POTHOLE DETECTING AND AVOIDING ROBOT

Second Year Project

PROJECT REPORT

BACHELOR OF ENGINEERING IN
ELECTRONICS & COMMUNICATION ENGINEERING

Under the Guidance of

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DEPARTMENT OF ELECTRONICS COMMUNICATION ENGINEERING

CERTIFICATE

This is to Certify that this project report

"**POTHOLE DETECTING AND AVOIDING ROBOT**"

is submitted by: -

"**JAYANT KUMAR**, **KANAV JAIN**, **JASANJOT SINGH**"

who carried out the project work under my supervision. I approve this project for submission of the Second year Bachelor of Engineering in the Department of Electronics & Communication Engineering, **SEEC Manipal University Jaipur** (Rajasthan)

ABSTRACT

The **Autonomous Pothole Avoidance Robot** (APAR) is an innovative solution designed to address the persistent problem of potholes on roadways, contributing to improved road safety and maintenance. Potholes pose significant threats to both vehicles and pedestrians, leading to accidents, damage to vehicles, and increased maintenance costs. The **APAR** employs advanced technologies including computer vision, machine learning, and robotics, to autonomously detect and navigate around potholes in real-time.

This **Autonomous Pothole Avoidance** technology not only reduces the risk of accidents and damage but also contributes to the overall improvement of road infrastructure. by identifying and avoiding potholes in real-time. The **APAR** helps prevent further deterioration of road surfaces, ultimately reducing the frequency and cost of road maintenance. The implementation of such robotic systems has the potential to revolutionize the way we address road hazards, making transportation safer and more efficient for everyone.

ACKNOWLEDGMENT

The completion of this **Autonomous Pothole Avoidance Robot** (APAR) project has been a collaborative effort, and we extend our sincere gratitude to those who have played a vital role in its development.

We would like to express our appreciation to **MANIPAL UNIVERSITY JAIPUR** for their invaluable guidance and support throughout the project. Their expertise in [relevant field] significantly contributed to the success of the **APAR** system.

We are also thankful to **JAYANT KUMAR, JASANJOT SINGH, KANAV JAIN** for their dedicated efforts and hard work in designing, implementing, and testing the robot. Their commitment to excellence and teamwork has been instrumental in achieving our project goals.

This project would not have been possible without the support of our mentor **Dr. ROHIT MATHUR SIR**, and we express our gratitude for their financial support and belief in the potential impact of the **APAR** on road safety.

Finally, we acknowledge the wider community and stakeholders who have shown interest in our work. Your feedback and engagement have been crucial in shaping the development of the **Autonomous Pothole Avoidance Robot**.

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COMPONENTS	**DESCRIPTION**
Microcontroller	Controls the robot's operation
Sensors	Detect potholes and lines
Actuators	Move the robot's wheels
Power Supply	Provides power to the robot

SENSORS	**TYPE**	**RANGE**
Ultrasonic Sensor	Distance	0-10 cm
Infrared Sensor	Line detection	0-10 cm

ACUTUATOR	**TYPE**
DC Motor	Gear Motor

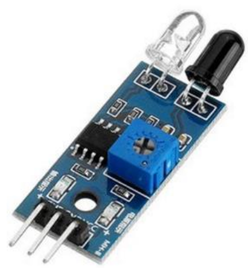
LIST OF FIGURES

- **Initial Components:**

Ultrasonic Sensor

Arduino (UNO)

