AUTONOMOUS FIRE PROTECTION ROBOT WITH NOTIFICATION

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ABSTRACT

The security of home, laboratory, office, factory and building is important to human life. We develop an intelligent multi sensor based security system that contains a fire fighting robot in our daily life. The destructive burnt cause by electrical is the highest source. It is because security system can't detect abnormal and dangerous situation and notify us. Besides, user had difficulties to detect the small burnt cause by electrical appliances. User may take a late time to extinguish fire like finding the water source to extinguish fire when want to extinguish the fire. The fire difficulties to detect the small burnt area and location that is hard to be reach by the user Sometimes tough fire extinguished for example spaces are hard to see. So, "Autonomous Fire Protection Robot With Notification" design with extinguisher for the intelligent building to controlled by microcontroller PIC18F4550 and supported by autonomous board CYTRON SK40C board and another additional circuit. This robot equipped with 3 flame sensor where each sensors has its own function and commanded control by PIC18F4550. This robot will move to the fire source when the flame sensor detected the fire and it will send message to any phone of the GSM network through the modem connected to the programmable device. This robot also programmed to stop before the robot hit the flame. This robot also can extinguish fire at 45 degree for upper side and 45 degree for lower side. This robot implicated the function of finger to clip the fire extinguisher clipper.

ABSTRAK

Keselamatan rumah, makmal, pejabat, kilang dan bangunan adalah penting untuk kehidupan manusia. Kami membangunkan sensor pelbagai sistem keselamatan berasaskan pintar yang mengandungi robot memadamkan api dalam kehidupan harian kita. Punca kebakaran daripada kerosakan oleh punca elektrik adalah sumber tertinggi. Ia adalah kerana sistem keselamatan yang tidak dapat mengesan keadaan yang tidak normal dan berbahaya . Selain itu, pengguna menghadapi kesukaran untuk mengesan punca kebakaran yang kecil yang berpunca daripada bahan elektrik. Pengguna juga mengambil masa yang lama untuk memadamkan api seperti mencari sumber air untuk memadamkan api. Kesukaran api untuk mengesan kawasan kebakaran dan lokasi yang sukar untuk dicapai oleh pengguna. Kadang-kadang berlaku kebakaran yang sukar dipadamkan contohnya di ruang-ruang yang sukar dilihat. Jadi, reka bentuk "Autonomous Fire Protection Robot With Notification" merupakan perlindungan kebakaran dengan alat pemadam untuk bangunan pintar yang dikawal oleh PIC18F4550 dan disokong oleh papan automasi CYTRON SK40C dan lain-lain litar tambahan. Robot ini dipasangkan dengan 6 pengesan api dimana setiap pengesan mempunyai aplikasi dan arahan tersendiri yang dikawal oleh PIC18F4550. Robot ini akan bergerak menuju ke arah api apabila menerima arahan dari pengesan api di setiap penjuru sisi robot Ia akan menghantar mesej kepada telefon tanpa mengira rangkaian GSM melalui modem yang disambungkankepada peranti diprogramkan. Robot ini juga diprogramkan untuk berhenti sebelum melanggar punca api apabila pengesan api di bahagian atas atau bawah robot mengesan api. Robot ini juga boleh memadam kebakaran pada sudut 45 darjah menghala keatas dan 45 darjah menghala kebawah. Robot ini mengaplikasikan fungsi jari untuk menekan picu pemadam api.

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LIST OF ABBREVIATIONS

°	-	Degree
A	-	Ampere
BC	-	Before Christ
C	-	Capacitor
DC	-	Direct Current
I/O	-	Input/Output
Kg	-	Kilogram
LDR	-	Light Dependent Resistor
LED	-	Light Emitting Diode
Nm	-	Newton per meter
PC	-	Private Computer
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Controller
PWM	-	Pulse-width Modulation
R	-	Resistor
RPM	-	Rotation per Meter
TR	-	Transistor
USB	-	Universal Serial bus
UV	-	Ultraviolet
V	-	Voltage
ZIF	-	Zero Insertion Force

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Project Overview

Nowadays, machinery and robotic design become important in helping human. This Fire Protection Robot was design to help people in any destructive burnt situation where this robot can extinguish burnt area immediately using autonomous system. This autonomous system will be designed using programming in PIC18F4550 and others additional circuit.

In real life, destructive burnt area often happens without our realization. Therefore, this type of robot will require a high demands in the market because of its usefulness to the human as well as the environment transmit fire information to cell phone using GSM modern.

The objective of the project will be to design a SMS electronic Fire Protection Robot toolkit which can replace the traditional Fire Protection Robot. The toolkit send the fire and send SMS to owner of the house, The system is made

efficient by SIMs so that the SMS can be received by number of devices boards in a locality using techniques of time division multiple access.

The GSM modem receives the SMS. The AT commands are serially transferred to the modem. In return the modem transmits the stored message through the wireless link. The microcontroller validates the SMS and then perform specific task on the device.

1.2 Project Objectives

The objectives for this project are:

i. To study a robot which can search, detect and extinguish burnt area immediately and develop a program using PIC18F4550 to control the movement of the robot. Besides, lean how to connect microcontroller and GSM modem.
ii. To design the robot that includes the flame sensor to detect the fire and than send notification by Short Message Service (SMS).
iii. To analyze how the robot performance to detect the angle of burnt area in front of the robot and detecting burnt area in 0m ~ 2m in radius.

1.3 Project Scope

The project scopes for this project are:

i. The robot detecting burnt area in 0m ~ 2m in radius.
ii. Robot detect fire event, and use extinguish to fight the fire source and the modem connected to the programmable device.

iii. The robot can turn 360° and than robot can extinguish fire at angle 30° from the fire extinguisher nozzle.

iv. The robot can extinguish fire from petrol, gasses and electrical appliance.

1.4 Problem Statement

The security of home, laboratory, office, factory and building is important to human life. We develop security system that contains a fire protection robot using sensor. The security system can detect abnormal and dangerous situation and notify us. First, we design a fire protection robot with extinguisher for the intelligent building. Besides, Human had difficulties to detect the small burnt cause by electrical appliances. The late time user takes to extinguish the fire. User may take a late time to extinguish fire like finding the water source to extinguish fire when want to extinguish the fire. The fire difficulties to detect the small burnt area and location that is hard to be reach by the user. Sometimes tough fire extinguished for example spaces are hard to see. Besides is cost the loss suffered in the event of fire slow to act.

