AUTONOMOUS CAR

by

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A project report submitted to

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School of Electronics Engineering (SENSE),
in partial fulfilment of the requirements for the course of

CSE2006 – MICROPROCESSOR AND INTERFACING

in

B. TECH COMPUTER SCIENCE ARTIFICIAL INTELLIGENCE AND ROBOTICS

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Vandalur – Kelambakkam Road

Chennai – 600127

APRIL 2020

BONAFIDE CERTIFICATE

Certified that this project report entitled "**Autonomous car"** is a bonafide work of **Abraham – 20BRS1119, Harsh -20BRS1197 and Sarath-20BRS1194** who carried out the Project work under my supervision and guidance for **CSE2006 MICROPROCESSOR AND INTERFACING.**

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ABSTRACT

One of the most difficult problems in autonomous car is figuring out how to get the car to move around the environment without getting stuck by other objects. Thus, using real-time ultrasonic sensors to build a system with the best and improved obstacle detection helping the autonomous car to go through unknown terrains without getting hit or stuck by obstacles. The main goal is to create an autonomous car navigation system based on the distance between the car and the obstacle and using several open-source map creation and path finding technologies. Therefore, in this project an obstacle avoiding autonomous car is designed which can detect obstacles in its path and manoeuvre around them without making any collision. Being a fully autonomous car, it successfully manoeuvred in unknown environments without any collision. The hardware used in this project is widely available and inexpensive which makes the robot easily replicable.

ACKNOWLEDGEMENT

We wish to express our sincere thanks and deep sense of gratitude to our project guide, **Dr.** Muthulakshmi S**,** Associate Professor, School of Electronics Engineering, for her consistent encouragement and valuable guidance offered to us in a pleasant manner throughout the course of the project work.

We are extremely grateful to **Dr. Ganesan R** **,** Professor and Dean, VIT Chennai, for extending the facilities of the School towards our project and for his unstinting support. We express our thanks to our Head of the Department **Dr. Rekha D** for her support throughout the course of this project.

We also take this opportunity to thank all the faculty of the School for their support and their wisdom imparted to us throughout the course.

We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution.

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INTRODUCTION

1.1 OBJECTIVES AND GOALS

An autonomous car is a vehicle capable of sensing its environment and operating without human involvement. Any type of human intervention is not required to take control of the vehicle at any time. An autonomous car can go anywhere a traditional car goes and perform on par with an experienced human driver.

1.2 APPLICATIONS

Robotaxis, Shuttles, and Delivery Vehicles. ...

