‘GO GREEN’ SMART ROBOT

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Abstract- The main objective of this project is to design and develop a robot to pick up a dustbin that is filled with rubbish, and will go to the main dustbin to transfer all rubbish. After that, the robot is place back the dustbin at the original position and the robot will be back to the original position. The movements are using line follower system that involved many part of sensor while the movement of robot is drive by two DC motors. The development of the robot involved several mechanical systems . One of the mechanical systems is based on forklift system that is used to pick up dustbin. The forklift system is one of the main mechanical systems in the robot. The system is selected as it is easy to implement, easy to control or programming and less of component in order to build the system. The forklift system in this robot is drive by 12V DC motor. There are three targets to achieve in order to build this robot. Firstly the component and system will be simple as can but still able to fulfill the task. Secondly is to get the best design hardware and lastly the robot will operate and do the task with smoothly and less of error. A 300 MHz Radio frequency Module is used as wireless link which is able to transfer signal between transmitter circuit and receiver circuit. The transmitter circuit is place at the dustbin system while the receiver circuit is place at the robot system. PIC16F877A is a microcontroller to control the entire component in the robot system. The robot is start to operate once the signal is send by the dustbin to the robot via transmitter

*Keywords-component ;*DC Motor, Forklift, Microcontroller PIC16F8771A, 315 MHz Radio Frequency Module

I INTRODUCTION

In this era, the technology is the most importance in order to increase the productivity of human live. This country is one of among the country that have try to build their own technology robotic to give big impact to economic growth.

Robotic can be regarded as a typical and reprensentive part of Mechatronics, as cutting edge technology in this rapidly expanding research field [4]. The interest among the people of this country towards the use of robotic in daily life is increasing. Hence, from that situation, an idea is came to design and develop the robot that is functioning to facilitate the people by pick up the dustbin and transfer it to the main dustbin. Thus, it will ensure the environment in office, factory, shopping mall and public area are always clean by pick up the dustbin at the right time. Therefore, the dustbin will not be full with rubbish and overflow. The type of robot that will be created is Service robot. The purpose is to serving human for making life easier and also will be built for delivery services in office environments and hospitals, cleaning or lawn mowing [1].

A dustbin is placed near the door of lecture’s office and there is a line near the all dustbin. The dustbin is equipped with a limit switch, a LED, a device transmitter signal and a power source (batteries) 9volt. The limit switch is use to detect the dustbin whether it is full or not. If the dustbin is full and heavy at certain weight, the weight of rubbish will push limit switch, make the LED to turn on and the device transmitter will send the signal to the robot.

The robot has three 12 volt DC motors, two infrared sensor act as colour sensors, a supply source (12 voltage batteries), a Microcontroller (brain robot), several limit switches, a device received signal and several mechanical part. Once the robot received the signal from one of the dustbins, the robot is triggered to move by drive using 2 DC motors. The robot move by following the line using line follower system. At this time, several infrared sensor act as colour sensor are operate to ensure the robot is following the line accurately.

The LED is turn on once the dustbin is full. The robot is move and stop at full dustbin only by detecting line from colour sensor. Then the mechanical part drive by a 12v DC

motor which is operate to pick up the dustbin. During this process, several limit switches are involved. After the robot has pick up the dustbin, the robot will move to main dustbin guide by a line. At the end of the line, the robot will stop. At this moment the process for transferring rubbish from dustbin to main dustbin using mechanical system and several limit switches is begin.

II TECHNICAL STUDIES

1) INFRARED SENSOR ACT COLOUR SENSOR

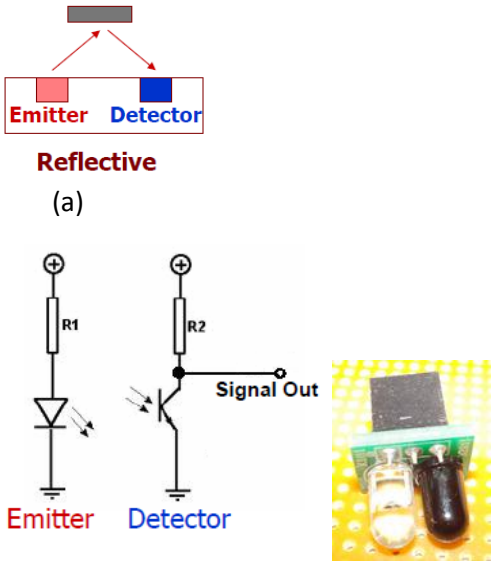

Figure 1: (a) The reflective infrared operation & (b) the shematic diagram of IR sensor & (c) SN-IRS-01