PUNCA KEBAKARAN BANGUNAN NEGERI PULAU PINANG

BULAN JANUARI - OGOS TAHUN 2006

KOD	PUNCA	JUMLAH PANGGILAN	KERUGIAN (RM)	DISELAMATKAN (RM)
PK 1	LETRIK	76	95,584,070.00	180,271,030.00
PK 2	PUNTUNG ROKOK	7	204,000.00	1,234,000.00
PK 3	PERCIKAN API	6	2,542,000.00	51,421,000.00
PK 4	MERCUN / BUNGA API	2	5,000.00	20,000.00
PK 5	UBAT NYAMUK / COLOK / LILIN	21	1,317,700.00	7,387,957.70
PK 6	DAPUR GAS / MINYAK	19	944,460.00	73,061,450.00
PK 7	REAKSI SPONTAN	3	225,000.00	5,105,000.00
PK 8	SENGAJA DIBAKAR - NIAT BAIK	3	200.00	0.00
PK 8	SENGAJA DIBAKAR - NIAT JAHAT	17	900,500.00	2,920,500.00
PK 9	TIDAK DIKETAHUI	7	3,900,000.00	2,798,400.00
PK 10	TINDAK BALAS KIMIA	1	8,000,000.00	10,100,000.00
PK 11	BUDAK BERMAIN MANCIS	2	7,500.00	217,500.00
PK 12	LAIN-LAIN PUNCA	34	3,961,500.00	6,916,200.00
	JUMLAH	**198**	**117,591,930.00**	**341,456,037.70**

Figure 1.1 : Destructive burnt source for Penang

From figure 1.1, the destructive burnt cause by electrical is the highest source. From this table, the designing of Autonomous Fire Protection Robot with Notification must be suitable with this type of destructive burnt

1.5 Expected Results

The expected results for this project are:

i. Autonomous searching, detecting and extinguish burnt area.
ii. Extinguish fire on the wall (315°) and 45° upper side.
iii. The robot can turn 360°.
iv. Send notification by Short Message Service (SMS) using GSM modem.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter are discussing about a study on the previous project based on fire fighter robot project and thesis. The entire project had been studied and analyzed their principles, method and applications.

2.2 Robot

Robot is a machine that looks like a human being and performs various complex tasks. Now, let's have a good look at existing firefighting robots.

Virtual Reality Simulation of Fire Fighting Robot [9] (Indonesia) is a virtual adaptation of competition robot, that took part in Panitia Kontes Robot Cerdas Indonesia competition in 2006. This system was developed in MATLAB/Simulink with the help of «Virtual Reality Toolbox» plug-in. It is oriented for initial testing of controlling algorithms. Its important to notice, that even the robot itself doesn't have enough level of functionality, because of low-detailed formalization of environment.

The robot could operate only in corridor-room environment, without strange objects. Only one fire source is meant and there are auxiliary marks on floor, that mean for example room entrance.

Pokey the Fire-Fighting Robot [10] (USA) is the firefighting robot, that made its way out of competitions, and became more “serious” than other systems. In [10] there are detailed description of used equipment and basic algorithms of operating. Robots operating environment is a building, so the robot is equipped with necessary sensors, for example, with a line sensor, that could be unuseful in conditions of dense smoke. The main advantages of robot are:

- using of two types of fire sensors, working in different ways;
- using of complex firefighting tool;

The main disadvantages are:

- short distance of sensor’s work. the fire could be recognized at the distance not more than 1.5m. at longer distances the sensors works bad, ad developers say
- low efficiency of onboard computer, able only to carry main tasks, without its extension and complexization;
- absence of optical means of environment perception.

The device is described as autonomous mean of firefighting in houses and any civil buildings. Fire Protection Robot [11] (USA) – another competition project, developed for «15th Annual Trinity College Fire Fighting Robot Competition». Robot has more complex organization, than one, shown above and is oriented for solving larger variety of tasks. The main system’s advantages are:

- more complex algorithms, used for fire detection.
- using of sound sensor for activating.
- presence of some additional navigation sensors.

The main disadvantages are:

- low-efficiency computer;
- low-power chassis;
- absence of home-return algorithm;
- absence of mapping;

Firefighting Robot [12] is an American Trinity College development, that was only on early-prototype stage (in 2008). It was supposed to this robot to be an autonomous device, with 15 minutes limited working time, after which it will return to the supply station. This approach is one of the best variants for firefighting in houses and non-industrial buildings. The main disadvantages are:

- the little working time;
- low-stock of "water";

The planning low-cost is a system's main advantage. In special order it's necessary to notice firefighting robots, included in Russian Ministry of Emergency Situations. Among them are "ABR-ROBOT", "El-4", "El-10". These models are far away from competition projects, they armed with a real armour and firefighting tools, but their main disadvantage consists in remote controlling. They aren't autonomous. The others history of robot development was shown in table 2.1 below:

Table 2.1: Robotic History

DESIGNER	YEAR	DESCRIPTION
Archytas	(347 BC)	A bird-shaped model propelled by a jet of what was probably steam, said to have actually flown some 200 yards. This machine, which its inventor called The Pigeon, may have been suspended on a wire or pivot for its flight.
Al-Jazari	(1206)	A boat with four automatic musicians that floated on a lake to entertain guests at royal parties.
Leonardo da Vinci	(1519)	Further analysis of the plans has led some to believe that the robot would have been able to sit up, wave its arms and move its head and jaw. It is not known whether he attempted to build the robot.
Jacques de Vaucanson	(1782)	A mechanical duck that was able to eat and digest grain, as well as flap its wings. Vaucanson gained celebrity across Europe for his constructs.

