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AUTOMATIC IDENTIFICATION AND REPAIR OF ROAD POTHOLES

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ABSTRACT

One of the most vital problems in developing countries is conservation of roads. Well maintained roads contribute a significant portion to the country's economy. Spotting of pavement distress like potholes helps drivers to avoid accidents or vehicle damages, conjointly helps authorities to take care of roads. Many on-going projects in the field of transport networks are operating in the direction of providing driver with relevant data concerning roads and traffic movements. In secondary Indian roads, one often encounters pot holes which can be either dry or water-filled. Accordingly, to ensure safe driving, it is imperative to detect potholes and estimate their depths in either condition. In this project, we develop an Arduino-based sensing model, where such detection and depth-estimation can be accomplished using the model, which will discharge the required number of materials which is needed for the detected pothole and to do the levelling process on the discharged material and hence the pothole on the road can be filled completely. In this project we are also providing manual control of Model if the user doesn't want to use the automatic control, then he can monitor using android application which has all control of model applications, like forward, backward, left, right, roll, fill.

INTRODUCTION

FIG 1.1: POTHOLES

India, the second most populous Country in the World and a fast-growing economy, is known to have a gigantic network of roads. Roads are the dominant means of transportation in India today. However, most of the roads in India are narrow and congested with poor surface quality and road maintenance needs are not satisfactorily met. No matter where you are in India, driving is a breath-holding, multi-mirror involving, potentially life-threatening affair. Over the last two decades, there has been a tremendous increase in the vehicle population. This has increased the number of roads. India has grown tremendously, as more and more people graduate by the minute and more and more of us gain employment by the hour, we are all bound to commute and spend most of our time travelling. Different reports and surveys are of the opinion that [1]. "Last year, 10,727 people were killed in crashes caused by potholes, speed breakers and roads under repair or being constructed. Though fatalities under these categories had come down marginally from 2014, the number of people killed due to potholes rose to 3,416 from 3,049 in the previous years.

"Evidently the key reason to road accidents happens to be faulty roads and unanticipated occurrence of potholes. The safety of the motorists should be prioritized and a smooth commute should be ensured for everyone. Thinking along such lines we came up with the idea of integrating a hardware system which detects the potholes using an IR sensor and ultrasonic. Filling of the pothole. In this fast-moving world that we live in, safe commute is not only everyone's priority but also to provide a hassle-free

shuttle between places is the government's duty. In this paper, we propose a system which detects potholes on the road. As we all know prevention is better than cure, we design and implement a system which not only recognizes potholes but also levels these potholes after filling it with the required materials. The proposed system contains two important functions, first is to detect the pothole which is done through a multi-sensor subsystem consisting of ultrasonic sensors and store this information on a Iot application which can be accessed through phone to control the model manually.

OBJECTIVE OF THE PROJECT:

Poorly maintained roads are a fact of life in most developing countries including our India. In Indian roads we often come across pot holes which can be either dry or water filled. So, to ensure safe driving, it is necessary to detect potholes and fill them as soon as possible. A well-maintained road network is a must for the well-being and the development of any country. So, we are going to create an effective road surface monitoring system. Automatic pot-hole detection and filling of potholes is our focus in the system. Levelling of potholes is done after the filling process. The project aims at producing pothole free roads by making a model which detects potholes and fills them automatically. An operational requirement was that the system must be productive and place as much as materials per day, with less labor and low cost. Pothole – pancake pavement, flexible base or rigid composite base. The main objective of the proposed system is road condition is detected based on the potholes and levelling of the potholes.

LITERATURE SURVEY

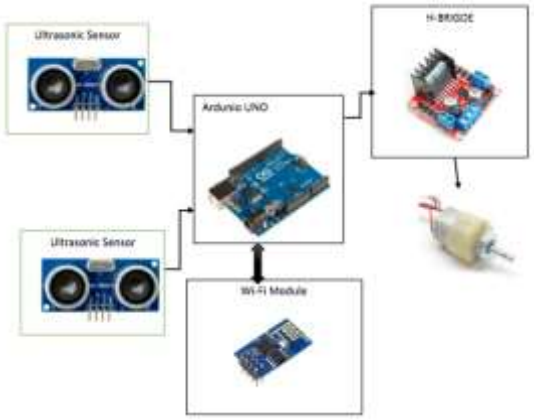
INTRODUCTION:

Before getting into the actual proposed system, it is always necessary to research on different systems that have been developed to solve the problem statement. Various technologies are used to design a project where different types of methods and components are involved. Having a basic idea of the existing systems helps to start a new project as it acts as the base system. Literature survey is a comprehensive summary of previous research on a topic. It should enumerate, describe, summarize, objectively evaluate and clarify the previous research. Below are different research papers discussed which we have taken as reference papers to our project. **[1]** In the year 2020, the length of national highways was around 9000 Kilometers, while for the same time frame the length that was constructed over 10000 Kilometers. Due to low maintenance of road infrastructure, in the year 2019, 4,37,396 road accidents were recorded. Among which 1,54,732 people died. **[2]** To develop a model to monitor the road infrastructure by automatic pothole detection. It is a low-cost effective solution for the safety of road infrastructure. This will help in preventing accidents and save lives.**[3]** A pothole is a depression on a road surface which is caused by a combination of traffic pressure and water. Due to presence of water in the primary soil and the traffic passing over the affected area, Mechanical failure is created on a road surface.**[4]** The statistics recorded by the Ministry of the Interior in Taiwan shows that 20% of road accidents occurs due to poor road conditions. Therefore, it is necessary to have a mechanism through which people in real time, can know about the road conditions in the routes on which travel. **[5]** The main aim is to provide a Pothole free System using different sensors and components.

SLNO	Project Name	Authors	Advantages	Disadvantages
[1]	Pit free: Pot-holes detection of Indian Roads using Mobile Sensors	Gaurav Singal, Anurag Goswami, Suneet Gupta, Tejalal Choudhary	Machine learning technology is used for the identification of potholes and the patching of potholes	The data captured from the GPS might not give accurate results. >Since SVM algorithm in machine learning is used, it is not suitable for large data sets
[2]	Path hole Detection System: Using Wireless Sensor Network"	Ashish Gaikwad, Yashwant Bellekar, Manike Dongre, Ankit Chaudhary	Pothole detection system is designed which assists the driver in avoiding potholes on the roads, by giving prior warnings.	The system only provides information of warning drivers about the potholes, but it does not help in filling these potholes.
[3]	Identifying and Reporting of Potholes and Humps using IoT"	SnitaSaitwalekar, Dr. Payalsaha	This system gives information about depth of potholes, height of humps as well as location, which is sensed by sensors and stored in database.	Using GPS leads to inaccuracy, lack of local knowledge, driving distraction, privacy issues.
[4]	Road Conditions Detection Using Arduino Based Sensing Module	And Smartphone Syuan-Yi Chen, Annie Shih and Chun-Yi Hsiao	1)The vehicle can obtain nearby road conditions information easily. 2)Traffic management	2)Sensing module should be mounted externally
[5]	Pothole Detection System using Machine Learning on Android	Aniket Kulkarni, Nitish Mhalgi, Sagar Gurnani, Dr. Nupur Giri	Despite hardware differences in terms of GPS accuracy, accelerometer sampling rate and noise, we postulate that accurate pothole detection is possible	Applications utilizing the machine learning implementations should have permissions matching those of the sensors used.

COMPARISON OF LITERATURE SURVEY:

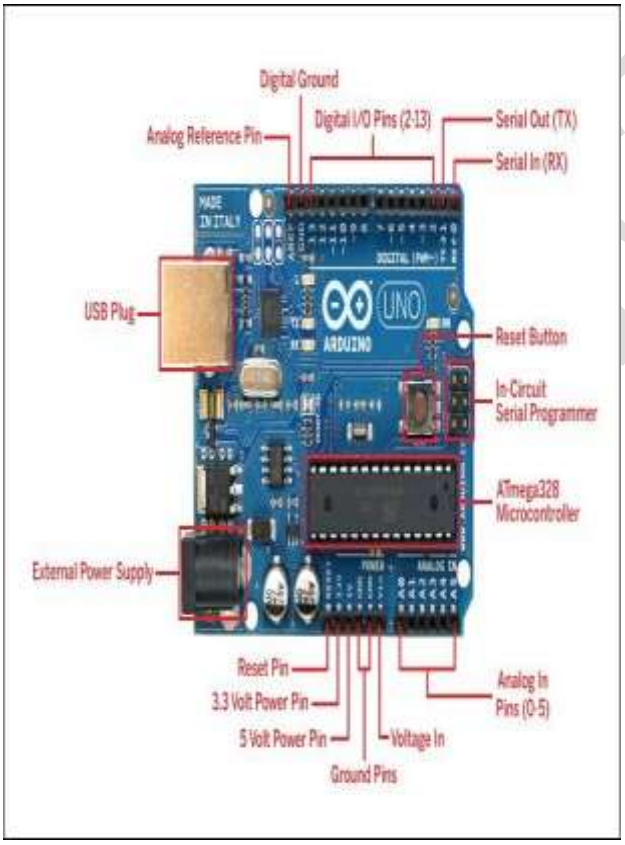
DESIGN AND METHODOLOGY:



INTRODUCTION:

In this chapter, design and methodology is explained in detail which will help in understanding the project with the technology point of view.