Driver Shield



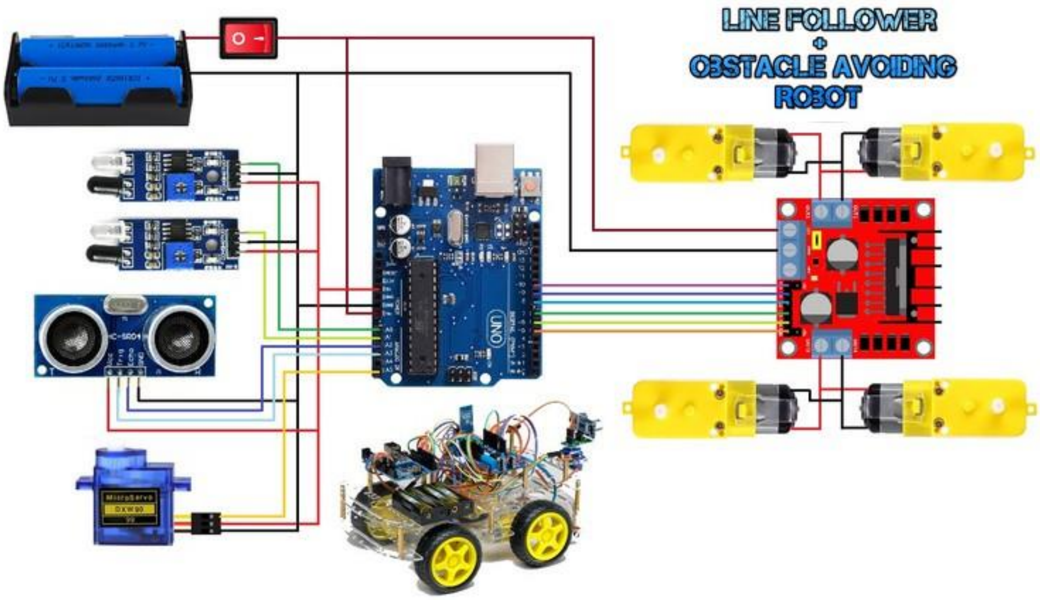
IR Sensor

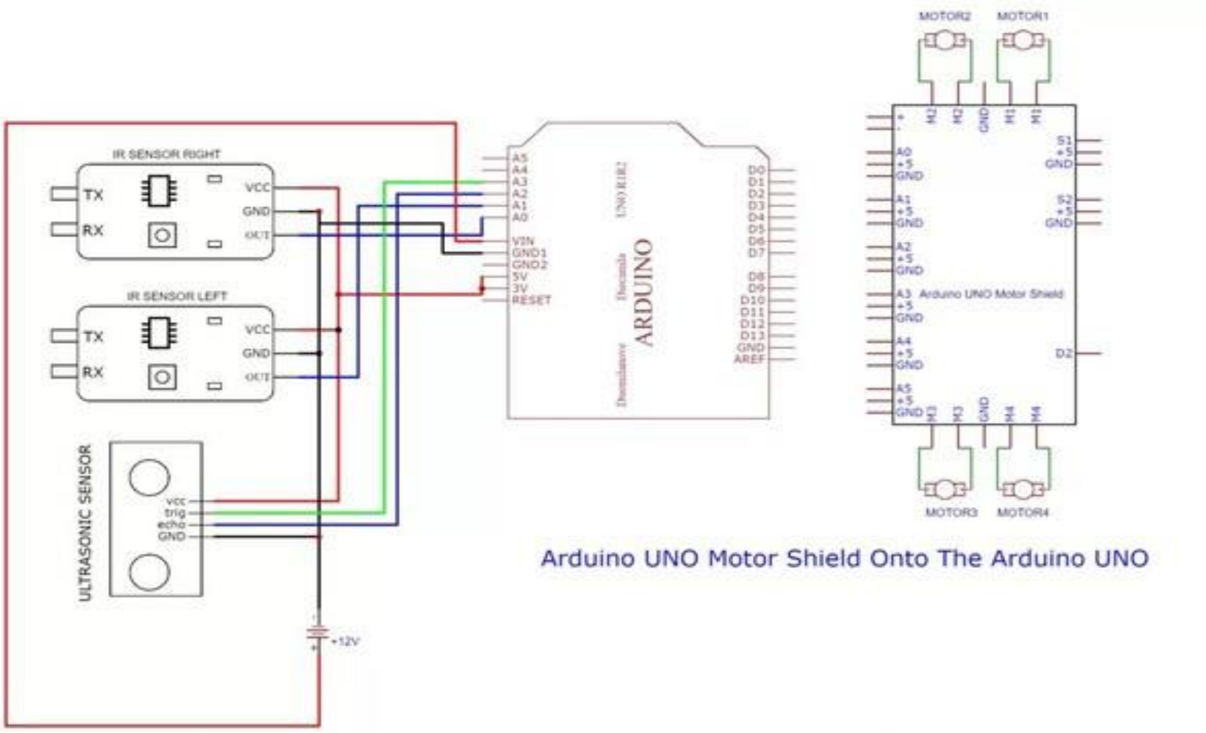
Battery

Wheels

Hobby Motor

FINAL CIRCUIT





LIST OF ACRONYMS

ACRONYMS	DESCRIPTION
LED	Light Emitting Diode
IR Sensor	Infrared Sensor
L293D	Driver Shield / Motor Shield

CHAPTER - 1

"INTRODUCTION"

INTRODUCTION

TO “POTHOLE DETECTING AND AVOIDING ROBOT”

In urban environments, the maintenance of roads and the safety of both vehicles and pedestrians are significant concerns. Potholes, a common road hazard, not only contribute to wear and tear of vehicles but also pose safety risks. Simultaneously, efficient, and reliable navigation is crucial for the smooth flow of traffic. To address these challenges, the development of a **Pothole Detecting and Avoiding Robot** emerges as a promising solution.

The primary objective of this innovative robot is twofold. Firstly, it aims to **autonomously** navigate through urban streets. Secondly, it is equipped with advanced sensor technologies to detect and avoid potholes effectively. By combining these functionalities, the robot strives to enhance road safety, minimize damage to vehicles, and contribute to the overall efficiency of urban mobility.

The Autonomous Avoiding of potholes in the robot involves leveraging sensors, such as **Ultrasonic** sensors, to detect and avoid the potholes on road surfaces automatically. This functionality enables the robot to navigate autonomously, making it suitable for applications like traffic management and automated guided vehicles in industrial settings. Further addition of **GPS module** it can even map the location of the potholes and with the availability of an application it can inform the organization responsible for the road management for repair and the people so that they may know of the upcoming potholes before hand and maintain their speed accordingly.

APPLICATION OF POTHOLE DETECTING AND AVOIDING ROBOT

The **POTHOLE DETECTING AND AVOIDING ROBOT** has a wide range of applications across various sectors due to its capabilities in navigation, pothole detection, and automated avoidance of the latter. Here are several potential applications for this innovative robot:

Urban Infrastructure Maintenance

The robot can be employed for regular inspections of urban roads, identifying and reporting potholes for timely maintenance. This proactive approach aids in preserving road quality and minimizing repair costs.

Traffic Management

Implementing the Pothole Avoiding capability, the robot can assist in traffic management by autonomously helping vehicles avoid potholes in the route. This is particularly useful in scenarios like parking lots, industrial facilities, and smart cities.

Public Safety and Law Enforcement

Law enforcement agencies can use the robot for monitoring and patrolling specific areas. The Mapping feature (in large scale project) allows the robot to map the location of the potholes and inform the management for repair and, people so that they can maintain their speeds while approaching the particular route. The Pothole Avoiding feature allows the robot to keep avoiding the potholes and successfully map the whole route without having to stop at every individual pothole, thus saving energy being used.

Advantages of Pothole Detecting and Avoiding robots

Improved safety: Potholes can be a major hazard for drivers, cyclists, and pedestrians. By detecting and avoiding potholes, robots can help to prevent accidents and injuries.

Increased efficiency: Pothole detection and repair can be a time-consuming and labor-intensive process. Robots can automate this process, freeing up human workers to focus on other tasks.

Reduced costs: The cost of pothole detection and repair can be significant.
Robots can help to reduce these costs by automating the process and improving efficiency.

Challenges of pothole detecting and avoiding robots

Sensor accuracy:
Robots need to be able to accurately detect potholes in a variety of conditions, including rain, snow, and darkness.

Obstacle avoidance:
Robots need to be able to avoid other obstacles on the road, such as parked cars and pedestrians.

Cost:
The cost of developing and deploying pothole-detecting robots can be high.

Maintenance:
Robots require regular maintenance to ensure that they are functioning properly.