Pierre Jaquet-Droz	(1790)	Animated dolls, or automata, to help sell watches and mechanical birds. He and his son created three dolls, each with a unique function. One can write, another plays music, and the third draws pictures. Some consider these devices to be the oldest examples of the computer.
Hisashige Tanaka	(1881)	Array of inventions including automatic gas lamps, clocks, and extremely complex mechanical toys, some of which were capable of serving tea, firing arrows drawn from a quiver, or even painting a Japanese kanji character.
Karel Čapek	(1938)	The word robot was introduced by Czech writer Karel Čapek in his play R.U.R. (Rossum's Universal Robots) premiered in 1920.
George Westinghouse	(1914)	A humanoid robot known as Elektro, exhibited at the 1939 and 1940 World's Fairs. Seven feet tall, weighing 265 pounds, humanoid in appearance, it could walk by voice command, talk (using a 78-rpm record player).
Nikola Tesla	(1943)	Tesla discovered remote control and patented a radio controlled robot-boat/submarine in November 8, 1898. Tesla used radio waves to move the craft in a small pool of water in Madison Square Garden, New York City during the Electrical Exhibition in 1898.
William Grey Walter	(1977)	The first electronic autonomous robot was created by William Grey Walter at Bristol University, England in 1948. It was named Elsie, or the Bristol Tortoise. This robot could sense light and contact with external objects, and use these stimuli to navigate.

2.3 Previous Robot Overview

The robot below shows the characteristic of the previous robot that have been similar with this robot project and used in the literature reviews:

2.3.1 Rolly Firefighter Robot by William Dubel, Hector Gongora, Kevin Bechtold, and Daisy Diaz

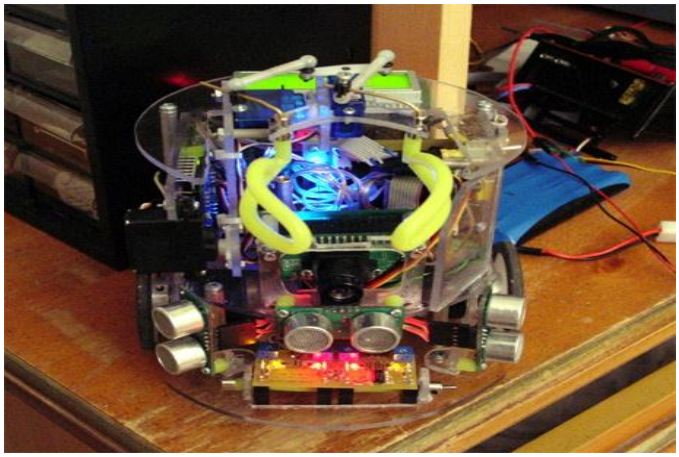


Figure 2.1 : Rolly Firefighter Robot by William Dubel, Hector Gongora, Kevin Bechtold, and Daisy Diaz

This firefighting robot is designed to search for a fire in a small floor plan of a house, extinguish the fire (by placing a cup over the LEDs), and then return to the front of the house. The navigation of the robot throughout the house is achieved by data provided by a line tracker and ultrasound transducers. The deployment of the extinguishing device is implemented with a custom arm controlled by servos.

2.3.2 Fire Protection Robot by Viet Do, Ryan Norder, and Ryan Spraetz

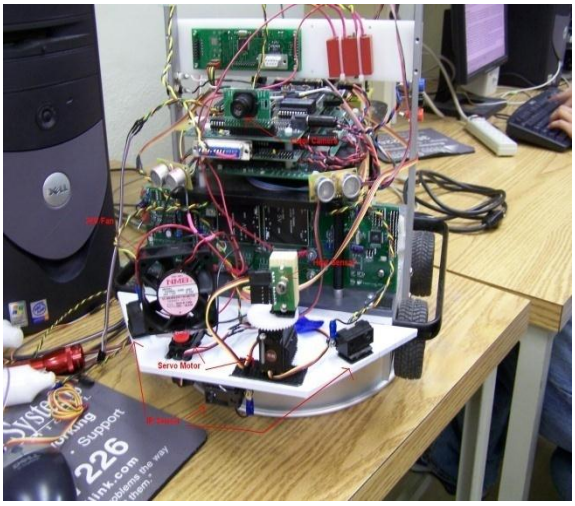


Figure 2.2 : Fire Protection Robot by Viet Do, Ryan Norder, and Ryan Spraetz

This robot designed to enter a room and seek out a spot where there is extreme heat possibly due to a fire. Upon entering the room, the robot will once again use the color camera to pinpoint a spot where there is a large concentration of light. Once the robot has driven up to the light source, the heat sensor is activated to check and see if there is a large amount of heat being generated. If there is an excessive amount of heat generated, the fan is turned on and rotated quickly with a servo motor to put out the flame. If the flame is not put out the fan will turn on again and continue to blow on the flame. Once the flame is extinguished, the robot leaves the home.

2.3.3 Autonomous Mobile Robot: Recognize and Response to fire by Nik Md Hafizul hasmi B Md Suhaimi

Figure 2.3 : Autonomous Mobile Robot: Recognize and Response to fire by Nik Md Hafizul hasmi B Md Suhaimi

This project will discuss about the development of a mobile robot which is can be train and control an autonomous robot that has a multifunction. The robot acquires basic navigation skills as well as the ability to detect a fire and to extinguish it. This robot is controlled by a microcontroller PlC16F84A and supported by RC circuits as driver for DC motors and other electronic components. This robot equipped with fire sensor that can be expand and attract so it can recognize and response to fire to operating water pump system. The battery monitoring circuit also equipped in this robot to make an easier to monitoring the overall robot battery power.

2.4 GSM Modem

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. Table 2.1 show the types of GSM Modem and used technology.

