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PROJECT REPORT

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HINDRANCE AVOIDANCE ROBOTS

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CERTIFICATE

We hereby certify that Project work entitled **'HINDRANCE AVOIDANCE ROBOTS'** submitted to the School of Computer Science and Engineering, VIT University, Vellore, is a record of the original work done by our team under the guidance of **Prof. Karthikeyan M.**

ACKNOWLEDGEMENT

We are thankful to and fortunate enough to get the constant encouragement, support and guidance from **Prof. Karthikeyan M** of SCOPE school which helped us in successfully completing our project work. We would like to extend our sincere esteems to our professor for the timely support which helped us in completion of this project.

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1. Abstract

The Hindrance Avoidance Robot is an intelligent machine that can detect and avoid obstacles in its path by rotating in a different direction. This design enables the robot to navigate in an unknown environment while avoiding collisions, which is a must for any autonomous mobile robot. The application of a hindrance avoidance robot is not restricted, and it is now utilised in almost every military organisation, assisting in the completion of numerous dangerous tasks that troops are unable to complete. By estimating the distance between the robot and the obstacle, an ultrasonic sensor is utilised to detect obstructions in the route.

2. Introduction

The computer world deserves to be classified as the most intelligent fields all around the universe when the human thinks that the world might completely work. Robotics is an interesting and fast-growing field. Being a branch of engineering, the applications of robotics are increasing with the advancement of technology. The concept of Mobile Robot is fast evolving and the number of mobile robots and their complexities are increasing with different applications. There are many types of mobile robot navigation techniques like path planning, self – localization and map interpreting. With respect to those presentations, Sony corporations presented an entertainment robot that kicks a ball by an interactive program in Delhi, 2004. It is obvious that the robot needs massive appreciations to discover ball location and to move towards it accordingly. The presentation even pointed that the robot can follow the new location of the ball in order to start new tracking under the robotic systems. The mobile robots are not wide spread due to their leisurely expanding and complexity of the applications. The creativity of the designed system shows that the robot can be controlled automatically or manually by a decision form the supervisor based on the android application.

3. Existing System

S.no	Topic	Author	Existing System
1.	Light Tracking Robot	By Mikaela Karlérus and Beata Törneman, Kth Royal Institute of Technology School of Industrial Engineering and Management	As the name suggests, this robot uses intensity, brightness, colour, wavelength and a suitable sensor would then be a sensor that reacts a lot to changes in one or several of these 2 aspects.
2.	Moving Object Tracking and its application to an Indoor Dual-Robot Patrol	By Cheng-Han Shih and Jih-Gau Juang * Department of Communications, Navigation and Control Engineering, National Taiwan Ocean University, Keelung 20224, Taiwan; 10267020@ntou.edu.tw	The objective of this study is to integrate image processing of hue, saturation, and lightness (HSL) for fuzzy color space, and use mean shift tracking for object detection and a Radio Frequency Identification (RFID) reader for confirming destination.
3.	Obstacle Avoiding Robot	By Faiza Tabassum, Susmita Lopa, Muhammad Masud Tarek & Dr. Bilkis Jamal Ferdosi	For obstacle detection, three ultrasonic distance sensors were used that provided a wider field of detection. The advantage of this type of sensor is that it is usually able to detect the obstacle at a distance ≥3 cm, something a vision sensor is not able to do.
4.	Comparison of edge detection methods for detection in a mobile robot environment	By Boris Crnokić, Snježana Rezić, Slaven Pehar University of Mostar, Faculty of Mechanical Engineering and Computing, Matice hrvatske bb, 88000, Mostar, BiH	Sobel, Prewitt, Roberts and Canny edge detection algorithms are implemented using MATLAB Simulink models by using Video and Image Processing Block sets. It allows the extraction and display of features such as curves, lines and angles for the purposes of identifying images from the environment. Images represented by edges are widely used to simplify the process of identifying and interpreting images to the navigation systems of mobile robots which use camera as primary sensor.
5.	Robot path planning with avoiding obstacles using free segments and turning points algorithm	By Cheng-Han Shih and Jih-Gau Juang * Department of Communications, Navigation and Control Engineering, National Taiwan Ocean University, Keelung 20224, Taiwan; 10267020@ntou.edu.tw	The aim of the developed strategy is to solve the problem when the robot is located between two obstacles, how the robot can detect that the distance between the two obstacles is safe enough to reach the target without collision and how to avoid obstacles and move between two obstacles in the shortest path.

4. Disadvantages of Existing System

- **Light Tracking Robot**, the major disadvantage of this system being that it is extremely ineffective in monochromatic surroundings and dimly lit surroundings. It relies heavily on the surrounding lighting conditions.

- **Moving Object Tracking and its application to an indoor dual-robot patrol**, the disadvantage of the proposed system is that the robots can only be applied to indoor service.