Trucking

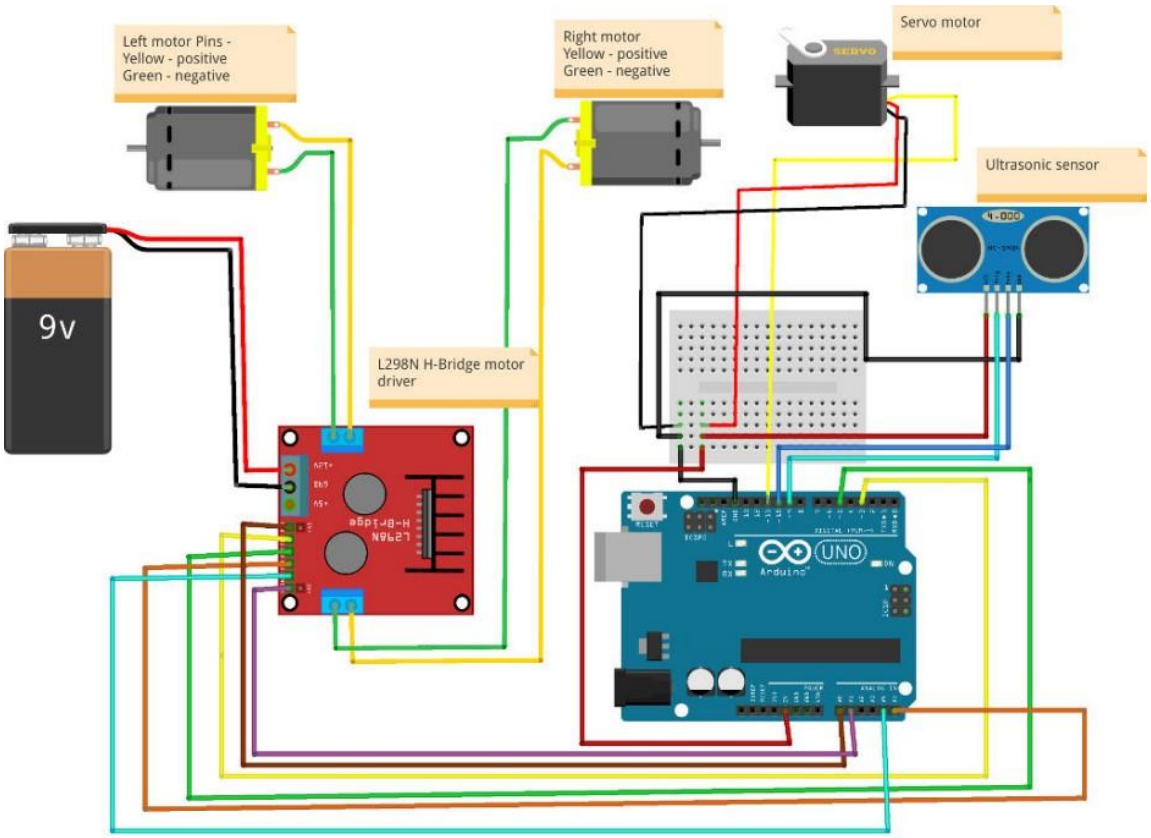
Logistics

Heavy Machinery

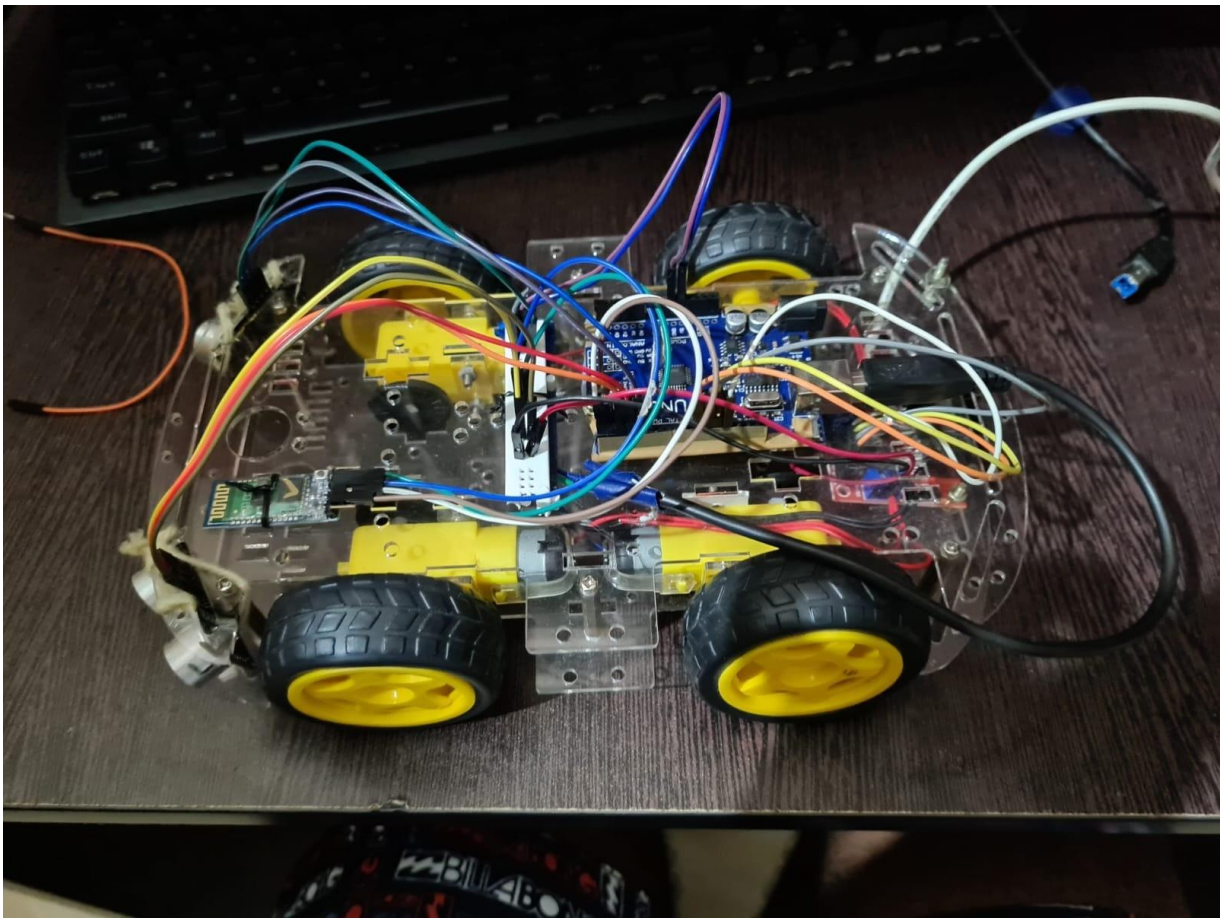
1.3 FEATURES

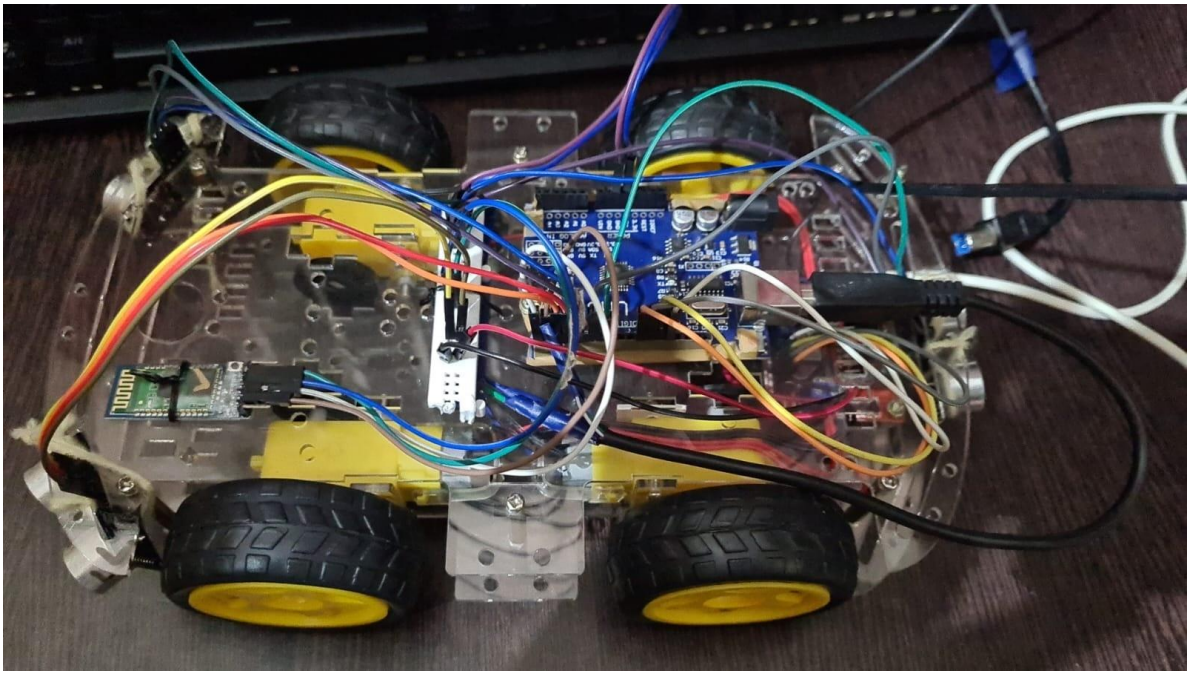
Decreased the number of accidents
Lessens traffic jams
Stress-free parking
Time-saving vehicle
Accessibility to transportation

BLOCK DIAGRAM



HARDWARE ANALYSIS





SOFTWARE –CODING AND ANALYSIS

```
char t;
#define echoPinL 2 // attach pin D2 Arduino to pin Echo of HC-SR04
#define trigPinL 3 //attach pin D3 Arduino to pin Trig of HC-SR04
#define echoPinR 4 // attach pin D4 Arduino to pin Echo of HC-SR04
#define trigPinR 5 //attach pin D5 Arduino to pin Trig of HC-SR04
#define echoPinB 6 // attach pin D6 Arduino to pin Echo of HC-SR04
#define trigPinB 7 //attach pin D7 Arduino to pin Trig of HC-SR04
#define echoPinF 8 // attach pin D8 Arduino to pin Echo of HC-SR04
#define trigPinF 9 //attach pin D9 Arduino to pin Trig of HC-SR04

// defines variables
long duration1; // variable for the duration of sound wave travel
int distance1; // variable for the distance measurement

long duration2; // variable for the duration of sound wave travel
int distance2; // variable for the distance measurement

long duration3; // variable for the duration of sound wave travel
int distance3; // variable for the distance measurement

long duration0; // variable for the duration of sound wave travel
int distance0; // variable for the distance measurement
```

```
void setup() {
  pinMode(trigPinF, OUTPUT); // Sets the trigPinF as an OUTPUT
  pinMode(echoPinF, INPUT); // Sets the echoPinF as an INPUT
  pinMode(trigPinL, OUTPUT); // Sets the trigPinL as an OUTPUT
  pinMode(echoPinL, INPUT); // Sets the echoPinL as an INPUT