Table 2.2 : The type of GSM Modem and Technology

YEAR	STANDARD	MOBILE TELEPHONE SYSTEM	TECHNOLOGY	PRIMARY MARKETS
1981	NMT540	NORDIC MOBILE TELEPHONY	ANALOG UE	EUROPE,MIDDLE EAST
1985	TACS	TOTAL ACCESS COMMUNUNICATION SYSTEM	ANALOG UE	EUROPE AND CHINA
1986	NMT900	NORDIC MOBILE TELEPHONY	ANALOG ue	EUROPE, MIDDLE EAST
1991	GSM	GLOBAL SYSTEM FOR MOBILE COMMUNICATION	DIGITAL	WORLD-WIDE
1991	TDMA	TIME	DIVISION DIGITAL MULTIPLE ACCESS	AMERICA
1993	CDMA	CODE	DIVISION DIGITAL MULTIPLE ACCESS	NORTH AMERICA, KOREA
1992	GSM 1800	GLOBAL SYSTEM FOR MOBILE COMMUNICATION	DIGITAL	EUROPE
1994	PDC	PERSONAL DIGITAL CELLULAR	DIGITAL	JAPAN
1995	PCS 1900	PERSONAL COMPUTER SERVICES	DIGITAL	NORTH AMERICA

2001	GSM 800	GLOBAL SYSTEM FOR MOBILE COMMUNICATION	DIGITAL	NORTH AMERICA
2006-TILL DATE	GSM 450	GLOBAL SYSTEM FOR MOBILE COMMUNICATION	DIGITAL	WORLD-WIDE

CHAPTER III

METHODOLOGY

3.1 Introduction

There are many sections in the development of designing autonomous robot. These sections can be simplified using methodic approach.

Figure 3.1(a) show the block diagram for this robot. This block diagram shows how Autonomous fire fighter robot implements. Sensors use as input and this input control by programming in PIC helped by SK40C board and additional circuit. With this input, main board set the references and uses this data to applying it at output where the output is brushless motor, actuator and message notification from GSM modem.

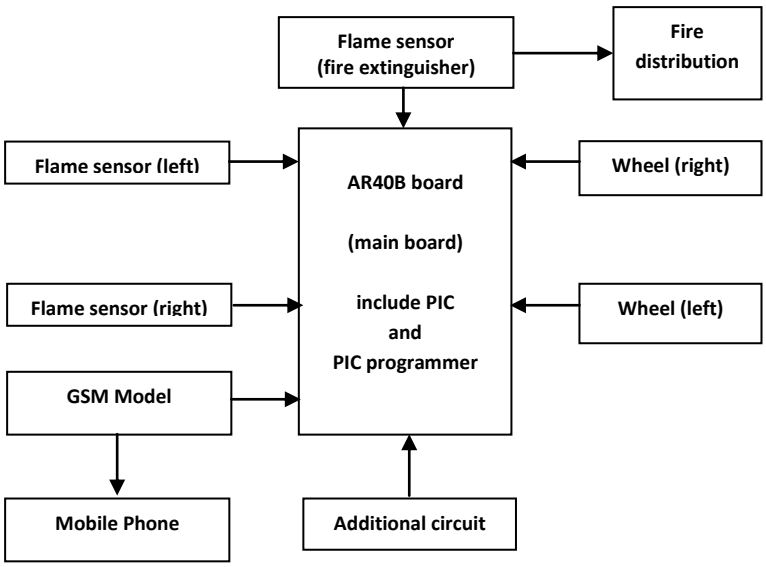


Figure 3.1(a): Block diagram of Autonomous Fire Protection Robot with Notification

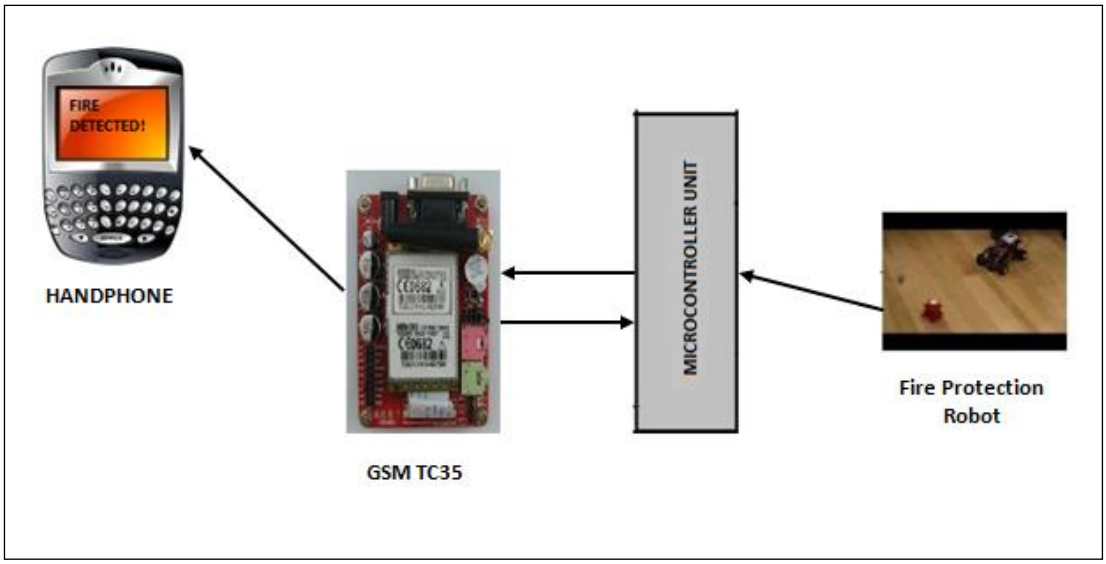


Figure 3.1(b): Operation of Autonomous Fire Protection Robot with Notification

Figure 3.1(b) show to how the operation of Autonomous Fire Protection Robot with Notification.