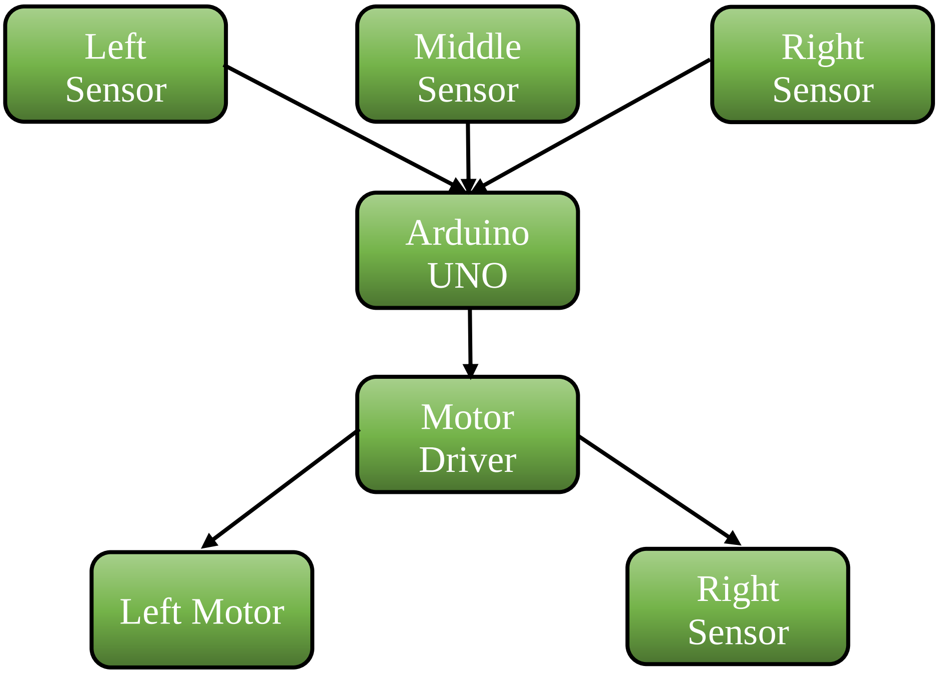
- **Obstacle Avoiding Robot**, the main weakness of this type of sensor is the interference between different sensors and the limited ability to identify the obstacle.

- **Comparison of edge detection methods for obstacles detection in a mobile robot environment**, a disadvantage with obstacle avoidance based on edge detecting is the need of the robot to stop in front of an obstacle in order to provide a more accurate measurement. If for some reason the quality of image decreases or there is noise in the pictures, the system is not able to define obstacles clearly. This can lead the robot to create a final image with more obstacles than there were originally.

- **Robot path planning with avoiding obstacles using free segments and turning points algorithm**, the disadvantages of this strategy are that it is focused firstly on finding the shortest path without taking into consideration the safety and, after that, it is focused on ensuring a safe path navigation which leads to an extensive and heavy computation and needs more time for planning the adequate path for a mobile robot.

5. Proposed System

The aim of this project is to implement an obstacle avoiding robot using ultrasonic sensor and Arduino. The basic principle behind the working of ultrasonic sensor is as follows: using an external trigger signal, the Trig pin on ultrasonic sensor is made logic high for at least 10µs. A sonic burst from the transmitter module is sent. This consists of 8 pulses of 40KHz.The signals return back after hitting a surface and the receiver detects this signal. The Echo pin is high from the time of sending the signal and receiving it. This time can be converted to distance using appropriate calculations. The Arduino is the main processing unit of the robot.



When the robot is powered on, both the motors of the robot will run normally and the robot moves forward. During this time, the ultrasonic sensor continuously calculates the distance between the robot and the reflective surface. This information is processed by the Arduino. This process continues forever and the robot keeps on moving without hitting any object.

5.1 Software & Components

a) Software Used

- Arduino IDE
- Proteus Software
- Arduino Libraries

b) Components used to build the circuit

- Arduino UNO
- Motor DC
- Motor Driver
- Virtual Terminal
- Ultrasonic Sensors
- AC Power
- Ground
- Wires for connecting the components

5.2 Methodology

Case 1: If distance between the middle sensor and the object is greater than max range then it moves forward irrespective of distance between the other two ultrasonic sensors and objects.

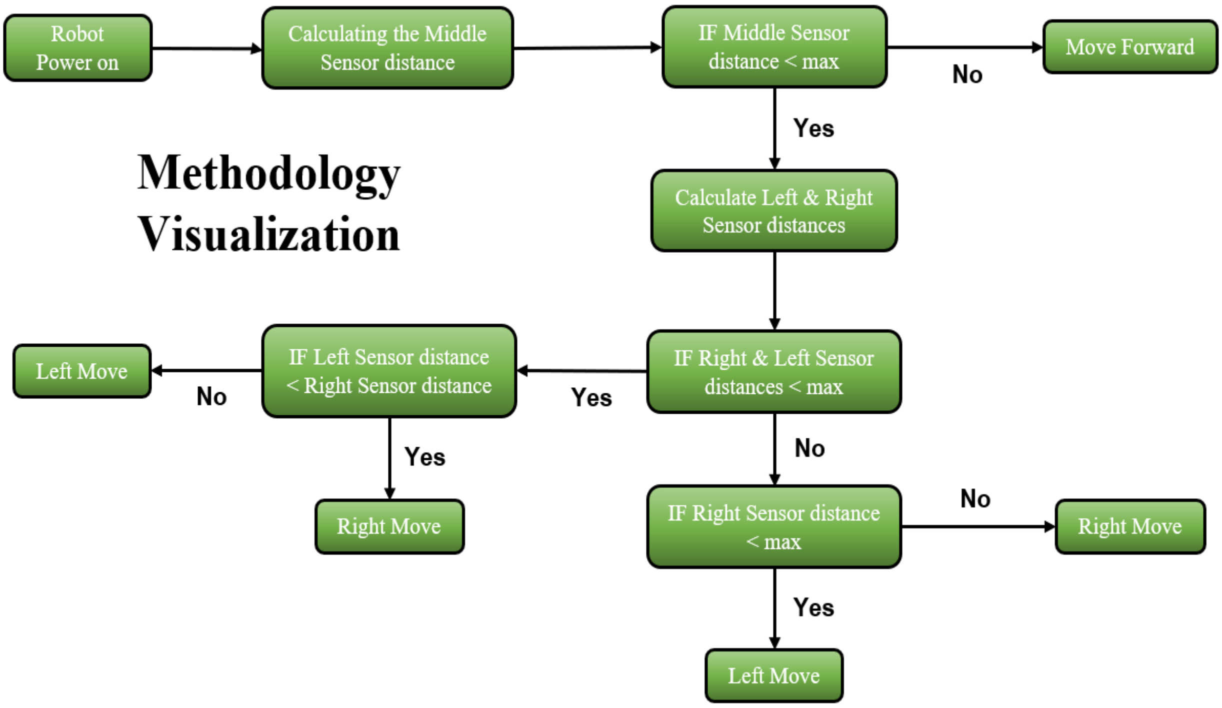
Case 2: If distance between right & middle sensor is less than max range and distance between left sensor and object is more then it moves left.

