Embedded Robotics ***issue: 29th Jan 2019***

(Prof.Dr. Witold Paluszyński)

Faculty of Electronics

Wroclaw University of Technology

Floor Cleaning Robot

(***Geo Babu , Mishal Ghayam)***

ABSTRACT: *The Report details about Floor cleaning Robot. Households of today are becoming smarter and more automated. In modern days interior decoration are becoming an important role in our life. Cleaning of floor is very important for our health and this BOT reduces the man power requirement. This Project is used for domestic purpose to clean the surface automatically. When its turned on it clears the dust by moving around the surface(floor or any other area) as it passes over it.Sensors are used to avoid Obstacles at the same time brushes attached to the motors to cleanse the surface. The approximate battery life is expected to be 45 minutes. This can be useful in improving the lifestyle of mankind.*

INTRODUCTION

In recent years, robotic cleaners have taken major attention in robotic research due to their effectiveness in assisting humans in floor cleaning applications at homes, hotels, restaurants, offices, hospitals, workshops etc. Basically, robotic cleaner is distinguished on their cleaning expertise like floor mapping. In this work "Floor Cleaning Robot" is used to clean the floor along its path. The robot is fully automatic and making decision on sensor used in the robot. Ultrasonic sensors detect the obstacles and hence change its direction while moving and also preventing the cleaner to fall from height. Sensor is controlled by Arduino controller which also controls the DC motors with the help of Motor drive. The robot is supplied with 9V.The weight of the robot is under 5kgms.

SYSTEM ARCHITECTURE

Microcontroller (AT mega 328p) is used with clock signal(quartz crystal operating 16 MHz frequency).Sensors and Bo motors are attached to the motor driver.

Hardware USED:

a. *ATmega328p/Arduino*

b. *Ultrasonic sensor (US 015)*

c. *Motor driver (L293D)*

d. *Bo motors and Brushes*

ATmega328/Arduino:

AT Mega 328p is the ATMEL Microcontroller on which Arduino board is based. The Atmel 8-bit AVR RISC-based microcontroller combines 32KB in-system Programmable Flash(ISP) memory with read-while-write capabilities,1KB EEPROM,2 KB SRAM, 23 general purpose I/O lines,32 general purpose working registers, three flexible time/counters which compare mode, internal and external interrupts, serial programmable USART, a byte oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between1.8-5.5volts. The device achieves through put approaching 1 MIPS per MHz Serial data to the MCU is clocked on the rising edge and data from the MCU is clocked on the falling edge. Power is applied to

VCC while RESET and SCK are set to zero. ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost microcontroller is needed.

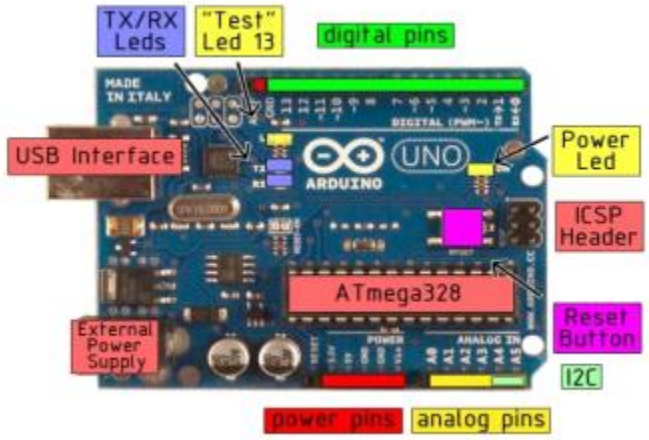


fig (a). **ARDUINO UNO R3**

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

Motor Driver (L293D)

a) Four H-Bridges: Two L293D Motor driver chips

b) L293D is rated at 0.65A per bridge (1.20A peak)with thermal shutdown protection, Motor Voltages from 4.5VDC to 16VDC. (up to 36V if C6 and C7 are upgraded)

c) Up to 4 bi-directional DC motors with individual

8-bit speed selection (256 speeds)