The robot used reflective infrared type sensor as shown in Figure 1(a). This sensor is in model SN-IRS-01 as shown in Figure1(c) which is suitable to detect black line on the white background. Light from the emitter that called a diode is reflected off an object and back into detector that called a phototransistor as shown in figure 1(b), which triggers some base current on the detector. The amount of light reflected is proportional to the current produced. Light reflected on dark surface is much less than white surface.

2) LINE FOLLOWING SYSTEM

The two infrared (IR) sensor, two 12V DC motor, resistance 4.7KΩ and 220Ω and a driver motor is connected to SK40C. Sensors is added to the controller as their feedback that become close loop system for the autonomous mobile robot. Without sensors to detect the environment, the robot will only do the basic movement and it just reflect depending on the programming that have been installing. In this case, the robot robot need to move by following the dark line. In other hand, the sensors need to ensure that the robot detect the dark line while give an order to the robot to move within the dark line. The dark line will drive green robot to actual direction by installing the software design to the controller. Then the output signal from the controller regarding to program installed, will be sent to motor driver. With some electrical energy given to the motor driver, it will generate mechanical energy to motor causes rotational of the wheels. The signals to the motor should able to make it rotates in clockwise or anticlockwise direction, and also at varying speed. Sensor is connected to measure obstacle which distance light and give feedback signal to the controller to make a corrective action when robot goes to the wrong direction, so that the robot could produce all the required movement.

3) 300MHz RADIO FRENQUENZY MODULE

Transmission through RF is better than IR (infrared) because of several factors. Firstly, signals through RF can travel through longer distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 300 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter

a) Situation for data transmitting
The radio controller transmitter is placing at dustbin. When the dustbin is full at certain weight. The limit switch is turn ON and the RC circuit send signal to robot, then the robot is start to operate.

b) The signal can be transmitted up to 100 meters in open space and continuously [5], that range enough for this application.

4) SK40C

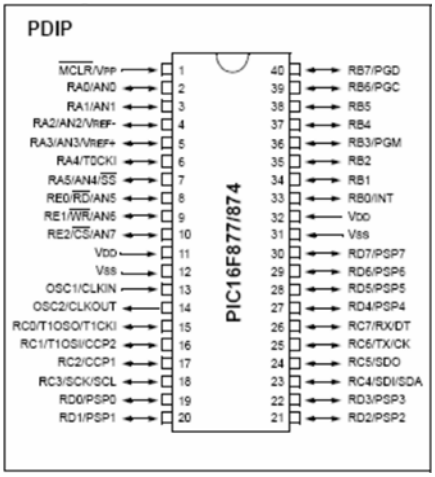

Figure 2: Pin Diagram PIC16F877

The implementing real command systems and automatic control are generally based on programmable digital electronic technology [2]. The microcontrollers as programmable are the most widely used because of the great flexibility in the design and the programming of the control system [3]. The PIC microcontrollers are product of microchip. The different PIC microcontrollers come in different packages, and offer different features. A suitable microcontroller is used to control all the input such as sensors [7]. Figure 2 shown the PIC16F877A that have 40pin dual in-line package has been chosen for application for this task. The size of PIC16F877A is small and its low cost [6]. The importance features for this pic is including PWM, ADC and comparator that will use for fulfill the task.

III METHODOLOGY

1) FLOWCHART OF METHODOLOGY

In order to design the electrical and mechanical hardware of robot, all the process must put in detailed flow of work of this project. It consist of the programming software that is use to get desired result and hardware to shown that the project is function and reliable. In general the flow chart of this methodology as shown in Figure 3 where is includes the important step in terms of procedure to design the robot hardware and programming.