Case 3: If distance between left & middle sensor is less than max range and distance between right sensor and object is more then it moves right

Case 4: If all the sensors have less than max range then it checks which is greater in them

Case 5: If all the sensors have equal distances, then it stops.

5.3 Flowchart



5.4 Advantages

- Earlier the robot moved in all directions as per the commands given to it. Later it was identified that it got stuck when there is an unexpected hindrance in front of it. So, an extreme research work has been done and we came with the Hindrance Avoidance Arduino robots.

- These robots can be used in almost all mobile robot navigation systems. They can be used for household work like automatic vacuum cleaning. They can also be used in dangerous environments, where human penetration could be fatal.

- Locating objects becomes easy just by a sensor and without using any high-level techniques. These robots are used in dangerous environments where human penetration could be fatal. Common situations that employed resumed robots are mining accidents when disasters urban and hostage situations.

5.5 Arduino Code

```
#include <Servo.h>

int echoPinRight = 6;        // RIGHT SENSOR
int trigerPinRight = 7;
int echoPinMiddle = 8;        // MIDDLE SENSOR
int trigerPinMiddle = 9;
int echoPinLeft = 13;        // left sensor
int trigerPinLeft = 10;
int motorA1 = 2;            // MOTOR A1
int motorA2 = 3;            // MOTOR A2
int motorB1 = 4;            // MOTOR B1
int motorB2 = 5;            // MOTOR B1
const int motorSpeed = 11;
double echoValueright, echoValuemiddle, echoValueleft;

float cmRight, cmMiddle, cmLeft;
Servo myservo;
```

void setup()

```
{
  Serial.begin(9600);
  myservo.attach(12);
  pinMode(echoPinLeft, INPUT);
  pinMode(trigerPinLeft, OUTPUT);
  pinMode(echoPinMiddle, INPUT);
  pinMode(trigerPinMiddle, OUTPUT);
  pinMode(echoPinRight, INPUT);
  pinMode(trigerPinRight, OUTPUT);
  pinMode(motorSpeed, OUTPUT);
  pinMode(motorA1, OUTPUT);
  pinMode(motorA2, OUTPUT);
  pinMode(motorB1, OUTPUT);
  pinMode(motorB2, OUTPUT);

  }
```

void loop()

```
{
  float cmR, cmM, cmL;
  int maxRange = 50;
  analogWrite(motorSpeed, 90);
```

```
  digitalWrite(motorA1, HIGH);
  digitalWrite(motorA2, LOW);
  digitalWrite(motorB1, HIGH);
  digitalWrite(motorB2, LOW);
  cmR = sensorRight();
  cmM = sensorMiddle();
  cmL = sensorLeft();
   Serial.println();
   Serial.println("Distance from the object to each sensor");
  Serial.println();
  Serial.print(cmL);
  Serial.print("        ");
  Serial.print(cmM);
  Serial.print("        ");
  Serial.print(cmR);

   if ((cmM > maxRange) )
  {
    digitalWrite(motorA1,HIGH);
    digitalWrite(motorA2, HIGH);
    digitalWrite(motorB1, HIGH);
    digitalWrite(motorB2, HIGH);
    Serial.println();
    Serial.println("MOVE FORWARD");
  }

  if ((cmR < maxRange) && (cmL > maxRange) && (cmM < maxRange) )
  {
    digitalWrite(motorA1,LOW);
    digitalWrite(motorA2, HIGH);
    digitalWrite(motorB1, HIGH);
    digitalWrite(motorB2, LOW);
    Serial.println();
    Serial.println("MOVE LEFT");
  }

  else if ((cmR > maxRange) && (cmL < maxRange) && (cmM <
maxRange) )
  {
    digitalWrite(motorA1, HIGH);
    digitalWrite(motorA2, LOW);
    digitalWrite(motorB1, LOW);
    digitalWrite(motorB2, HIGH);
```