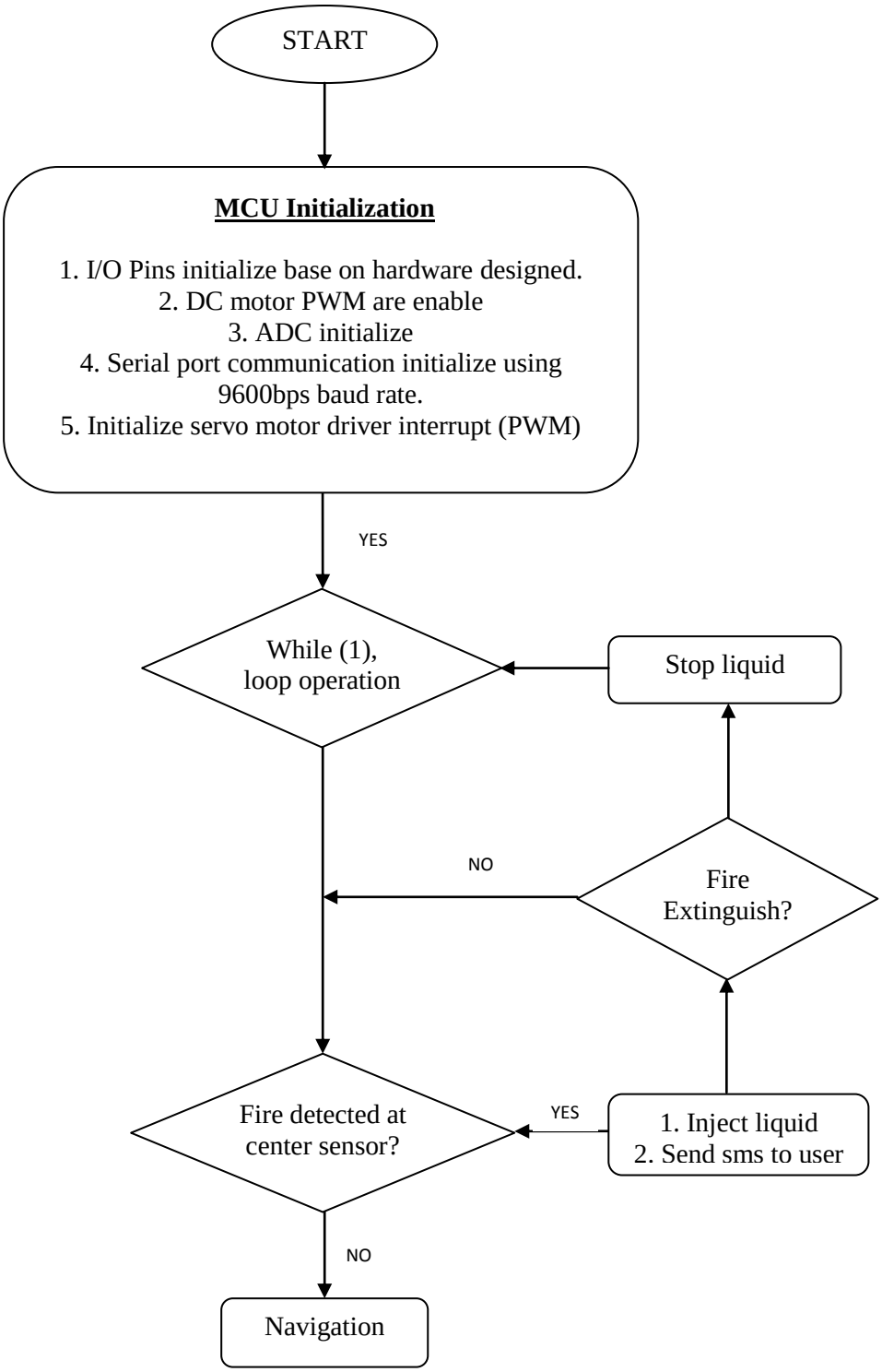


Figure 3.1(c): Flow Chart of Autonomous Fire Protection Robot with Notification

Figure 3.1(d) show the methodology flowchart during the progress in completing the Autonomous Fire Protection Robot with Notification.