  pinMode(trigPinR, OUTPUT); // Sets the trigPinR as an OUTPUT
  pinMode(echoPinR, INPUT); // Sets the echoPinR as an INPUT
  pinMode(trigPinB, OUTPUT); // Sets the trigPinB as an OUTPUT
  pinMode(echoPinB, INPUT); // Sets the echoPinB as an INPUT
  pinMode(13,OUTPUT);   //left motors forward
  pinMode(12,OUTPUT);   //left motors reverse
  pinMode(11,OUTPUT);   //right motors forward
  pinMode(10,OUTPUT);   //right motors reverse
  pinMode(9,OUTPUT);   //Led
  Serial.begin(9600);
}

void _stop(){
  digitalWrite(13,LOW);
  digitalWrite(12,LOW);
  digitalWrite(11,LOW);
  digitalWrite(10,LOW);
}
```

```
void forward(){
  digitalWrite(11, LOW);
  digitalWrite(13, LOW);
  digitalWrite(12,HIGH);
  digitalWrite(10,HIGH);
}
void backward(){
  digitalWrite(13,HIGH);
  digitalWrite(11,HIGH);
}
void left(){
  digitalWrite(11, LOW);
  digitalWrite(12, LOW);
  digitalWrite(10, LOW);
  digitalWrite(13,HIGH);
  delay(0);
}
void right(){
  digitalWrite(13, LOW);
  digitalWrite(12, LOW);
  digitalWrite(10, LOW);
  digitalWrite(11,HIGH);
  delay(0);
}
```

```
void autonomousMode(){
//  Serial.print("\nDistL: ");
//  Serial.print(distance1);
//  Serial.print("\nDistR: ");
//  Serial.print(distance2);
  if(distance0 > 8 && distance1 > 10 && distance2 > 10 && distance3 > 10){
    forward();
    Serial.println("\nforward\n");
  }
  else if(distance1 < 10 && distance2 > 10){
    left();
    Serial.println("\nright\n");
  }
  else if(distance2 < 10 && distance1 > 10){
    right();
    Serial.println("\nleft\n");
  }
  else if(distance1 < 10 && distance2 < 10 && distance3 > 10){
    backward();
    Serial.println("\nback\n");
  }
  else if(distance0 < 8 || distance1 < 10 && distance2 < 10 && distance3 < 10){
    _stop();
```