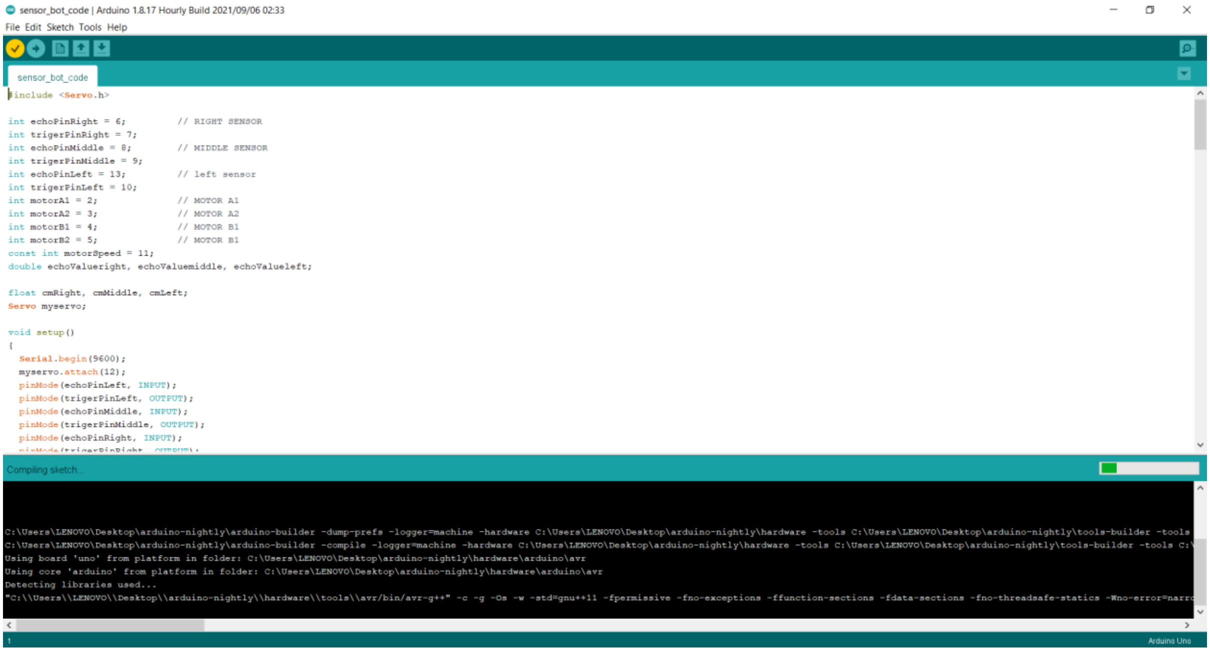
```
    Serial.println();
Serial.println("MOVE RIGHT");
  }

    else if ((cmR < maxRange) && (cmL < maxRange) && (cmM <
maxRange) )
  {
  if (cmR>cmL && cmR>cmM)
  {
     digitalWrite(motorA1, HIGH);
     digitalWrite(motorA2, LOW);
     digitalWrite(motorB1, LOW);
     digitalWrite(motorB2, HIGH);
      Serial.println();
Serial.println("MOVE RIGHT");
    }

   else if (cmR<cmL && cmL>cmM)
  {
     digitalWrite(motorA1, LOW);
     digitalWrite(motorA2, HIGH);
     digitalWrite(motorB1, HIGH);
     digitalWrite(motorB2, LOW);
      Serial.println();
   Serial.println("MOVE LEFT");
    }

    else if(cmM>cmR && cmM>cmL)
    {
     digitalWrite(motorA1, HIGH);
     digitalWrite(motorA2, HIGH);
     digitalWrite(motorB1, HIGH);
     digitalWrite(motorB2, HIGH);
      Serial.println();
    Serial.println("MOVE FORWARD");
    }

    else if (cmM == cmR == cmL )
     {
     digitalWrite(motorA1, LOW);
     digitalWrite(motorA2, LOW);
     digitalWrite(motorB1, LOW);
     digitalWrite(motorB2, LOW);
```

```
      Serial.println();
   Serial.println("STOP");
    }
    }

     else if ((cmR > maxRange) && (cmL > maxRange) && (cmM <
maxRange) )
  {
     if (cmL > cmR)
    {
      digitalWrite(motorA1, LOW);
      digitalWrite(motorA2, HIGH);
      digitalWrite(motorB1, HIGH);
      digitalWrite(motorB2, LOW);
      Serial.println();
Serial.println("MOVE LEFT");
    }

    else if (cmR > cmL)
    {
      digitalWrite(motorA1, HIGH);
      digitalWrite(motorA2, LOW);
      digitalWrite(motorB1, LOW);
      digitalWrite(motorB2, HIGH);
           Serial.println();
Serial.println("MOVE RIGHT");
    }
    }
  delay(2000);
}

float sensorRight()
{
  digitalWrite(trigerPinRight, LOW);
  delayMicroseconds(2);
  digitalWrite(trigerPinRight, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigerPinRight, LOW);
  echoValueright = pulseIn(echoPinRight, HIGH);
  cmRight = echoValueright / 650;
  //inchesRight=cmRight/2.54;
  //Serial.print(cmRight);
  return (cmRight);
```

```
}

float sensorMiddle()
{
  digitalWrite(trigerPinMiddle, LOW);
  delayMicroseconds(2);
  digitalWrite(trigerPinMiddle, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigerPinMiddle, LOW);
  echoValuemiddle = pulseIn(echoPinMiddle, HIGH);
  cmMiddle = echoValuemiddle / 650;

  //inchesMiddle=cmMiddle/2.54;
  //Serial.print(cmMiddle);
  return (cmMiddle);
}

float sensorLeft()
{
  digitalWrite(trigerPinLeft, LOW);
  delayMicroseconds(2);
  digitalWrite(trigerPinLeft, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigerPinLeft, LOW);
  echoValueleft = pulseIn(echoPinLeft, HIGH);
  cmLeft = echoValueleft / 650;
  //inchesLeft=cmLeft/2.54;
  //Serial.print(cmLeft);
  return (cmLeft);
}
```