OVERALL BLOCK DIAGRAM AND ITS



EXPLANATION:

Roads are normally placed with speed breakers that are used to control the speed of the vehicle. But these speed breakers have been a cause of accidents because a definite dimension is not followed throughout. Likewise, potholes are formed due to oil spills, heavy rains and also due to movement of heavy vehicles. These bad road conditions cause accidents, affect the quality of driving and also consumes more fuel. Hence, in this paper we have proposed a system that would notify the drivers regarding any hurdles such as potholes and humps and this information can be used by the Government to correct these roads effectively.

METHODOLOGY:

The Infra-red sensor on the front of the Model is allowed to sense the surface of the road, if the pothole will be detected the sensor send the signals to the micro controller, and the controller suddenly stops the movement of Model near the pothole, and allows to discharge the required concrete needed for the detected pothole. Then the pothole is levelled by slider crank mechanism.

This system will make an online record of all the locations of potholes which were came in the way of the vehicle having this system. This record of potholes will help the road maintenance department to locate these bad roads. This can help to make maintenance work faster. In this System the driver of the vehicle will be able to avoid the pothole as he/she can get alert 10 sec before, when the vehicle speed will be medium i.e. 30 mph. If speed of vehicle will be less, then alert time will be earlier and vice versa. The architecture of proposed system consists of 3 i.e. parts: sensing unit, server unit and user unit. Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the audio range. The HC-SR04 module includes ultrasonic transmitter, receiver and control circuit. It measures distance between two objects and this distance is calculated depending upon the time taken by the ultrasonic pulse to travel a particular distance. The module sends a 40 kHz square wave and detect the received pulse signal automatically. The distance is calculated based on the time taken by the transmitted signal to return. In this system there is a Arduino based sensing module and android based user interface. The low-cost modules are placed on the vehicles so its efficient for users as they don't have to have an external sensing function when they get on or off the vehicles. System can be divided into two parts first the Arduino part and second one android part.

ALGORITHM:

1. Start
2. Initialize the movement of the model.
3. Check for the depth on the surface of the road.
4. If depth found, Fill it with the required materials.
5. Level it to the surface level.
6. Else, continue the movement of the model
7. End

GANG CHART:

COMPONENTSPECIFICATIONS:

ARDUINO

ARDUINO ATMEGA-328

The following Table 6.1 General Specifications Arduino Atmega-328 shows the component specifications were done in this project.

DC MOTOR

The motor Specifications are shown in the Specifications of DC Motor.

Parameter	Value
Operating voltage	5 V
Input voltage	7-12 V
Digital I/O Pins	14(of which 6 provide PWM output)
Analog input pins	8
Memory	Flash memory(16KB OR 32KB)
Clock speed	16 MHz
Dimensions	0.73 X 1.70

Table 6.1 General Specifications Arduino Atmega-328

PARAMETER	VALUE
Voltage	12V
Speed	30rpm
Current	1 amp
Weight	Able to lift 5kg
No of motor	2

Specifications of DC Motor

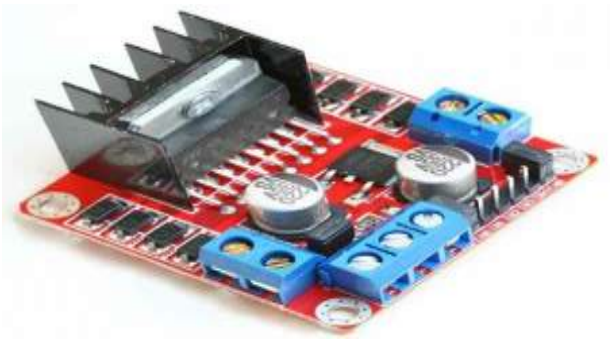
ULTRA SONIC SENSOR

PARAMETER	VALUE
Working voltage	DC 5v
Working current	15mA
Working frequency	40Hz
Max range	4m
Minimum range	2cm
Measuring angle	15 degrees
Trigger input signal	10uS TTL pulse
Echo output signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Ultrasonic Ranging Module HC - SR04

H-BRIGDE

- A H bridge is an electronic circuit.
- H-bridge circuits are frequently used in robotics and many other applications.
- It's used to control the MOTOR Moving Direction.