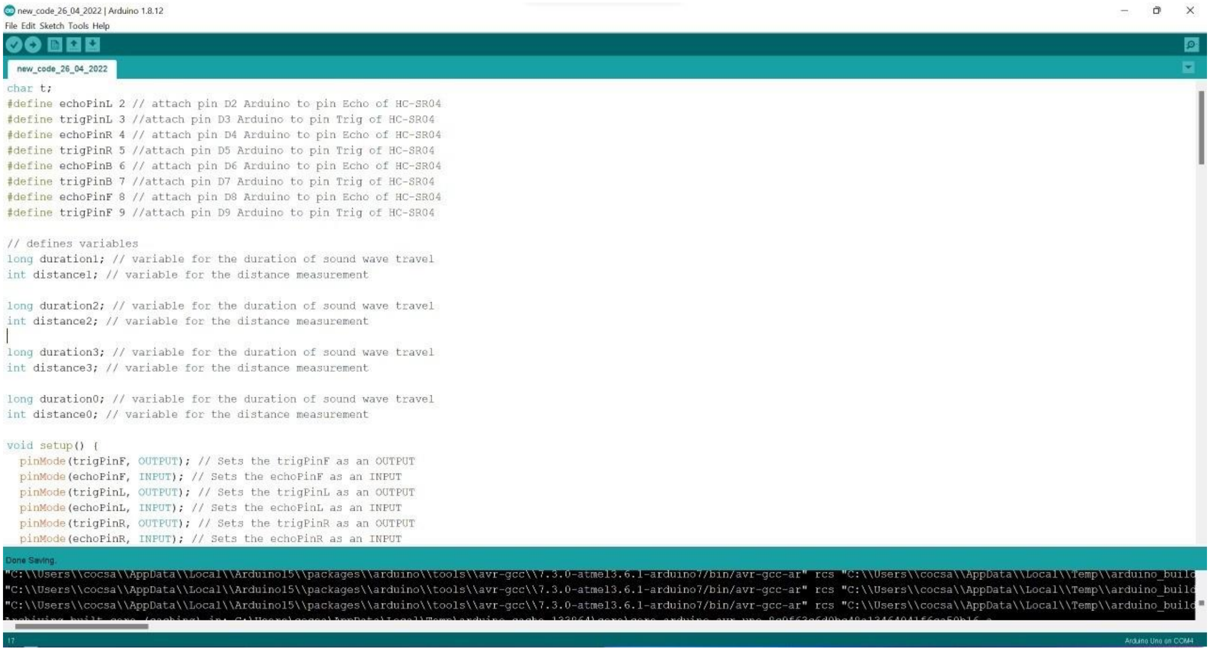
```
    Serial.println("\nstop\n");
  }
}

void loop() {
  digitalWrite(trigPinF, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinF, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinF, LOW);
  duration0 = pulseIn(echoPinF, HIGH);
  distance0 = duration0 * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)

  digitalWrite(trigPinL, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinL, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinL, LOW);
  duration1 = pulseIn(echoPinL, HIGH);
  distance1 = duration1 * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)

  digitalWrite(trigPinR, LOW);
  delayMicroseconds(2);
```

```
  digitalWrite(trigPinR, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinR, LOW);
  duration2 = pulseIn(echoPinR, HIGH);
  distance2 = duration2 * 0.034 / 2;

  digitalWrite(trigPinB, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinB, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinB, LOW);
  duration3 = pulseIn(echoPinB, HIGH);
  distance3 = duration3 * 0.034 / 2;

//  Serial.print("\nDistL: ");
//  Serial.print(distance1);
//  Serial.print("\nDistR: ");
//  Serial.print(distance2);
//  Serial.print("\nDistB: ");
//  Serial.print(distance3);

  if(Serial.available()){
    t = Serial.read();
    Serial.println(t);
```