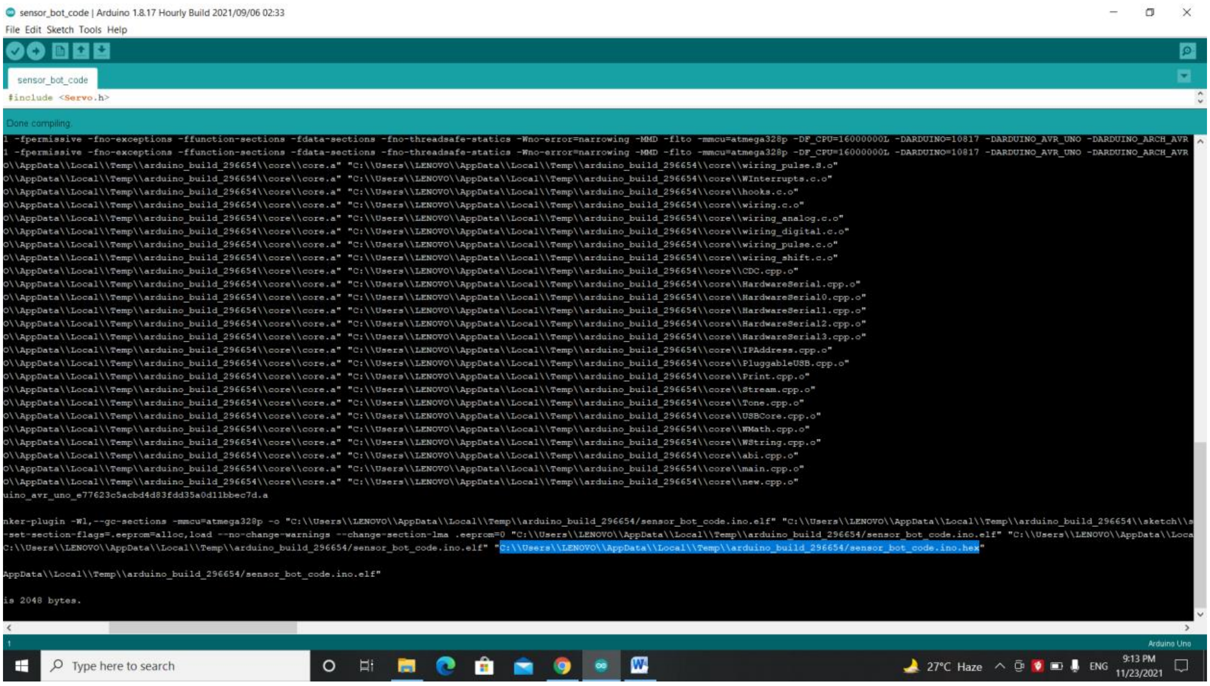
6. Results & Discussions

a) Compilation of Arduino Code

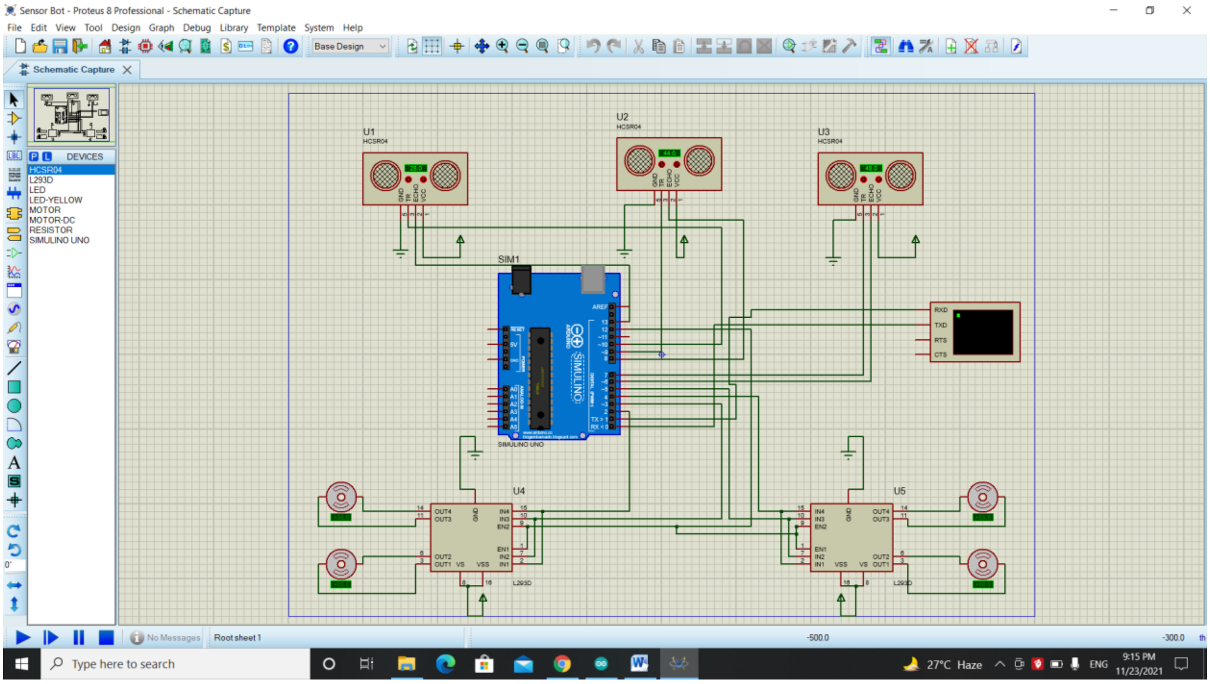


b) The Hex code generation

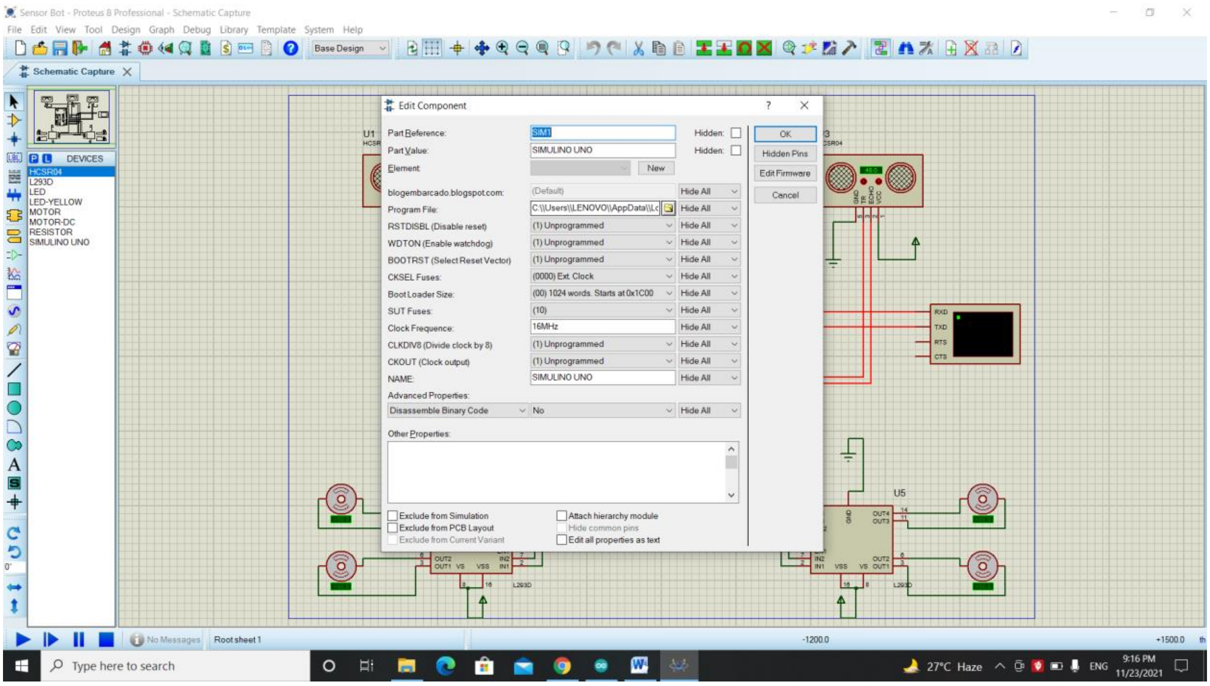
(C:\\Users\\LENOVO\\AppData\\Local\\Temp\\arduino_build_296654/sensor_bot_code.ino.hex)