Wi-Fi ModuleESP8266

The ESP8266 is a very user friendly and low-cost device.

The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi).

- It can also fetch data from internet using API's.
- Wi-Fi module used to get the input from the smart phones.
- It updates each operation executed during the automatic condition.

Implementation and Results

4.1 Introduction

This Robot is designed, which helps the society in promoting the road safety and to reduce the difficulties in detecting the pothole and also reduce the usage of human power, and hence saves the time. This is done in ensuring perfection in all the aspects such as speed, accuracy, flexibility, safety, reliability and cost effective during the maintenance and service of the robot. The overall concept of the system will be explained in this chapter.

Arduino Uno

Arduino is an open-source computer hardware and software that designs single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public

License (LGPL). Arduino boards are available commercially in preassembled form or by designing the kits with respect to different application. Figure 4.2 and 4.3 shows the Arduino Uno board and pin diagram respectively. The different types of Arduinos UNO are Arduino Nano, Arduino Pro Mini, Arduino Mega, Arduino Due, and Arduino Leonardo.

Fig 4.2: Arduino UNO board

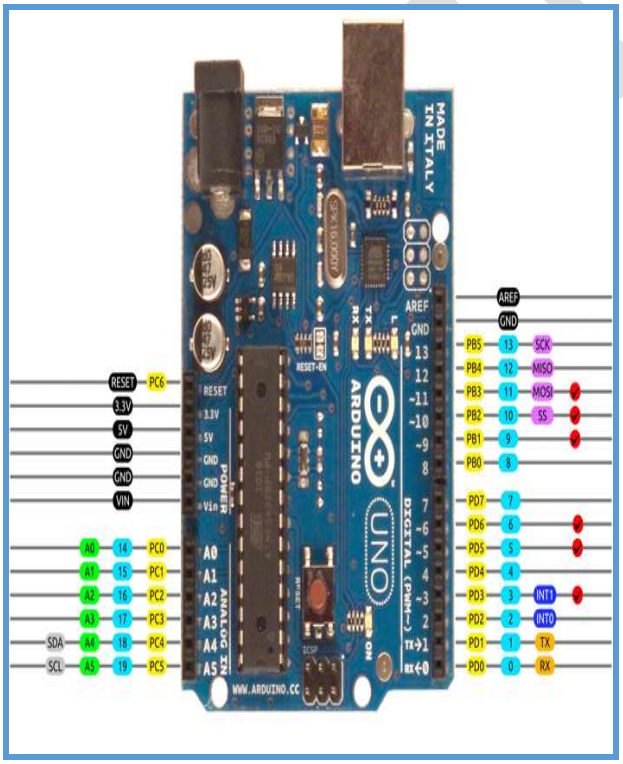


Fig 4.3: Arduino UNO board pin diagram

OVERVIEW

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

HOW TO USE AURDINO BOARD

The 14-digital input/output pins can be used as input or output pins by using pin Mode (), digital Read () and digital Write () functions in Arduino programming. Each pin operates at 5V and can provide or receive a maximum of 40mA current and has an internal pull-up resistor of 20-50 K Ohms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

1. **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
2. **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
3. **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analog Write () function.
4. **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
5. **In-built LED Pin 13:** This pin is connected with built-in LED. When pin 13 is high, then LED will ON and when 13 pin is low, it represents led is OFF.

There are 14digital pins and 6 analog input pins, each of which provides 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog reference () function.

Analog pin 4 Serial Data Access (SDA) and pin 5 scratch controlling Arduino (SCA) also used for TWI communication using wire library. Arduino Uno has a couple of other pins as explained below:

1. **AREF:** Used to provide reference voltage for analog inputs with analog Reference () function.
2. **Reset Pin:** Making this pin LOW, resets the microcontroller.

COMMUNICATION

Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a in file is required.
The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. There are two RX and TX LEDs on the Arduino board which will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (not for serial communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328P also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus.