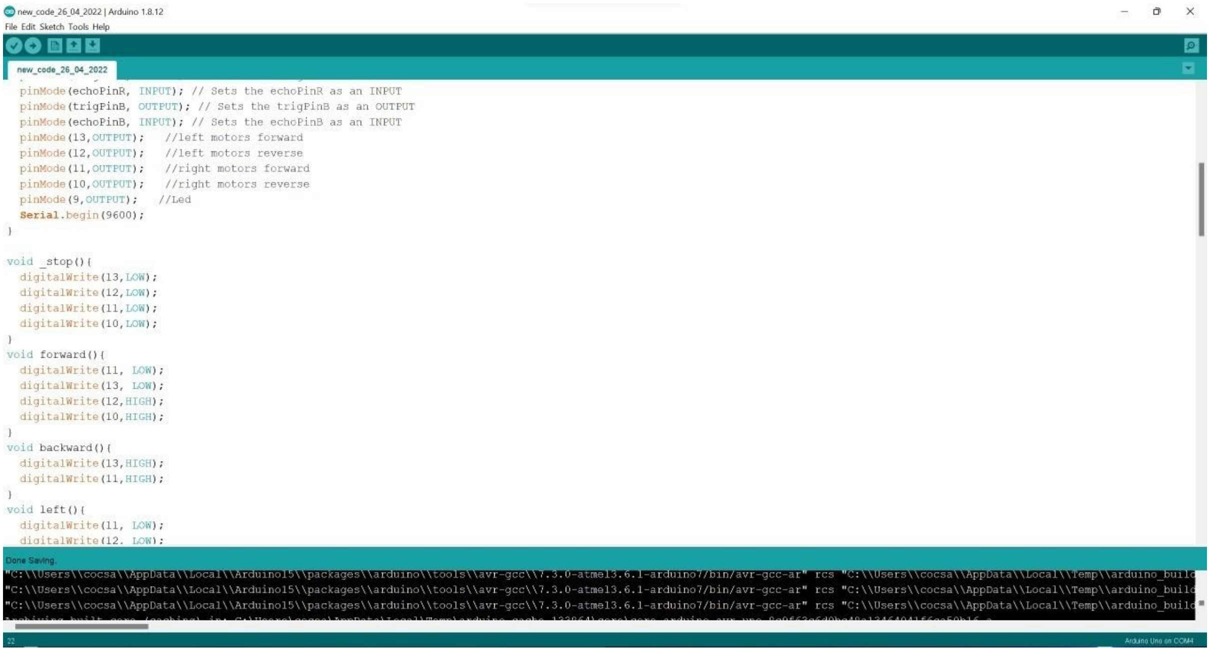
```
  }


  if(t != 'A'){
    _stop();
    if(distance0 > 8 && distance1 > 8 && distance2 > 8 && distance3 > 10){
      if(t == 'F'){            //move forward(all motors rotate in forward direction)
      forward();
      }
      else if(t == 'B'){      //move reverse (all motors rotate in reverse direction)
        backward();
      }
      else if(t == 'L'){      //turn right (left side motors rotate in forward direction, right side motors doesn't rotate)
        right();
      }
      else if(t == 'R'){      //turn left (right side motors rotate in forward direction, left side motors doesn't rotate)
        left();
      }
      else if(t == 'S'){      //STOP (all motors stop)
        _stop();
      }
    }
    else {
      if(distance3 > 10 && t == 'B'){
```

```
      backward();
    }
    else if(distance0 > 8 && distance1 > 8 && distance2 > 8 && t == 'F'){
      forward();
    }
    else {
      _stop();
    }
   }
  }
  else if(t == 'A'){
   autonomousMode();
  }
  delay(5);
}
```

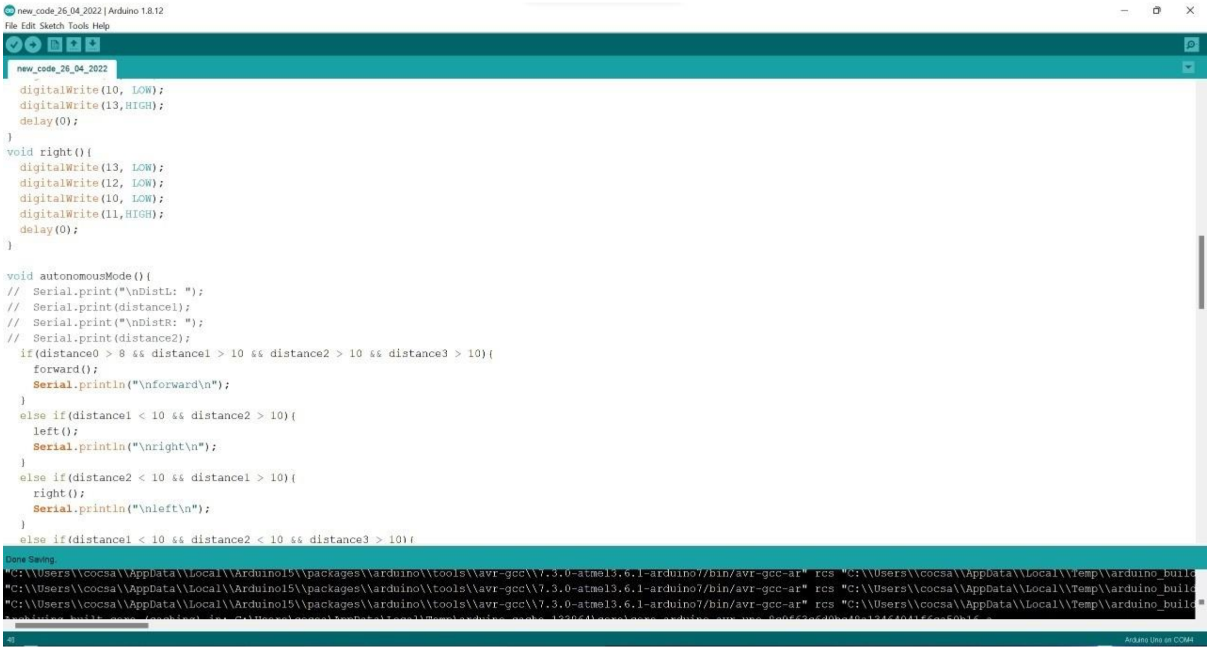
SNAPSHOTS OF CODING AND RESULTS



```
char t;
#define echoPinL 2 // attach pin D2 Arduino to pin Echo of HC-SR04
#define trigPinL 3 //attach pin D3 Arduino to pin Trig of HC-SR04
#define echoPinR 4 // attach pin D4 Arduino to pin Echo of HC-SR04
#define trigPinR 5 //attach pin D5 Arduino to pin Trig of HC-SR04
#define echoPinB 6 // attach pin D6 Arduino to pin Echo of HC-SR04
#define trigPinB 7 //attach pin D7 Arduino to pin Trig of HC-SR04
#define echoPinF 8 // attach pin D8 Arduino to pin Echo of HC-SR04
#define trigPinF 9 //attach pin D9 Arduino to pin Trig of HC-SR04

// defines variables
long duration1; // variable for the duration of sound wave travel
int distance1; // variable for the distance measurement

long duration2; // variable for the duration of sound wave travel
int distance2; // variable for the distance measurement

long duration3; // variable for the duration of sound wave travel
int distance3; // variable for the distance measurement

long duration0; // variable for the duration of sound wave travel
int distance0; // variable for the distance measurement

void setup() {
  pinMode(trigPinF, OUTPUT); // Sets the trigPinF as an OUTPUT
  pinMode(echoPinF, INPUT); // Sets the echoPinF as an INPUT
  pinMode(trigPinL, OUTPUT); // Sets the trigPinL as an OUTPUT
  pinMode(echoPinL, INPUT); // Sets the echoPinL as an INPUT
  pinMode(trigPinR, OUTPUT); // Sets the trigPinR as an OUTPUT
  pinMode(echoPinR, INPUT); // Sets the echoPinR as an INPUT
```