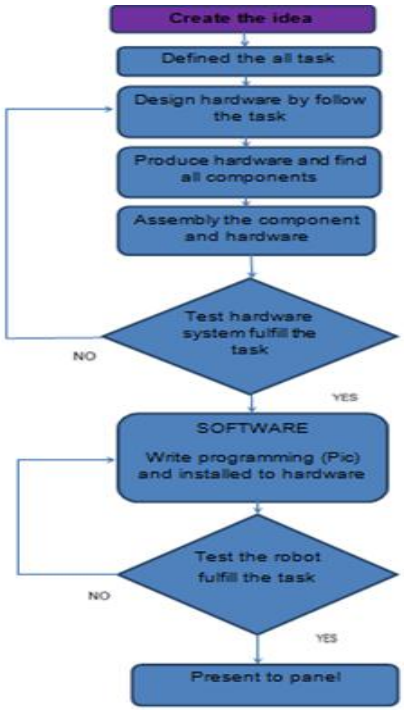

Figure 3: Flowchart of methodology

2) DESIGN CONCEPT

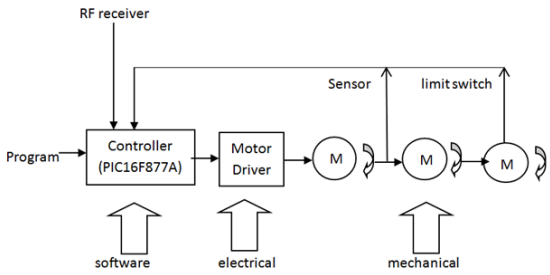

Figure 4.robot design

The project combined three types of design which are mechanical design, electric design, and software design. The design are combined together to make a complete robot shown in Figure 4.

IV RESULT AND DISCUSSION

MECHANICAL DESIGN

Figure 5a: Main body of robot

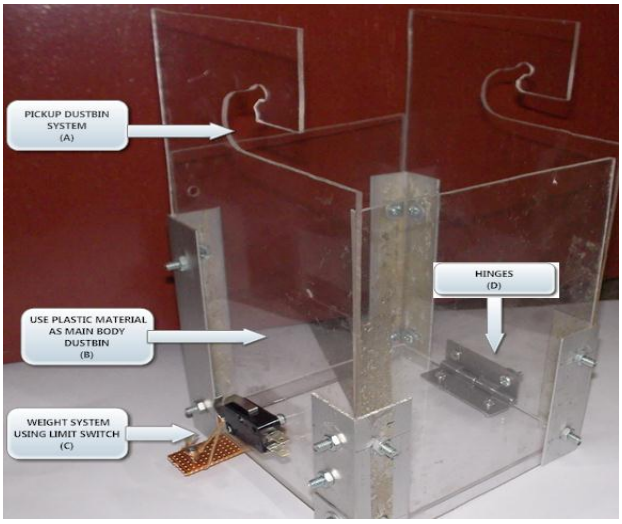

Figure 5b: Dustbin system

The total weight main body robot without controller and power supply around 3.5kg. The robot used aluminum material as main material for base body. The aluminum material was chosen because despite has quite light weight material it is tough and strong. The plastic material is used for roller in forklift system. The nuts and bolts were used to connect several mechanical parts for build main body of robot. Figure 5a(A) shown the two 12V DC motor coupling with wheel to generate motion of robot for pickup a dustbin and use two caster bearing as shown in figure 5a(F) to give most stability of the robot base. The system for collecting the dustbin is completed by combining the two system together. The first one is the forklift system as shown in figure 5a(B) that has one 12V DC which is used to generate motion forklift system as shown in figure 5a(A). Two pulley for guiding cable motion as shown in figure 5a(C)) and four plastic roller for upward and downward motion move smoothly and less friction. Second is the pickup dustbin system that is used by the robot for holding the dustbin during the process of transferring filled rubbish from dustbin to main dustbin. This system has specific design that combined several parts and is fix and suit for holding the dustbin.

The dustbin has unique design and plastic is used as main material as shown in figure 5b(B). The reason why plastic material is choosen is because it is light in weight and easy to implement. The pickup dustbin system as shown in figure 5b(A) at dustbin body is design for suit with pickup dustbin system at robot body as shown in figure 5a(D). The weight system as shown in figure 5b(C) is used limit switch to control maximum weight before trigger. The weight maximum around 250gram can be hold. The hinges are used to hold between base and side of the dustbin. By using hinges a dustbin base can be adjustable depend on rubbish weight that filled into the dustbin.