CHAPTER - 2

"LITERATURE REVIEW"

Pothole Detection

Potholes are a major safety hazard for drivers, cyclists, and pedestrians. They can cause damage to vehicles and lead to accidents. Traditional methods of pothole detection rely on human inspections, which can be time-consuming and inaccurate. **Automated pothole detection systems** have the potential to improve the efficiency and accuracy of pothole detection.

Several different approaches have been used to develop **automated pothole detection systems**. One common approach is to use image processing techniques to analyze images of roads. Other approaches include using ultrasonic sensors, infrared sensors, and lidar sensors to detect potholes.

Image processing techniques can be used to detect potholes by analyzing the texture and shape of the road surface. For example, potholes can be identified by their dark color and irregular shape. However, image processing techniques can be affected by changes in lighting conditions and the presence of debris on the road surface.

Ultrasonic sensors can be used to detect potholes by measuring the distance to the road surface. Potholes can be identified by their sudden change in depth. However, ultrasonic sensors can be affected by changes in temperature and humidity.

Infrared sensors can be used to detect potholes by measuring the temperature of the road surface. Potholes can be identified by their colder temperature.
However, infrared sensors can be affected by changes in ambient temperature and wind conditions.

Pothole Avoidance

Pothole avoidance systems use automated pothole detection systems to avoid potholes. These systems can be used to control the steering and speed of vehicles.
Pothole avoidance systems can be used to prevent vehicles from driving over potholes. This can help to prevent damage to vehicles and accidents.
Pothole avoidance systems can also be used to reduce the speed of vehicles over potholes. This can help to minimize the damage to vehicles caused by potholes.

Conclusion

Automated Pothole Detection, Mapping, and Avoidance systems have the potential to improve the safety and efficiency of road maintenance. These systems can help to prevent accidents, reduce vehicle damage, and improve the quality of roads.

CHAPTER - 3

“CIRCUIT DESIGN AND ANALYSIS”

CIRCUIT DESIGN

The circuit design for a **Pothole Detecting, Mapping, and Avoiding Robot** will depend on the specific components and sensors used. However, a general circuit diagram for such a robot could include the following components:

Microcontroller: The microcontroller is the central processing unit of the robot and is responsible for controlling all of the robot's systems.

Sensors: The sensors used to detect potholes will depend on the specific sensor technology used. Common sensors include **ultrasonic sensors** and **infrared sensors.**

Actuators: The actuators are the motors that control the robot's movement. The specific motors used will depend on the size and weight of the robot.

Power supply: The power supply provides power to all the robot's components. The specific power supply used will depend on the power requirements of the robot.

Here is a more detailed description of the circuit design for a pothole detecting, mapping, and avoiding robot using ultrasonic sensors:

MICROCONTROLLER: The microcontroller used in this robot is an **Arduino Uno**. The Arduino Uno is a popular microcontroller board that is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards and can control relays, LEDs, Servos, and Motors as an output.

SENSORS: The sensors used in this robot are **HC-SR04 Ultrasonic sensors** and **Infrared Sensors**.

HC- SR04 is a low-cost, high-performance ultrasonic sensor that is well-suited for pothole detection. The **HC-SR04 Ultrasonic sensor** uses **SONAR** to determine the distance of an object just like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package from 2 cm to 400 cm or 1” to 13 feet.

Infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm to 50 µm. **Infrared light** (IR) is based on the principles of optics. An **IR** proximity sensor works by applying voltage to a pair of **IR** light-emitting diodes (LEDs) which in turn, emit infrared light. This light propagates through the air and once it hits an object it is reflected towards the sensor.

ACTUATORS: The actuators used in this robot are two **DC motors**. The **DC motors** are used to control the robot's movement. A **gearmotor** delivers high torque at low horsepower or low speed. The speed specifications for these motors are normal speed and stall-speed torque. These motors use gears, typically assembled as a gearbox, to reduce speed, which makes more torque.

POWER SUPPLY: The power supply used in this robot is an 18V battery pack. The 18V battery provides power to all the robot's components.

The Arduino Uno is connected to ultrasonic sensors and DC motors. The ultrasonic sensors are used to detect potholes and the DC motors are used to control the robot's movement. The 18V battery provides power to all the robot's components.