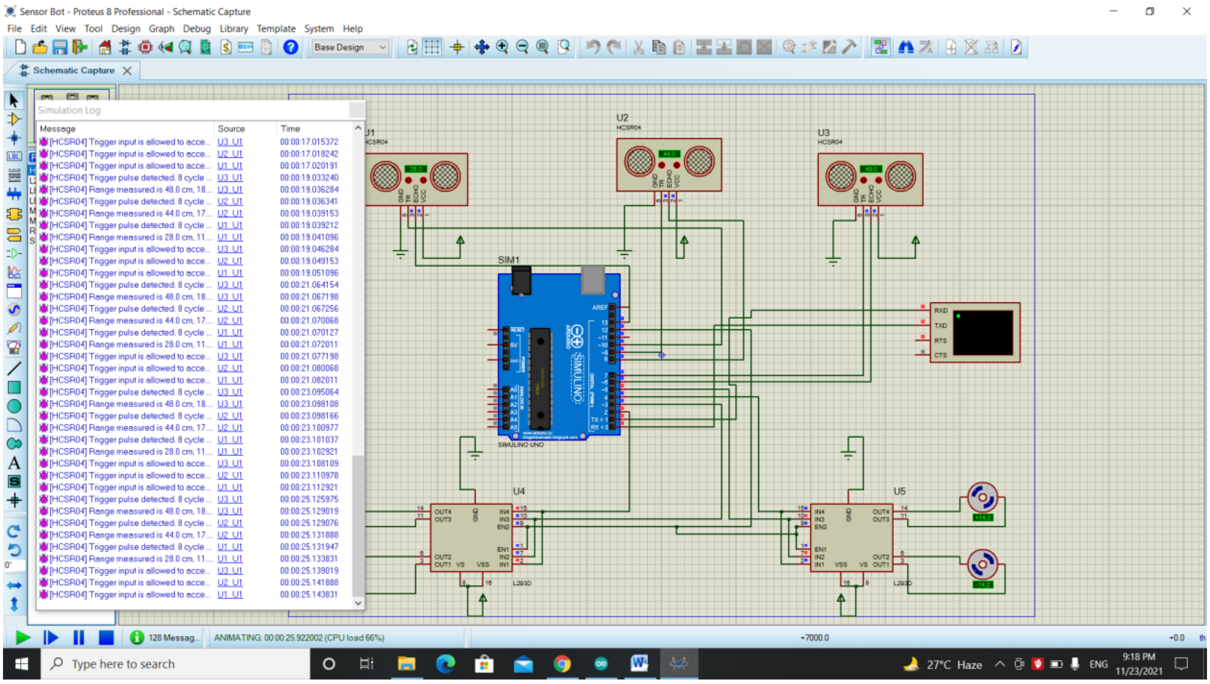
c) Circuit diagram



d) Setting up the connection using the Hex code

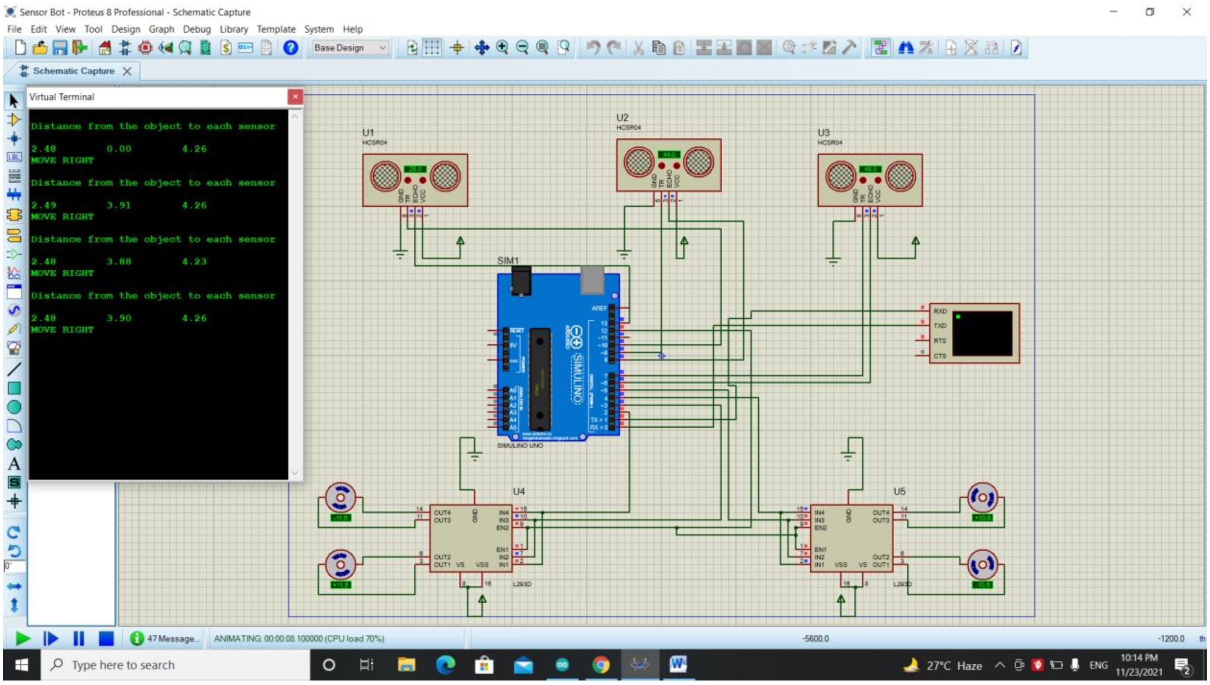


e) Simulation log

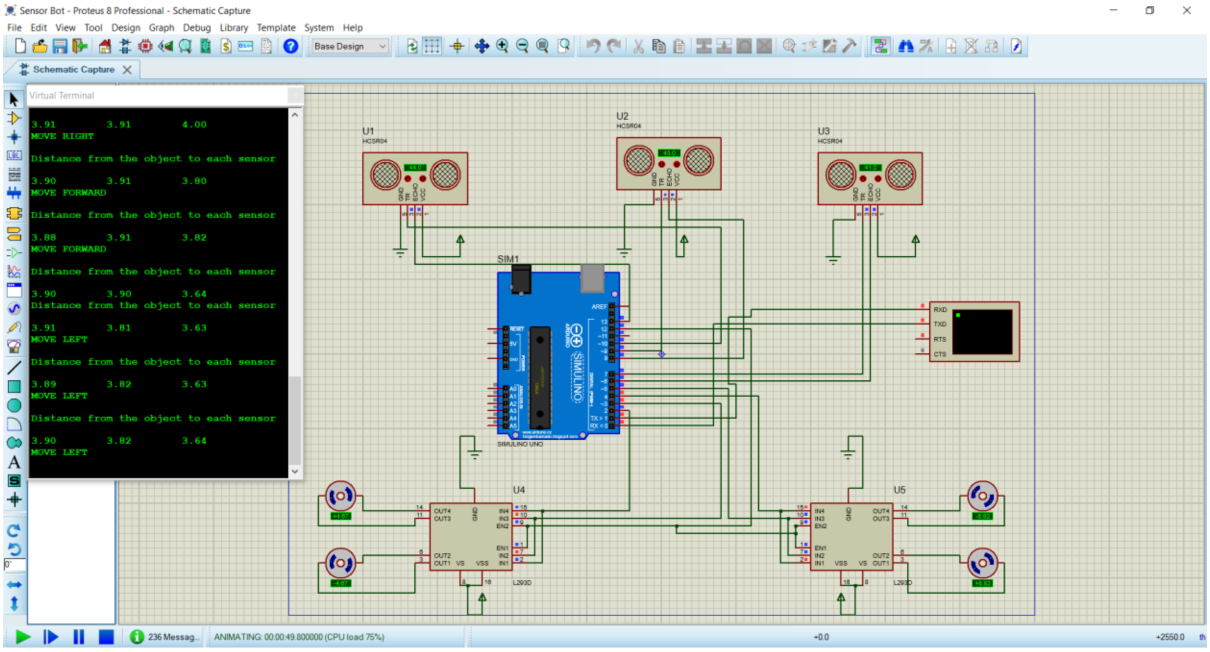


f) Checking the conditions

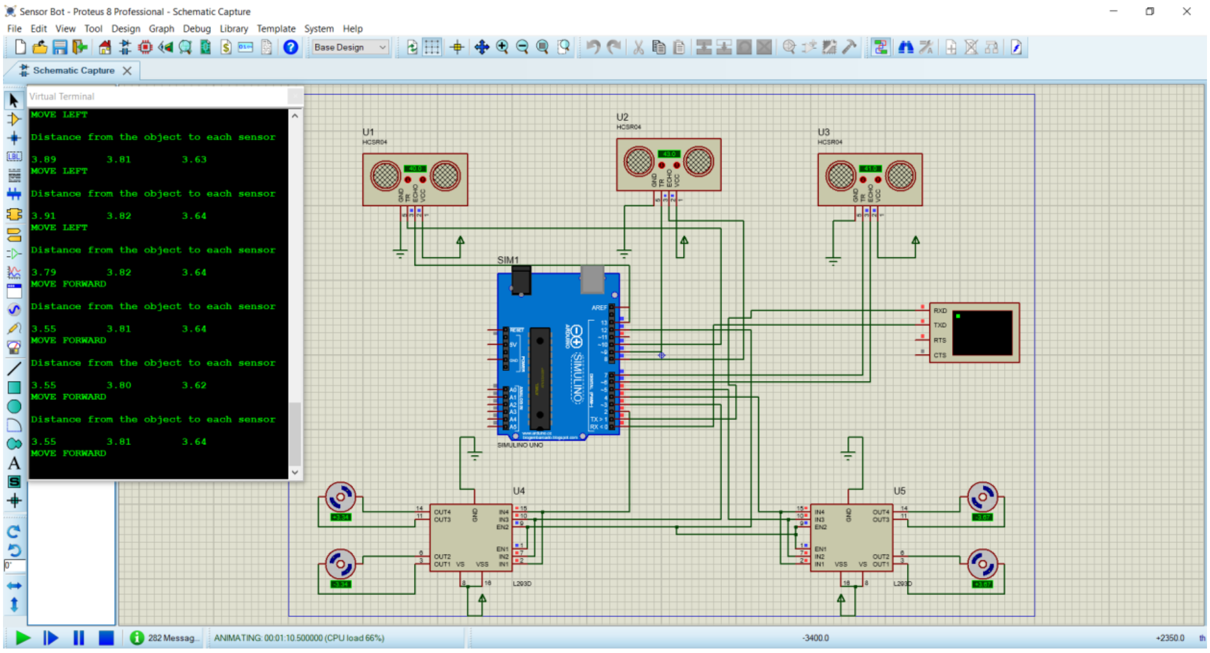
- When the Robot moves right



- When the Robot moves left



- When the Robot moves forward



7. Conclusion

The necessity to use navigation has increased recently while such a technique needs to avoid the obstacles that might be faced. Hereby, the importance of the hindrance avoidance strategy is emerged clearly. The applications of the hindrance avoidance robots are wide spread in various fields. Theses robots can be implemented in major applications such as inside the house as a service robot, hindrance avoidance robot, reconfigurable manufacturing systems, and so many serious scientific applications such as sending the robot to some risky places that human being cannot reach. The proposed hindrance avoidance robot entered those applications majorly due to the endless effort performed to collect the required information about the environment to get rid of the obstructions. As an example, the most appropriate field that such a robotic system can be applied is the reconfigurable manufacturing