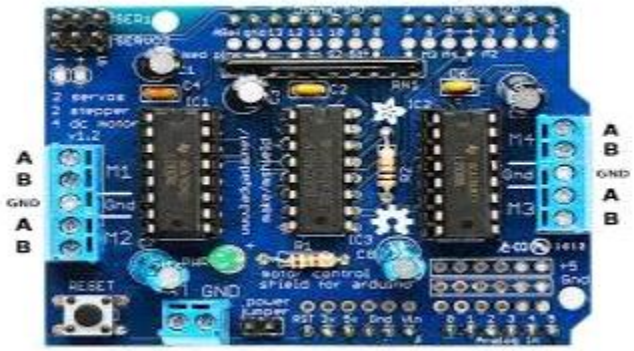
d) Up to 2 stepper motors (unipolar or bipolar)

e) Pull down resistors keep motors disabled during power-up

f) Separate Logic and Motor power connections

g) Terminal block connectors for motors and power

h) 2 connections for 5V 'hobby' servos



fig(b) ***.Motor driver (L293D)***

ULTRASONIC SENSOR (US 015)

Ultrasonic ranging module US 015 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

fig(c). **Ultrasonic sensor (US 015)**

a. *The power supply voltage is DC 5 v, working current is 2.2 mA, support GPIO communication mode*

b. *Operating temperature:0~+70°*

c. *Output mode: GPIO*

d. Detection angle: less than 15°

e. Detecting precision: 0.1cm+1%

*f. Size: 45mm*20mm*1.2mm*

The basic principle of work:

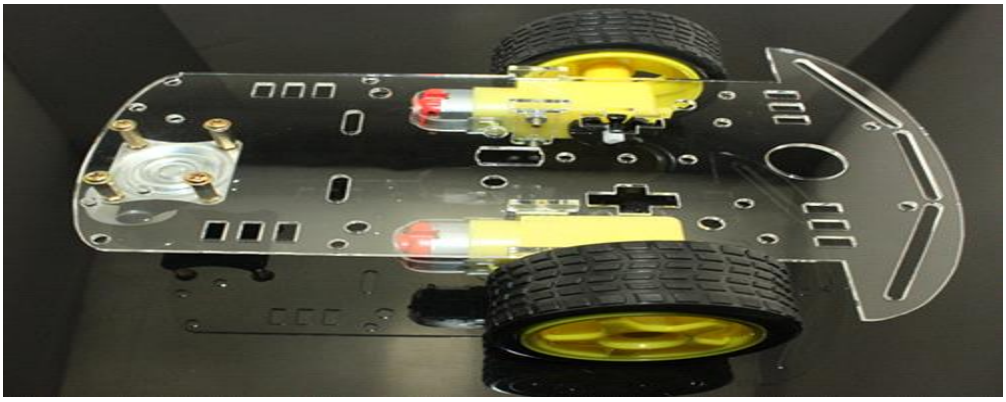
(1) Using IO trigger for at least 10us high level signal.

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

*(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time) * (velocity of sound (340M/S) / 2.*

CHASSIS and WHEELS

A chassis is the basic framework of the robot. It is one of the most important components , without which the robot would have no structure. Since 2WD robot chassis is light weight approx. 40 grams the power consumption can be reduced too.



fig(d). **Chassis framework**

a. 2WD robot chassis platform with wheel encoder discs

b. 40mm wheels and a rear caster

c. Acrylic body cut by high-precision lasers

d. Plastic rims with solid rubber tires

e. Wheels: Thickness of 2cm

f. Bottom: thickness of 3 mm

g. Length: 208mm

h. Width: 147mm

BO Motor

DC motor (BO) Battery Operation. Dc motor converts electrical energy into mechanical energy.DC MOTOR concept is where gears reduce the speed of the vehicle but increase its torque known as gear reduction, Speed of motor is counted in terms of RPM. This light weight DC geared motor which gives good torque and rpm at lower voltages. This motor can run at approximately 200 rpm when driven by a single Li-Ion cell. Great for battery operated light weight robots. It can do reverse and forward directions.

fig(e). **Battery Operated Motor**

a. Working Voltage 3-12V

b. No Load Speed: 200 rpm /- 10rpm

c. No Load Current: 125mA (max.170mA)

d. Torque: 500gf.cm

e. 40gm weight

f. Motor speed: 100 r / min

g. Size : 70.50×27.00×23.00 mm (L × W × H)

SOFTWARE DESCRIPTION

To program the Arduino the Arduino IDE is used which is free software that enables programming in the language that the Arduino understands. In the case of the Arduino, the language is based on C/C++ and can even be extended through C++ libraries. The IDE enables writing a computer program which is a set of step-by-step instructions that is then uploaded to the Arduino. Arduino will then carryout those instructions and interact with whatever it has been connected to it. In the Arduino world, programs are known as "sketches".