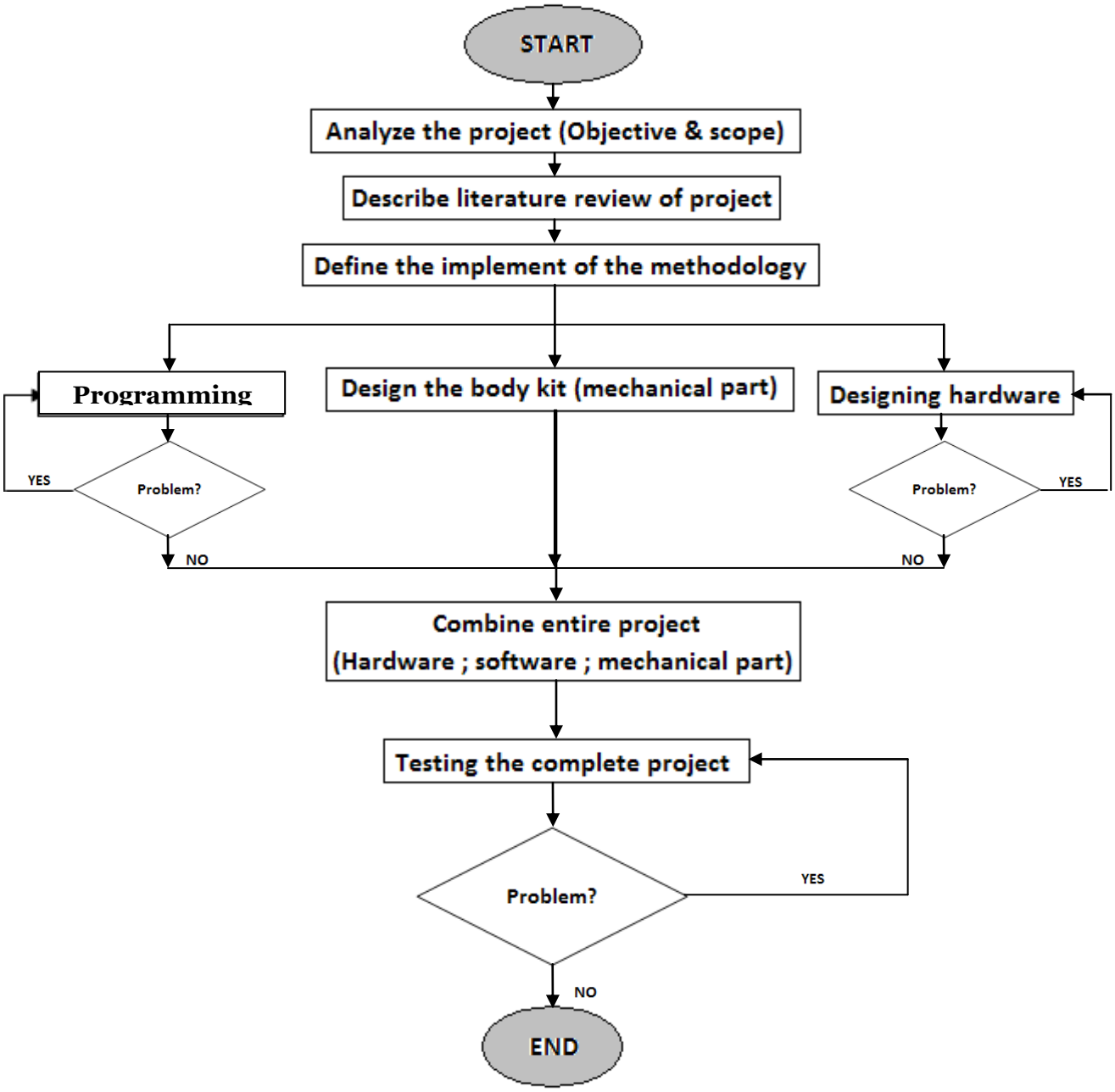


Figure 3.1(d): Flow Chart Methodology

The methodology flow chart first start the project and than analyze the project depend the objective and scope project. Describe the literature review of the project and define the implement of the methodology part. The system can be categorized into three parts at the methodology. First part mechanical part, second part is

hardware part and last part the system is software part. Than combine the three of part and than testing for the complete flow system at the figure 3.1(c).

The progress of designing an autonomous fire protection robot will be discussed in detail. Therefore, this chapter deals with the actual design and construction of the system. The system can be categorized into three parts as below:

i. Mechanical part,
ii. Hardware part and simulations, and
iii. Software part (microprogramming).

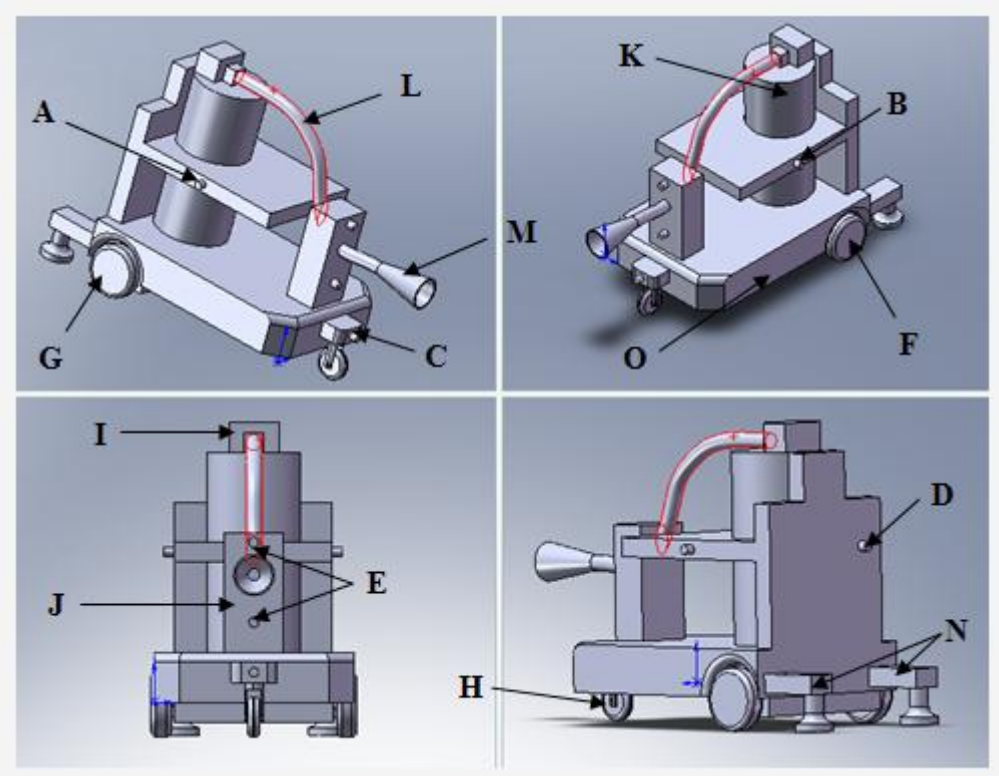
3.2 Phase I - Mechanical Part Design

This sub-topic will discusses about the mechanical part design of the Autonomous Fire Fighter Robot. The body kit is used to protect the electronic circuit from the any obstacles especially liquid where it may cause the electronic circuit malfunction. The designing of robot body kit were base on ideas below:

i. Base on the functions that the robot will perform,
ii. Determine where to place the internal components that will necessary to make the robot operational,
iii. Minimize the weight of load that the robot carrying to reduce the power needed by the robot, and
iv. Minimize the gravity centre for easy to spot the stability point while static or moving condition.
v. The microcontroller validates the SMS and then perform specific task on the device.

3.2.1 Robot Design Chassis

This robot contains two wheels at rear side and one free wheel at front side. The free wheel used to stabilize the robot and use to rotate the robot 360°. Figure 3.2.2 shows the design of robot body kit using Solid Work® 2007 SP2.0.



CODE	FUNCTION
A	RIGHT sensor
B	LEFT sensor
C	FRONT sensor
F	LEFT wheel
G	RIGHT wheel
H	FRONT wheel (freewheel)
I	Clipper
J	Actuator
K	Fire extinguisher
L	Hose
M	Nozzle
N	Stabilizer
O	Electronic circuit

Figure 3.2: Design of robot body kit using Solid Work® 2007 SP2.0

3.2.2 Body Kit Design Structure

The body kit is used to protect the electronic circuit from the any obstacles especially liquid where it may cause the electronic circuit malfunction for the robot. The designing of the robot body kit was base on ideas below :

i. Base on the functions that the robot will perform.
ii. Determine where to place the internal components that will necessary to make the robot operational.
iii. Minimize the weight of load that the robot carrying to reduce the power needed by the robot.
iv. Minimize the gravity centre for easy to spot the stability point while static or moving condition.

