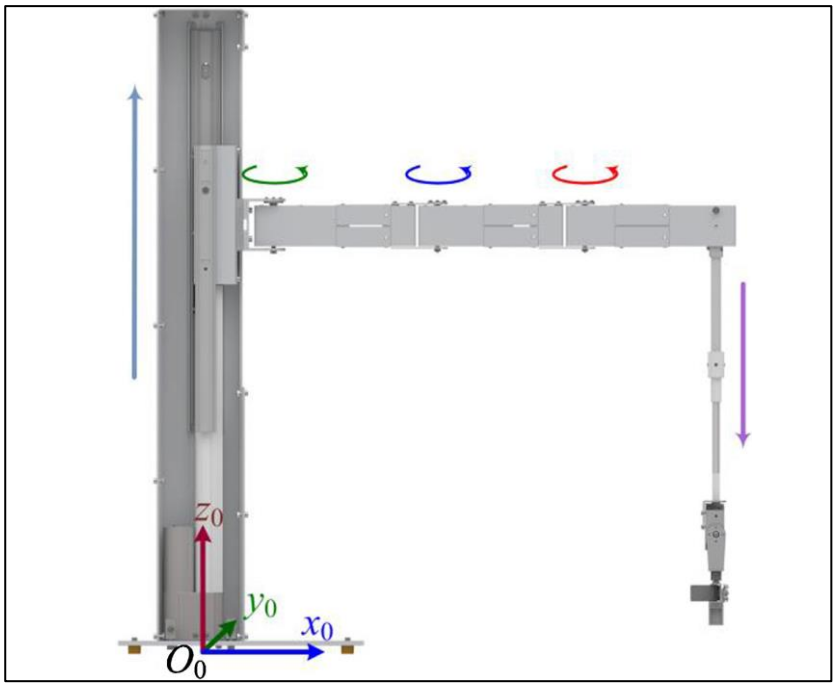

Figure 2.1: Scheme of a robotized manipulator with rotational and prismatic redundance (Urrea & Kern, 2016)

2.1.2 Space Robots

Robots in space uses are lightweight, can manage with greater masses and own a unique feature that, not like robots on earth, their casings are not settled, somewhat they float with whatever is left of the robot, combine with the space vehicle (Dasgupta, 2016).

2.1.3 Flexible Robots

Really, all solid forms are elastic. Ordinary demonstrating of robot manipulators has to remember the connections of a robot as rigid, for which the deflections must be small from the perspective of positional precision. Thusly, the connections are to be created stronger than required and weighty. But, from a physical perspective, it is never required and we must not care the connections being flexible given that within maximum elasticity and we

understand their character. Thus, the current attention has been to use along flexible robots and to exploit their light weight via including their flexibility towards the mathematical model which, obviously, make difficulties the dynamics of the system --- a cost to be paid for the advantage obtained (Gulhane, 2016).

2.1.4 Parallel-actuated Robots and Closed-loop Robots

Parallel robots are closed-loop machineries which give very good fulfillment in terms of accurateness, rigidity and potentiality to employ massive loads (Merlet, 2012). A parallel robot states to a kinematic chain in which a settled platform and movable platform are associated with each other through few legs or, serial chains. The legs, which regularly need the similar kinematic arrangement, are associated with the settled and movable platforms at focuses that are spread in a geometrically symmetric way.

Parallel robots would be viewed as a different class of closed chain machineries (i.e., chains that have more than one closed loop) and are intentionally intended to abuse the particular advantages gave by the closed chain arrangement, e.g., to enhanced stiffness, more prominent positioning accurateness, or faster speed. Parallel robots could be recognized for more than two collaborating sequential robots that might shape closed loops throughout caring of a duty (e.g., a robotic hand handles an object).

A portion of the quickest accelerations and velocities take by industrial robots has been accomplished by parallel robots, basically via locating the actuators on the stable platform and in that way decreasing the mass of the movable portions. A considerable lot of the model-related methods created for managing the traditional serial chain robots are likewise relevant to a massive class of parallel robots. Then again, dynamic and kinematic models for parallel robots are so difficult. Moreover, parallel robots possess characteristics not obtained in serial robots, e.g., passive connections,