Software :Arduino IDE

Algorithm USED;

```
#include <AFMotor.h> //import your motor shield library

#define trigPin 11 // define the pins of your sensor

#define echoPin 12

AF_DCMotor motorBL(3,MOTOR34_8KHZ); // set up motors.

AF_DCMotor motorBR(4, MOTOR34_1KHZ);

AF_DCMotor motorL(2, MOTOR12_64KHZ);

AF_DCMotor motorR(1, MOTOR12_64KHZ);

void setup() {

  Serial.begin(9600); // begin serial communitication

   pinMode(trigPin, OUTPUT);// set the trig pin to output (Send sound
waves)

  pinMode(echoPin, INPUT);// set the echo pin to input (recieve sound
waves)

  motorL.setSpeed(225); //set the speed of the motors, between 0-255

  motorR.setSpeed (225);
```

```
  motorBL.setSpeed (100);
  motorBR.setSpeed (100);
}
 void loop() {
  long duration, distance; // start the scan
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2); // delays are required for a succesful sensor
operation.
  digitalWrite(trigPin, HIGH);


  delayMicroseconds(10); //this delay is required as well!
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2)/29.1;// convert the distance to
centimeters.
  motorBL.run(FORWARD);
  motorBR.run(FORWARD);


if (distance < 30)/*if there's an obstacle 25 centimers, ahead, do the
following: */ {
   motorL.run(FORWARD);  // Turn as long as there's an obstacle ahead.
   motorR.run (BACKWARD);
   }
  else {
   delay (15);
   motorL.run(FORWARD); //if there's no obstacle ahead, Go Forward!
   motorR.run(FORWARD);
  }
```

```
}
```

Review the Code:

a. *import the AFmotor(Adafruit) library, which we installed in the Arduino UNO board*

b. *Assigning TrigPin from Ultrasonic sensor to pin11 on the Arduino Board(sends the waves from Ultrsonic sensor to measure the distance)*

c. *Assigning echoPin US 015 to Pin 12 (which receives the previously emitted signal from US 015)*

d. *setting up the motor.('motorl' and 'motorR'for the left and right wheels of the robot respectively and 'motorBL' and 'motorBR' two motor for the brushes are assigned to each motor shield ports)*

e. *starting serial communication*

f. *setting the trigPin to output and set the echo Pin to input(this commence the scan from Ultrasonic sensor, when the trigPin in HIGH state a wave is emitted and after a delay on 10 microseconds ,a delay which is required to to receive the exact return signal. When the echoPin in HIGH state, the distance is calculated with respect to the time taken for the signal to that of speed of sound in air as medium, as formulated) *NOTE: the duration/2 because it's the time taken for signal to reach the obstacle and back.*

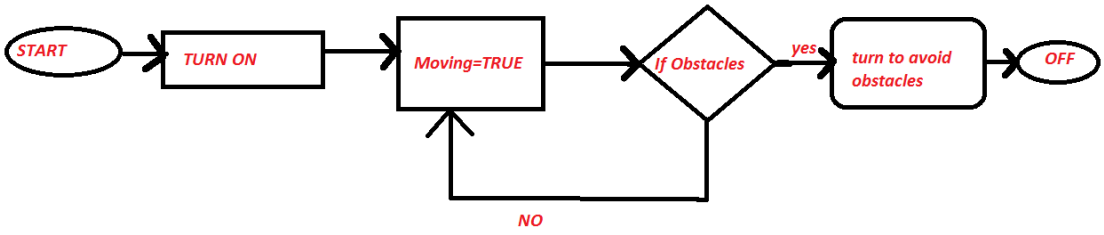
g. *setting the speed of motors between 0-225(each motor is assigned to a certain speed motorR and motorL for the wheels are 225 each as it's the maximum. The brushes are set to 100 which is continuous and connected to low speed like 1KHz which will use less power*

h. *alternative path for obstacles (if the obstacle is in range that is distance<30 motorL will run forward and motorR will run backwards so the robot can take the turn, the remaining motors will stay in direction(FORWARD).)*

i. *if there is no obstacle(all the motors are set to run in FORWARD direction)*

Working:

The automatic floor cleaner is intelligently programmed to clean a specific area through spinning brush cleaning assembly. The cleaner is cost effective, convenient, environment friendly that saves the valuable time of any person. The cleaning assembly is made on a rectangular piece of chassis that has two wheels beneath it and brushes attached at it's front and back in order to sweep the dirt as it passes over the surface. DC motor is used to change direction of wheels which is connected to the platform. If the enough current is produced then DC motors can be operated directly otherwise a motor driver is required so as to provide it a high current upto 0.7 to 1.2 ampere. Driver Used is named as L293D with H-Bridge Configuration. The cleaner is handy and can spin anywhere in any direction.



*fig(f).***Flow chart**

As the Robot is powered it starts moving in random pattern avoiding everything in its path, the 9V battery is facilitated with a connector for easy power ON and OFF. The battery powers the Motor Driver which is merged with Arduino Board. The power is distributed to each BO motors and ultrasonic sensor. The speed of the motors is assigned in the code and the motor can rotate in both directions as needed which comes in handy for the obstacle avoidances. when the US 015 sends and receives the signals and an obstacle is detected, The right wheel of the robot run by motorR goes the opposite direction(BACKWARD) and the left wheel (motorL) maintains the FORWARD Direction which results in a right turn of the whole robot. The other two BO motors(motorBL,MotorBR) is continuous and turning in a speed of 100rpm at its axis, thus maintaining a steady cleaning process no matter what the robot's path is. Which is the full scope of the project.

Connections:

9V battery being the only power source, which is connected to the motor shield. The positive of the battery is connected to the +M and negative to the GND.

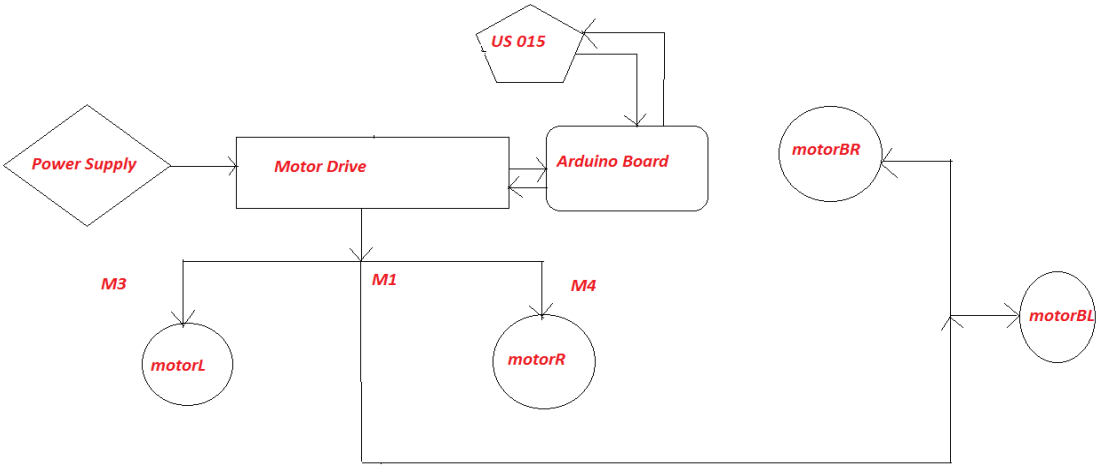
In 4 BO motors used in the robot ,2 of them which is motorR and motorL is connected to the M4 and M3 ports of the motor Drive respectively. The other two BO motors(motorBR,motorBL)is connected from a bread board located at the front of the robot which is in turn connected with the M1 port of the Motor Drive.