ELECTRICAL DESIGN IN SHEMATIC DIAGRAM

The electrical schematic as shown in figure 6 using Smartdraw software. It has a PIC16F877A as brain of robot. It is three 12V DC motor and three driver motor MD10C that function to generate motion for a robot. The two IR sensors are functioning to make line following system for the robot.

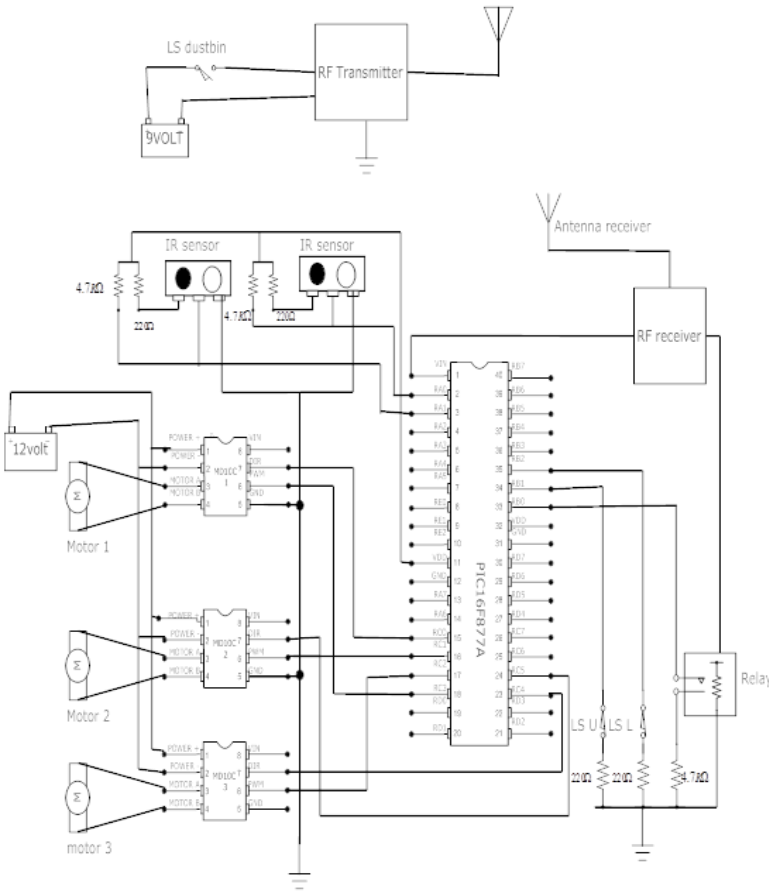

Figure 6: Electrical design

component	first	replace	reason	result
Motor driver	L293 D	MD10C	Ic L293D max current < 1200mA.	The current blow a ic L293D. The ic L293D not suitable to matching with 12V motor dc. Replacing to three MD10C.
Power supply	12V 1.2AH	12V 7.0AH	Not enough Current to support motor driver MD10C	Power supply 12V 1.2AH not enough to support MD10C. Replace with 12V 7.0AH. 2 of 3 MD10C operate normally. But one of them not functioning.

Table 1: Troubleshooting

The Table 1 indicates that the robot has two problems and action has been taken to overcome the problems.

However, the problems is still could not be solved due to some factors. Firstly, one of the MD10C is not functioning. New MD10c is needed for a replacement. But the MD10C has out of stock at supplier in selangor area. Thus, it cause the robot not fully functioning as actual planning. The other problem for this project is the power supply. The power supply that is used in this project is 12V 7.0 AH has disadvantage which is weak quickly in a short time. Besides, to charging it back also demand a long period before it is fully charged.

V CONCLUSION

At the end of this project, ' GO GREEN' robot is not fully functioning as actual planning. However, the robot is still realistic to be commercialization. This is due to the benefits that the human will gain as the robot will make the human job easier and more efficient. Other than that, the environment in this county will also maintain to be clean as there will be no overflowing rubbish that could effect the environment. Lastly, I can conclude that " Go Green " robot has a lot of benefits that contribute to the society and can also be practically used in our country as it will increase the sustainability of earth.