systems specially the part that manufactures car bodies by using an autonomous system to detect the touched part by the ultrasonic and apply the tasks on the section. Finally, most of the researchers are convinced that the other face of the proposed robotic system which is named as anti- collision or hindrance avoidance is going to be included in major applications in the future.

8. References

[1] Najia Manjur, Minhajul Arifin, Rehennuma Islam,: India, IEEE, pp: 983 - 987, 2017. "Light following & obstacle avoiding robot using autonomous & android based manual controller" 18th International Conference on Computer and Information Technology(ICCIT),DHAKA,Bangladesh,IEEE,pp:511-515-2015.

[2] Md Sayedul Aman, Md Anam Mahmud, Haowen Jiang, Ahmed Abdelgawad, Kumar Yelamarthi,: "A sensor fusion methodology for obstacle avoidance robot" IEEE International Conference on Electro Information Technology (EIT), Grand Forks, ND, USA, IEEE, pp: 0458 - 0463, 2016.

[3] N Poornima Varma, A Vivek, V Ravikumar Pandi,: "Target tracking, path planning and obstacle avoidance by intelligent robot" International Conference on Technological Advancements in Power and Energy (TAP Energy), Kollam, India, India, IEEE, pp: 1 - 6, 2017.

[4] Sofiane Tchoketch Kebir, Mounir Bouhedda, Slimane Mekaoui, Mohamed Guesmi, Abderrahim Douakh,: "Gesture control of mobile robot based arduino microcontroller" 8th International Conference on Modelling, Identification and Control (ICMIC), Algiers Algeria, IEEE, pp: 1081 - 1085, 2016.

[5] Yusuf Abdullahi Badamasi;: "The working principle of an Arduino" 11th International Conference on Electronics, Computer and Computation (ICECCO), Abuja, Nigeria, IEEE, pp: 1 – 4, 2014.

[6] I.G.A.P. Raka Agung, S. Huda, I.W. Arta Wijaya,: "Speed control for DC motor with pulse width modulation (PWM) method using infrared remote control based on A Tmega16 microcontroller" International Conference on Smart Green Technology in Electrical and Information Systems (ICSGTEIS), Kuta, Indonesia, IEEE, pp: 108 - 112, 2014.

[7] Kittipat Khreasarn, Kittikorn Hantrakul,: "Automatic gate using Bluetooth technology (Open the gate with the strength of the Bluetooth signal on the smartphone)" International Conference on Digital Arts, Media and Technology (ICDAMT), Phayao, Thailand, IEEE, pp: 54 - 58, 2018.

[8] Antonio Tedeschi, Stefano Calcaterra, Francesco Benedetto,: "Ultrasonic RAdar System (URAS): Arduino and Virtual Reality for a Light-Free Mapping of Indoor Environments" Sensors Journal, IEEE Sensors Council, IEEE, pp: 4595 - 4604, Volume: 17, Issue: 14, July15, 15 2017.