This is just a basic circuit diagram, and the specific details of the circuit will vary depending on the specific components and sensors used. However, this gives a general idea of how to design a circuit for a **Pothole Detecting, Mapping, and Avoiding robot**.

CODE

```
#include <NewPing.h>
#include <AFMotor.h>

//hc-sr04 sensor
#define TRIGGER_PIN A4 //grey
#define ECHO_PIN A5    //blue
#define max_distance 50

//ir sensor
#define irLeft A2
#define irRight A0

//motor
#define MAX_SPEED 200
#define MAX_SPEED_OFFSET 20



NewPing sonar(TRIGGER_PIN, ECHO_PIN, max_distance);

AF_DCMotor motor_left(1, MOTOR12_1KHZ);
AF_DCMotor motor_right(4, MOTOR12_1KHZ);



int distance = 0;


void setup()
{
  Serial.begin(9600);
  pinMode(irLeft, INPUT);
  pinMode(irRight, INPUT);


  motor_left.setSpeed(200);
  motor_right.setSpeed(200);
```

```
    }
//line follow
    void loop()
    {
      if(digitalRead(irLeft) ==1 && digitalRead(irRight) ==1)
      {
        objectAvoid();
        //forword
      }
      else if(digitalRead(irLeft) ==1 && digitalRead(irRight) ==0)
      {
        objectAvoid();
        Serial.println("TL");
        //leftturn
        moveLeft();
      }
      else if(digitalRead(irLeft) ==0 && digitalRead(irRight) ==1)
      {
        objectAvoid();
        Serial.println("TR");
        //rightturn
        moveRight();
      }
      else if(digitalRead(irLeft) ==0 && digitalRead(irRight) ==0)
      {
        //Stop
        Stop();
      }
    }
//object avoiding

    void objectAvoid()
    {
      distance = getDistance();
      if (distance >= 10)
      {
        //stop
        Stop();
        Serial.println("Stop");
```

```
    turn();
    Serial.println("moveLeft");
  }
  else
  {
    //forword
    Serial.println("moveforword");
    moveForward();
  }
}

int getDistance()
{
  delay(50);
  int cm = sonar.ping_cm();
  if (cm == 0)
  {
    cm = 100;
  }
  return cm;
}


void Stop() {
  motor_left.run(RELEASE);
  motor_right.run(RELEASE);
}
void moveForward() {
  motor_left.run(FORWARD);
  motor_right.run(FORWARD);
}
void moveBackward() {
  motor_left.run(BACKWARD);
  motor_right.run(BACKWARD);

}
void turn()
{

  Serial.println("turn left");
```

```
  moveLeft();
  delay(700);
  moveForward();
  delay(800);

  moveRight();
  delay(800);
  moveForward();
  delay(800);

  moveRight();
  delay(800);
  moveForward();

  if (digitalRead(irRight) == 0)
  {
    loop();
  }
  else
  {
    moveForward();
  }

}
void moveLeft()
{
  motor_left.run(BACKWARD);
  motor_right.run(FORWARD);
}
void moveRight()
{
  motor_left.run(FORWARD);
  motor_right.run(BACKWARD);
}
```

CHAPTER - 4

"CONCLUSION"

In conclusion, the circuit design and analysis presented in this report form the technological foundation for the **Pothole Detecting, Mapping, and Avoiding Robot**.

This innovative solution has the potential to revolutionize how we approach road safety and infrastructure maintenance in urban environments. As technology advances and the robot undergoes further iterations, its impact on creating safer and more efficient urban spaces is promising.

The collaboration between circuit design, sensor technologies, and intelligent control systems lays the groundwork for a transformative solution in the realm of autonomous robotics.

In conclusion, the circuit design and analysis presented in this report form the technological foundation for the **Pothole Detecting, Mapping, and Avoiding Robot**. This innovative solution has the potential to revolutionize how we approach road safety and infrastructure maintenance in urban environments. As technology advances and the robot undergoes further iterations, its impact on creating safer and more efficient urban spaces is promising.

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CHAPTER - 5

“REFERENCES"

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