VI FEATURED WORK AND RECOMMENDATION

In the future, the robot can be improved by replaced weight system to object sensor or level sensor to determine level filled of dustbin. It is also can improve by putting sensor obstacle in robot. If there is an obstacle in front, the robot can react smartly by avoiding the obstacle automatically. The operation cost and energy can be saved by using solar system as a power supply to the robot.

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APPENDIX

PROGRAMING

```
#include<pic.h>

#include <stdio.h>

__CONFIG(0x3732);

void main (void)

{

        unsigned char right_sensor;

        unsigned char left_sensor;

        TRISC=0b00000000;  //for motor

        TRISB=0b00000000;  // for limit switch upper
n lower, RF receiver,

        PORTC=0b00000000;

        PORTC=0b00000000;

        CMCON=0b00000110; //comparator

        CVRCON=0b11000011; //CVRR=0 bit ke
5,VR=1.74V

        int STEP;

        int n;

if (RB0==0)        // detect input from RF receiver

{

PORTC=0b00011011; // forward // move out from
starting area

        for (n=0; n<30000; n++);

        for (n=0; n<30000; n++);


}

while (STEP=7) // move from strating area to dustin
area


{       right_sensor=C1OUT;

        left_sensor=C2OUT;

        if (C1OUT==0&&C2OUT==0) //stop

{

        PORTC=0b00000000;

        STEP = STEP -1;

}

        else if(C1OUT==1&&C2OUT==0) //right

{

        PORTC=0b00001011;

}

        else if(C1OUT==0&&C2OUT==1) //left

{

        PORTC=0b00000101;

}

        else if(C1OUT==1&&C2OUT==1) //forward

{

        PORTC=0b00001111;

}

}

while (STEP=6) // dustbin area (process of pickup
dustbin)

{

        PORTB=0b00000010;

        if (RB1==0) // upper limit switch
```

```
        PORTC=0b00011011; // forward (out from dustbin area)
        for (n=0; n<30000; n++);
        for (n=0; n<30000; n++); // delay
        STEP= STEP -1;
}
while (STEP=5) // move from dustin area to main dustin
{
        right_sensor=C1OUT;
        left_sensor=C2OUT;
        if (C1OUT==0&&C2OUT==0) //stop
{
        PORTC=0b00000000;
        STEP=STEP -1;
}
        else if(C1OUT==1&&C2OUT==0) //right
{
        PORTC=0b00001011;
}
        else if(C1OUT==0&&C2OUT==1) //left
{
        PORTC=0b00000101;
}
        else if(C1OUT==1&&C2OUT==1) //forward
{
        PORTC=0b00001111;

}
}
while (STEP=4) // tranfer rubbish to main dustin
{       PORTC=0b00000011; // reversing direction// forward // move out from main dustbin area
        for (n=0; n<30000; n++);
        for (n=0; n<30000; n++);
        STEP=STEP-1;
}
while (STEP=3) // move from main dustbin to dustbin area
{
        right_sensor=C1OUT;
        left_sensor=C2OUT;
        if (C1OUT==0&&C2OUT==0) //stop
{
        PORTC=0b00000000;
}
        else if(C1OUT==1&&C2OUT==0) //right
{
        PORTC=0b00000111;
}
        else if(C1OUT==0&&C2OUT==1) //left
{
        PORTC=0b00001011;
}
        else if(C1OUT==1&&C2OUT==1) //forward
{
        PORTC=0b00000011;
        STEP=STEP-1;
```

```
}

}

while (STEP=2) //place back dustbin at original position

{

        PORTB=0b00000100;

        if (RB2==0) // lower limit switch

        {

        PORTC=0b00000011; // forward (out from dustbin area)

        for (n=0; n<30000; n++);

        for (n=0; n<30000; n++); // delay

        STEP= STEP -1;

}

}

while (STEP=1)

{

        right_sensor=C1OUT;

        left_sensor=C2OUT;

        if (C1OUT==0&&C2OUT==0) //stop

{

        PORTC=0b00000000;

}

        else if(C1OUT==1&&C2OUT==0) //right

{

        PORTC=0b00001011;

}

        else if(C1OUT==0&&C2OUT==1) //left

{

        PORTC=0b00000101;

}

        else if(C1OUT==1&&C2OUT==1) //forward

{

        PORTC=0b00000011;

        STEP=STEP-1;

}

}

}
```