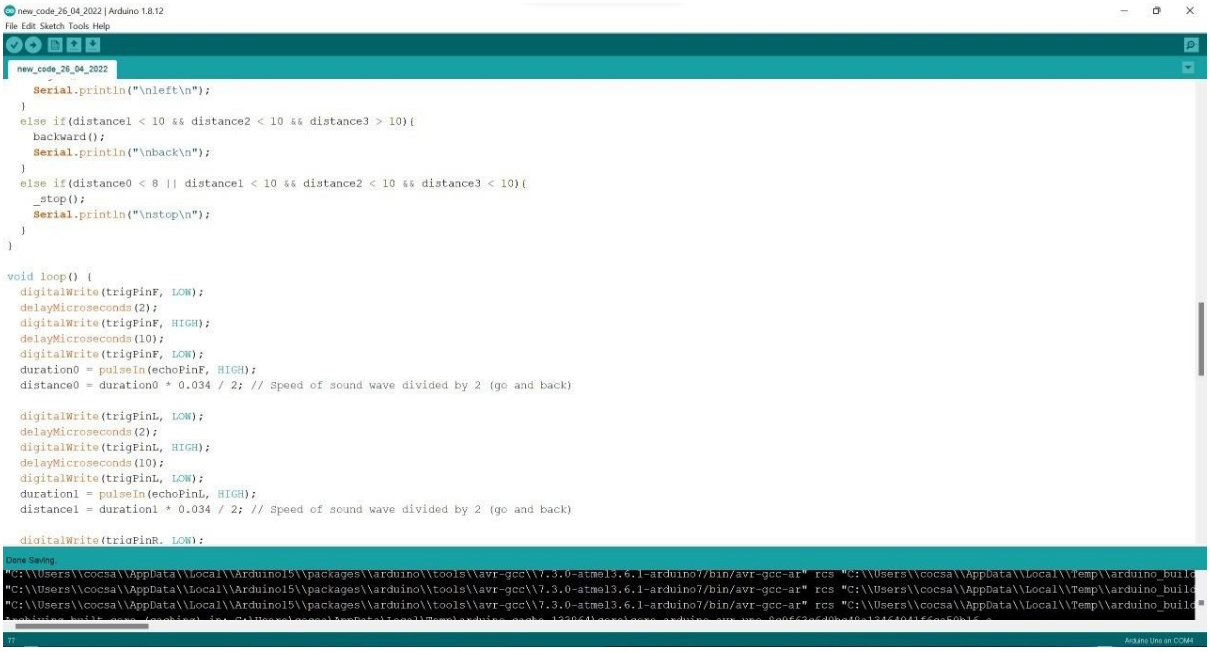



```
  pinMode(echoPinR, INPUT); // Sets the echoPinR as an INPUT
  pinMode(trigPinB, OUTPUT); // Sets the trigPinB as an OUTPUT
  pinMode(echoPinB, INPUT); // Sets the echoPinB as an INPUT
  pinMode(13,OUTPUT);   //left motors forward
  pinMode(12,OUTPUT);   //left motors reverse
  pinMode(11,OUTPUT);   //right motors forward
  pinMode(10,OUTPUT);   //right motors reverse
  pinMode(9,OUTPUT);   //Led
  Serial.begin(9600);
}

void _stop(){
  digitalWrite(13,LOW);
  digitalWrite(12,LOW);
  digitalWrite(11,LOW);
  digitalWrite(10,LOW);
}
void forward(){
  digitalWrite(11, LOW);
  digitalWrite(13, LOW);
  digitalWrite(12,HIGH);
  digitalWrite(10,HIGH);
}
void backward(){
  digitalWrite(13,HIGH);
  digitalWrite(11,HIGH);
}
void left(){
  digitalWrite(11, LOW);
  digitalWrite(12, LOW);
```




```
  digitalWrite(10, LOW);
  digitalWrite(13,HIGH);
  delay(0);
}
void right(){
  digitalWrite(13, LOW);
  digitalWrite(12, LOW);
  digitalWrite(10, LOW);
  digitalWrite(11,HIGH);
  delay(0);
}

void autonomousMode(){
//  Serial.print("\nDistL: ");
//  Serial.print(distance1);
//  Serial.print("\nDistR: ");
//  Serial.print(distance2);
  if(distance0 > 8 && distance1 > 10 && distance2 > 10 && distance3 > 10){
    forward();
    Serial.println("\nforward\n");
  }
  else if(distance1 < 10 && distance2 > 10){
    left();
    Serial.println("\nright\n");
  }
  else if(distance2 < 10 && distance1 > 10){
    right();
    Serial.println("\nleft\n");
  }
  else if(distance1 < 10 && distance2 < 10 && distance3 > 10){
```

```
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
```




```
    Serial.println("\nleft\n");
  }
  else if(distance1 < 10 && distance2 < 10 && distance3 > 10){
    backward();
    Serial.println("\nback\n");
  }
  else if(distance0 < 8 || distance1 < 10 && distance2 < 10 && distance3 < 10){
    _stop();
    Serial.println("\nstop\n");
  }
}

void loop() {
  digitalWrite(trigPinF, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinF, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinF, LOW);
  duration0 = pulseIn(echoPinF, HIGH);
  distance0 = duration0 * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)

  digitalWrite(trigPinL, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinL, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinL, LOW);
  duration1 = pulseIn(echoPinL, HIGH);
  distance1 = duration1 * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)

  digitalWrite(trigPinR, LOW);
```

```
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
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"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
```