The Ultrasonic sensor is placed on the bread board as well.

two circular brushes which spins in opposite directions are attached to the motorBR and motorBL

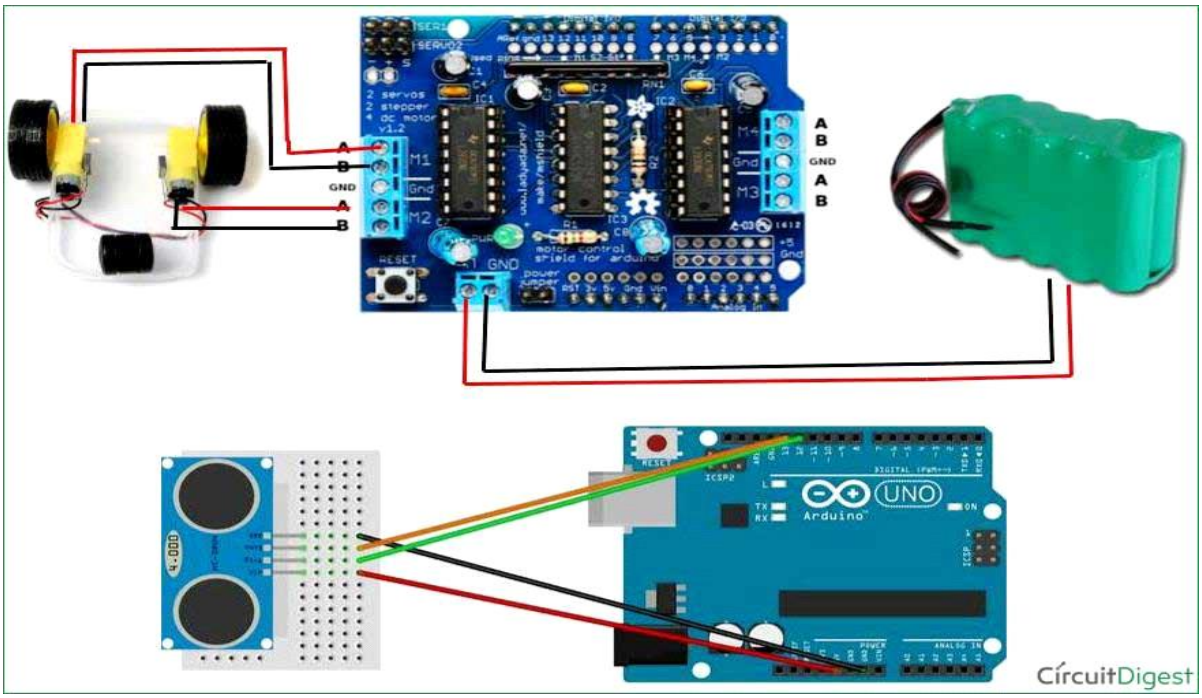
the tail of the robot is fixed with two small stationary brushes which intake clears the remaining dust particles in it's trail as a final touch.

all the Hardware's are fixed on the base frame of the chassis which is subtended by two wheels and a supporting wheel.



fig(g). **Block Diagram**

The Trig pin of Ultrasonic is connected to the 11th pin on the Arduino, the Echo pin is connected to the 12th pin, the voltage pin to the 5V pin and the Ground pin to the ground pin. The Echo pin and the Trig pin allow the Arduino to communicate with the sensor. Power is delivered to the sensor through the voltage and Ground pins, and the Trig and Echo pins allow it to send and receive data with the Arduino