Figure 3.3 shows the design Of Autonomous Fire Protection Robot with Notification body kit in difference angle design by Solid Work® 2007 SP2.0 software. The explanation for Solid Work® 2007 SP2.0 will be in next subchapter

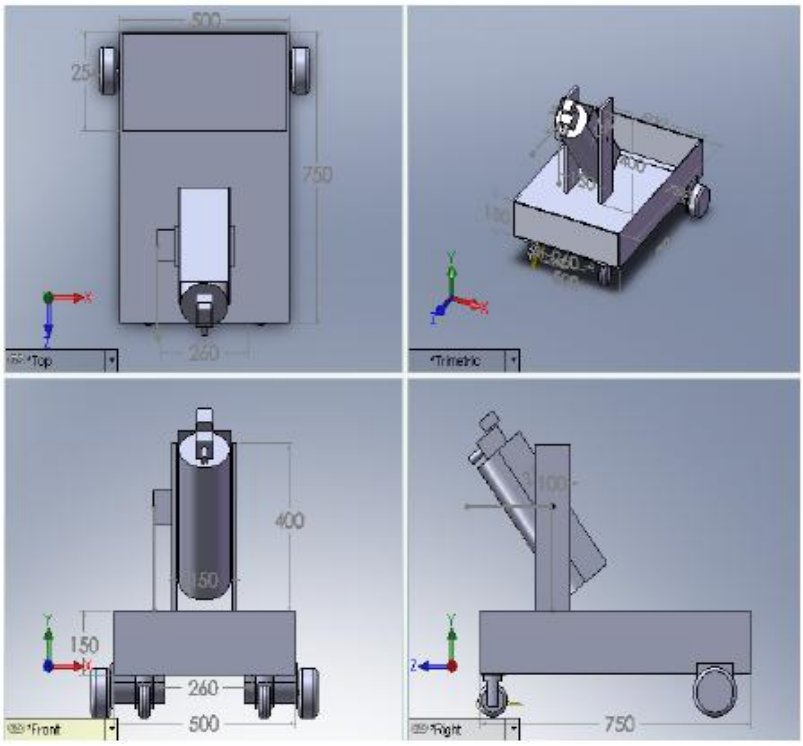


Figure 3.3: Design of Autonomous Fire Protection Robot with Notification robot body kit using

3.2.3 Steering Method

In order to tasking robot to finding and extinguish the destructive burnt area, the steering method is the important thing that must be emphasis. These methods help the Autonomous Fire Fighter Robot to achieved objectives to extinguished fire fully. Table 3.1 below shows the detected sensor and its future task in commanding the motor that rotate wheel.

Table 3.1: The detected sensor and future task

SENSOR	TASK
Left	Rotate right wheel till front sensor detected flame.
Right	Rotate left wheel till front sensor detected flame.

This Autonomous Fire Fighter Robot will use two identical motor to spin forward helped by free wheel as figure 3.4.

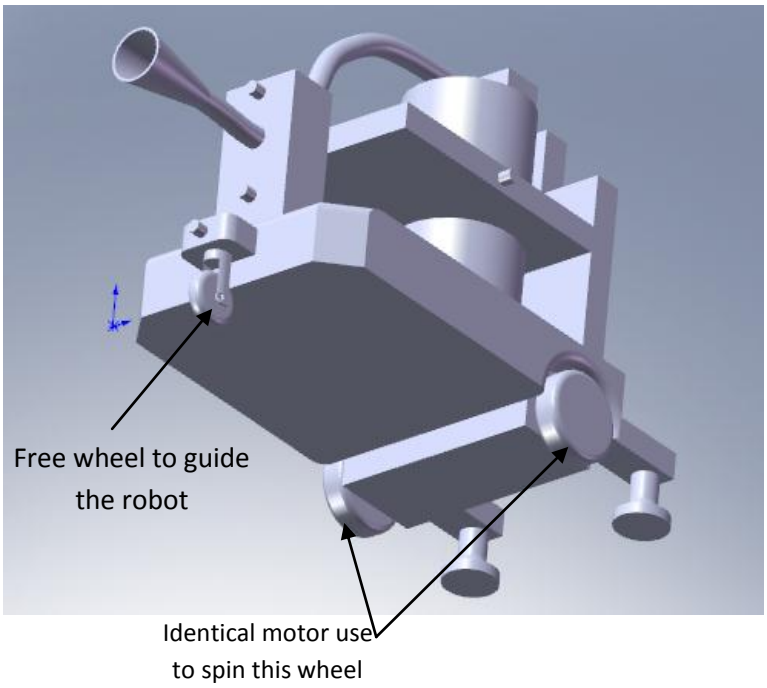


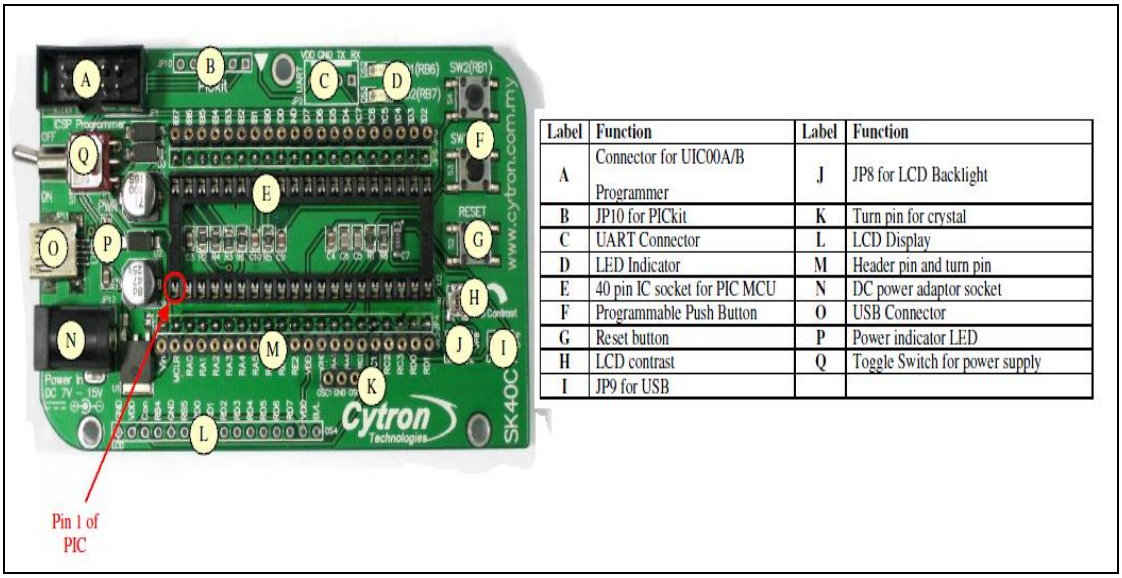
Figure 3.4: Design of the robot chassis

3.3 Phase II - Hardware and Circuit Design

To operate the robot, it requires an electronic circuit combination. All the equipment that use in this project will be explain in next subchapter.