new_code_26_04_2022 | Arduino 1.8.12

File Edit Sketch Tools Help

new_code_26_04_2022

```
  digitalWrite(trigPinR, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinR, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinR, LOW);
  duration2 = pulseIn(echoPinR, HIGH);
  distance2 = duration2 * 0.034 / 2;

  digitalWrite(trigPinB, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPinB, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPinB, LOW);
  duration3 = pulseIn(echoPinB, HIGH);
  distance3 = duration3 * 0.034 / 2;

//  Serial.print("\nDistL: ");
//  Serial.print(distance1);
//  Serial.print("\nDistR: ");
//  Serial.print(distance2);
//  Serial.print("\nDistB: ");
//  Serial.print(distance3);

  if(Serial.available()){
    t = Serial.read();
    Serial.println(t);
  }

  if(t != 'A'){
     stop();
```

Done Saving.

```
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
```

128 Arduino Uno on COM4

new_code_26_04_2022 | Arduino 1.8.12

File Edit Sketch Tools Help

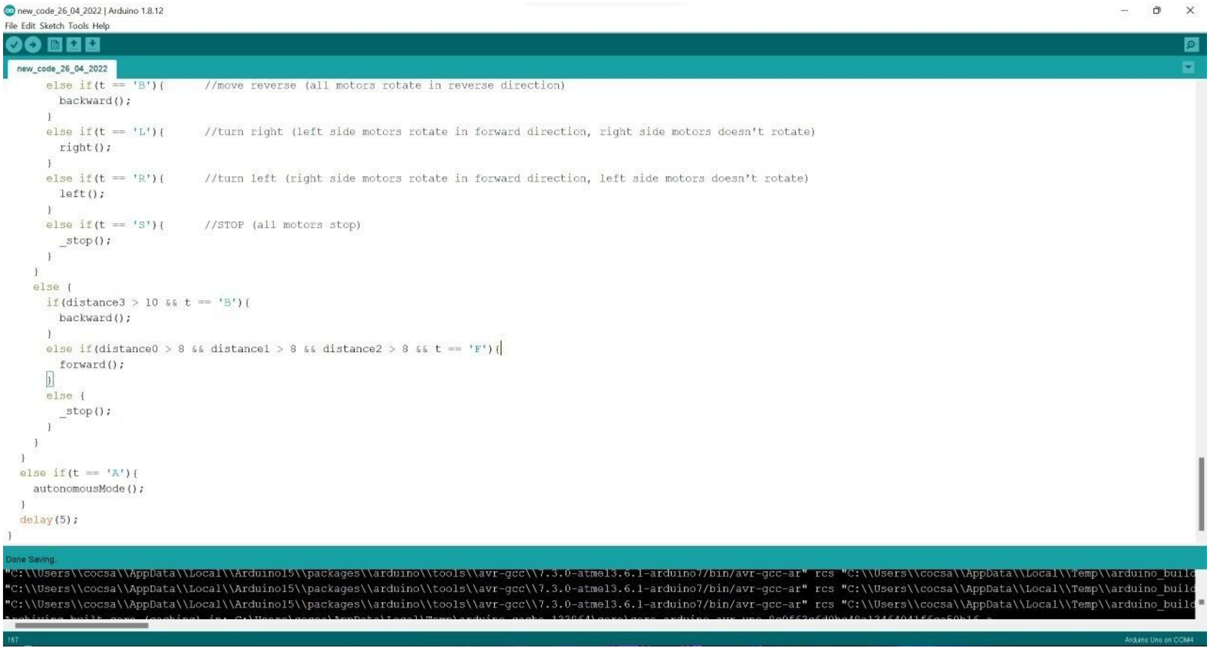
new_code_26_04_2022

```
  if(t != 'A'){
    _stop();
    if(distance0 > 8 && distance1 > 8 && distance2 > 8 && distance3 > 10){
      if(t == 'F'){            //move forward(all motors rotate in forward direction)
        forward();
      }
      else if(t == 'B'){      //move reverse (all motors rotate in reverse direction)
        backward();
      }
      else if(t == 'L'){      //turn right (left side motors rotate in forward direction, right side motors doesn't rotate)
        right();
      }
      else if(t == 'R'){      //turn left (right side motors rotate in forward direction, left side motors doesn't rotate)
        left();
      }
      else if(t == 'S'){      //STOP (all motors stop)
        _stop();
      }
    }
    else {
      if(distance3 > 10 && t == 'B'){
        backward();
      }
      else if(distance0 > 8 && distance1 > 8 && distance2 > 8 && t == 'F'){
        forward();
      }
      else {
        _stop();
      }
```