fig(h). **Basic connection of Obstacle Avoidance Robot**

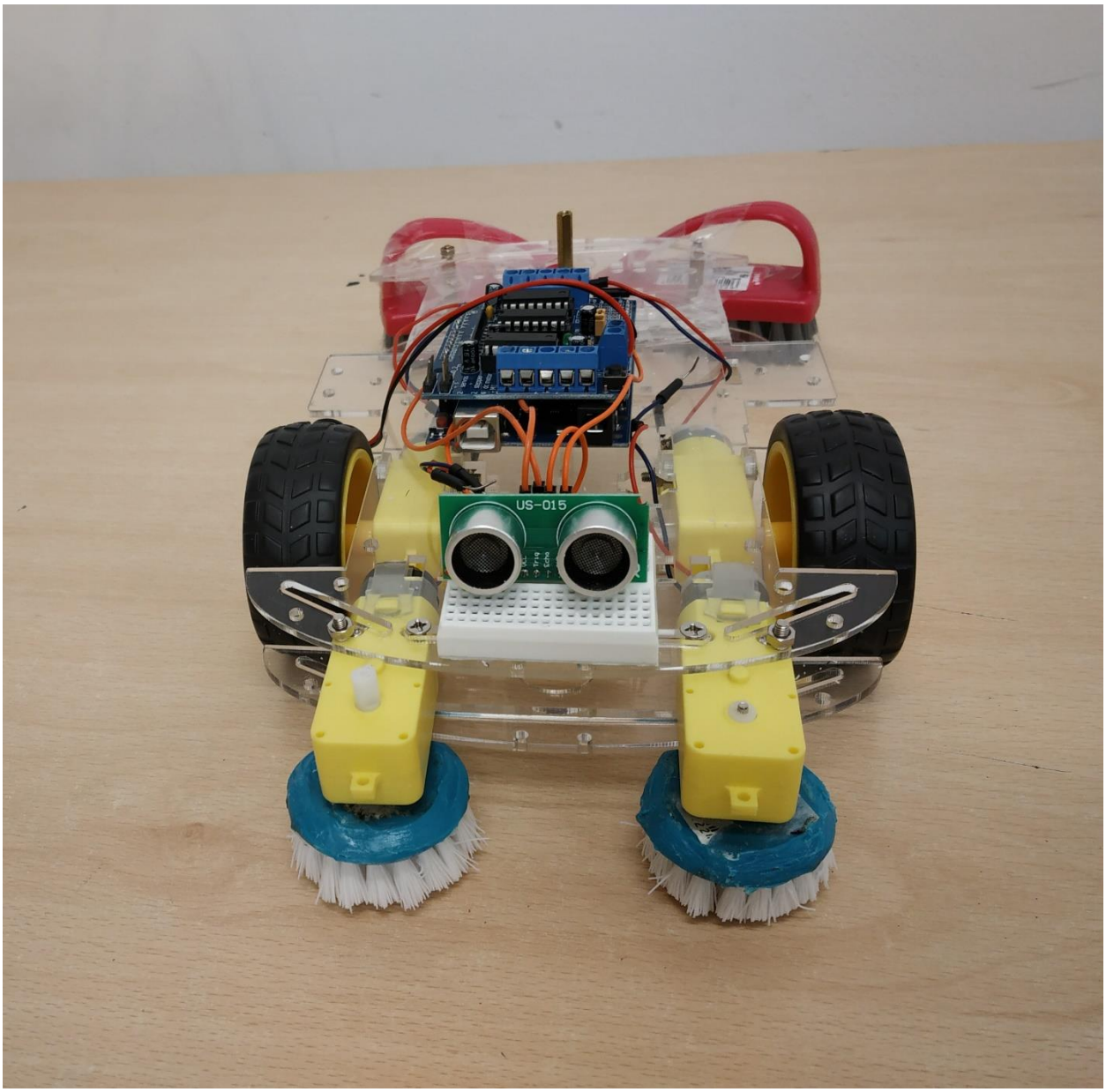
CONCLUSION:

This research facilitates efficient floor cleaning. Since in project the floor cleaner is incorporated with different devices like DC motor(s), ultrasonic sensors etc., so it will be easy to handle it also saves time and will work automatically for cleaning purpose at homes and offices at the same time cost efficient. With simple algorithm and program, the cleaner will be able to cover large floor areas as well as find its way into and out of small corners. As the cleaner traverses the room, the sweeper installed in it will manage to pick up a significant amount of dirt. Sweeping might not be that effective as it will not be picking up everything.

FUTURE SCOPE

In today's era, 95 percent of the cost of cleaning a floor is done by labor. the high cost of this simple task has inspired alternative solutions. We think Floor cleaning Robot will be one of them.

FINAL WORKING MODEL



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