3.3.1 Cytron™ SK40C Board

SK40C board is designed for autonomous robot by utilizing 40 pins PIC microcontroller. This board is On board USB programmer where this board is easily to use and user friendly. Pins configuration is fully compatible for 40 pins PIC microcontroller especially for PIC18F4550. SK40C SK40C is another enhanced version of 40 pins PIC microcontroller start up kit. It is designed to offer an easy to start board for PIC MCU user. However, all interface and program should be developed by user. This board comes with basic element for user to begin project development. It offer plug and use features. Figure 3.5 show the picture of Cytron™ SK40C board.



Label	Function	Label	Function
A	Connector for UIC00A/B Programmer	J	JP8 for LCD Backlight
B	JP10 for PICkit	K	Turn pin for crystal
C	UART Connector	L	LCD Display
D	LED Indicator	M	Header pin and turn pin
E	40 pin IC socket for PIC MCU	N	DC power adaptor socket
F	Programmable Push Button	O	USB Connector
G	Reset button	P	Power indicator LED
H	LCD contrast	Q	Toggle Switch for power supply
I	JP9 for USB		

Figure 3.5: Cytron™ SK40C Board layout and Function

Another advantage of Cytron™ SK40C board is listed below:

i. Save the time in designing and developing interface between electronics component.
ii. Save the time purchasing and choosing the suitable components,
iii. Eliminate the frustration on soldering, testing and downloading program.
iv. Reduce unstable condition of self develop controller board.
v. With UIC00A/B, program can be loaded in less than 5 seconds.
vi. Maximum current is 0.5A.

3.3.2 PIC18F4550 Microcontroller

A microcontroller is an inexpensive single chip computer, the entire computer system lies within the confines of the integrated circuit chip. Low cost, low power consumption, easy handling and flexibility make PIC18F4550 applicable in areas where microcontrollers had not previously considered. It has 33 I/O pins. Figure 3.6 shows the block diagram of PIC18F4550.

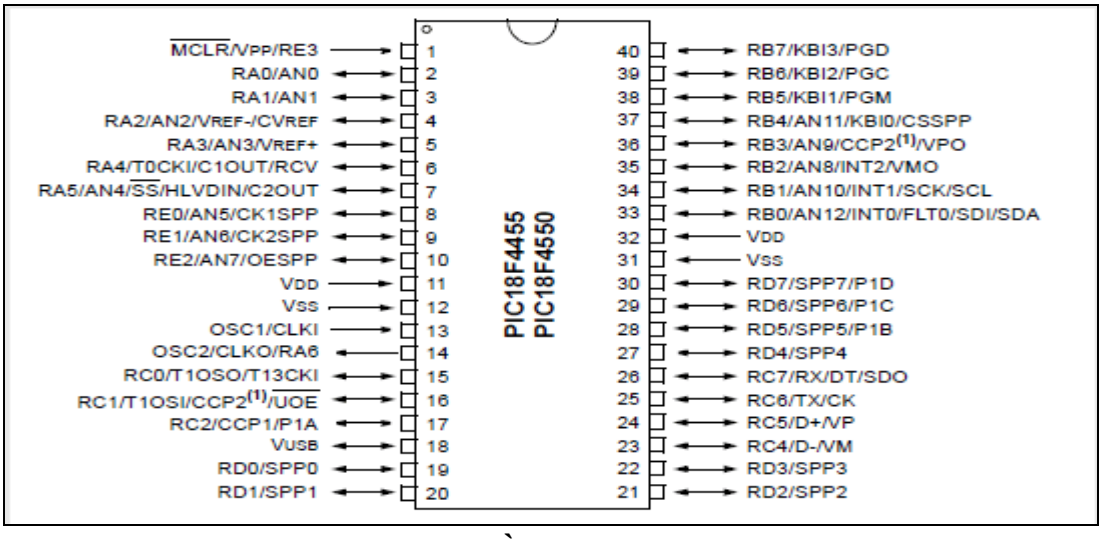


Figure 3.6: Pinouts of PIC18F4550

The description of the PIC18F4550 Ideal for low power (nanoWatt) and connectivity applications that benefit from the availability of three serial port FS-USB(12Mbit/s), I²C™ and SPI™ (up to 10 Mbit/s) and an asynchronous (LIN capable) serial port (EUSART). Large amounts of RAM memory for buffering and Enhanced Flash program memory make it ideal for embedded control and monitoring applications that require periodic connection with a (legacy free) personal computer via USB for data upload/download and/or firmware updates. Table 3.1 show to parameter of the PIC18F4550.

Table 3.2 : Parameter of PIC18F4550

PARAMETER	
Pin Count	40
Program Memory	32 Flash (KB)
CPU Speed (MIPS)	12 RAM Bytes 2,048
Data EEPROM	256 bytes
Digital Communication Peripherals	1-A/E/USART, 1-MSSP(SPI/I2C)
Capture/Compare/PWM Peripherals	1 CCP, 1 ECCP
Timers	1 x 8-bit, 3 x 16-bit
ADC	13 ch, 10-bit
Comparators	2
USB (ch, speed, compliance)	1, Full Speed, USB 2.0
Operating Voltage Range	2 to 5.5 (V)

3.3.3 Servo Motor

RC servos are hobbyist remote control devices servos typically employed in radio-controlled models, where they are used to provide actuation for various mechanical systems such as the steering of a car, the flaps on a plane, or the rudder of a boat.

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