Done Saving.

```
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
```

148 Arduino Uno on COM4


new_code_26_04_2022 | Arduino 1.8.12
File Edit Sketch Tools Help
new_code_26_04_2022
else if(t == 'B'){   //move reverse (all motors rotate in reverse direction)
backward();
}
else if(t == 'L'){   //turn right (left side motors rotate in forward direction, right side motors doesn't rotate)
right();
}
else if(t == 'R'){   //turn left (right side motors rotate in forward direction, left side motors doesn't rotate)
left();
}
else if(t == 'S'){   //STOP (all motors stop)
_stop();
}
}
else {
if(distance3 > 10 && t == 'B'){
backward();
}
else if(distance0 > 8 && distance1 > 8 && distance2 > 8 && t == 'F'){
forward();
}
else {
_stop();
}
}
}
else if(t == 'A'){
autonomousMode();
}
delay(5);
}
Done Saving.
"C:\\Users\\cocsa\\AppData\\Local\\Arduino15\\packages\\arduino\\tools\\avr-gcc\\7.3.0-atmel3.6.1-arduino7/bin/avr-gcc-ar" rcs "C:\\Users\\cocsa\\AppData\\Local\\Temp\\arduino_build
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167
Arduino Uno on COM4

Result,Conclusion and Inference

In this project, we were able to implement the autonomous mode for the car successfully with the help of power bank as the power source. Firstly we implemented a obstacle avoiding robot with the help of the ultrasonic sensors and then we used a bluetooth controller model so that we can control the movement of car. Later on when we added the autonomous mode we set a button A for autonomous mode to get activated.

When we activate the autonomous mode it starts travelling by its own and when obstacles come they get avoided as car moves right and left and check for a way to get away from obstacles and avoid it. The movements after sensing an obstacle are right,left and backwards. When there is no possible way in left & right then the car moves backwards. If these 3 actions dont have anything possible movements the car automatically stops and doesn’t move further.

Hence a model for autonomous system was successfully implemented.

FUTURE WORK

In future the scope for the project is to implement the multi-terrain functionality to the autonomous car. Installing a camera for detecting objects and avoiding it or for pick and place. It will be used to identify the obstacles as well and implementing raspberry pi for machine learning algorithms to make it more efficient is the future plan . The autonomous car will have automatic parking system as well so that it will be helpful for old people as they face problem while parking cars. Making more efficient and having implementation for machine learning is the plan for this model in future .

REFERENCES

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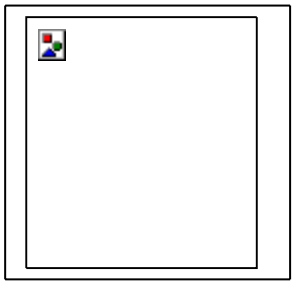
https://www.google.com/selfdrivingcar/how/

BIODATA



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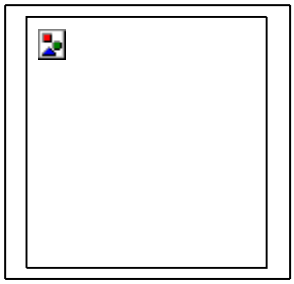

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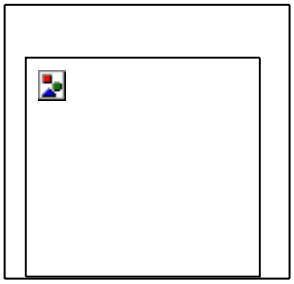

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