ARDUINO PROGRAMMING

Once Arduino IDE is installed on the computer, connect the board with computer using USB cable. Now open the Arduino IDE and choose the correct board by selecting Tools>Boards>Arduino/Genuine Uno and choose the correct Port by selecting Tools>Port. Arduino Uno is programmed using Arduino programming language based on Wiring. To get it started with Arduino Uno board and blink the built-in LED, load the example code by selecting Files>Examples>Basics>Blink. Once the example code (also shown below) is loaded into the IDE, click on the 'upload' button given on the top bar. Once the upload is finished, it should see the Arduino's built-in LED blinking. Below is the example code for blinking.

```
// the setup function runs once if press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}
// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);                      // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LOW
  delay(1000);                      // wait for a second
}
```

APPLICATIONS

1. Prototyping of Electronics Products and Systems
2. Multiple DIY Projects.
3. Easy to use for beginner level DIY and makers.
4. Projects requiring Multiple I/O interfaces and communications.

Voltage Specification

VCC is the voltage that it needs for its own internal operation 5v; L293D will not use this voltage for driving the motor. For driving the motors, it has a separate provision to provide motor supply VSS (V supply). L293d will use this to drive the motor. It means if you want to operate a motor at 9V then you need to provide a Supply of 9V across VSS Motor supply.

Figure 4.14 L293D Motor Driver

The maximum voltage for VSS motor supply is 36V. It can supply a max current of 600mA per channel. Since it can drive motors Up to 36v hence you can drive pretty big motors with this l293d.

- VCC pin 16 is the voltage for its own internal Operation. The maximum voltage ranges from 5v and up to 36v.
- TIP: Don't Exceed the Vmax Voltage of 36 volts or it will cause damage.

DC MOTORS

Electric motors are everywhere! almost every mechanical movement that can see around is caused by an AC (alternating current) or DC (direct current) electric motor. Let us start by looking at the overall plan of a simple two-pole DC **electric motor**. A simple motor has six parts, as shown in the diagram below:

1. Armature or rotor
2. Commutator
3. Brushes
4. Axle
5. Field magnet
6. DC power supply of some sort
7. Armature or rotor
8. Commutator
9. Brushes
10. Axle
11. Field magnet
12. DC power supply of some sort

An electric motor is all about magnets and magnetism: A motor uses magnets to create motion. If that have ever played with magnets about the fundamental law of all magnets: Opposites attract and likes repel. So have two bar magnets with their ends marked "north" and "south," then the north end of one magnet will attract the south end of the other. On the other hand, the north end of one magnet will repel the north end of the other (and similarly, south will repel south). Inside an electric motor, these attracting and repelling forces create rotational motion**.**

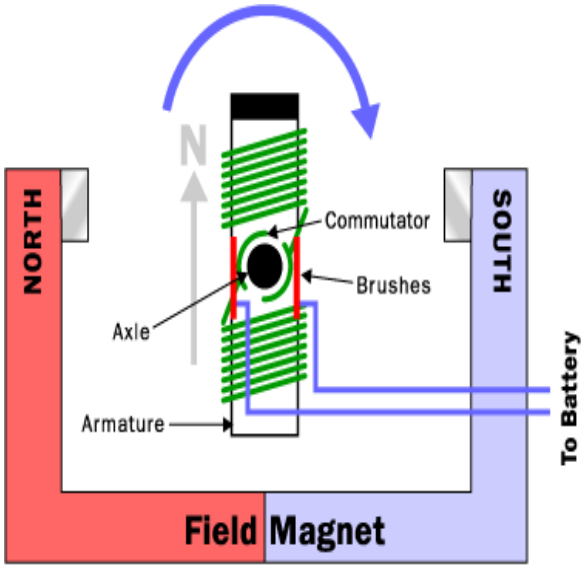


Figure 3.5: Principle of working of motor

An electromagnet is the basis of an electric motor. It's understood how things work in the motor by imagining the following scenario. Say that created a simple electromagnet by wrapping 100 loops of wire around a nail and connecting it to a battery. The nail would become a magnet and have a north and south pole while the battery is connected. Now say that take the nail electromagnet, run an axle through the middle of it and suspend it in the middle of a horseshoe magnet as shown in the figure below. If were to attach a battery to the electromagnet so that the north end of the nail appeared as shown, the basic law of magnetism tells that what would happen: The north end of the electromagnet would be repelled from the north end of the horseshoe magnet and attracted to the south end of the horseshoe magnet. The south end of the electromagnet would be repelled in a similar way. The nail would move about half a turn and then stop in the position shown.

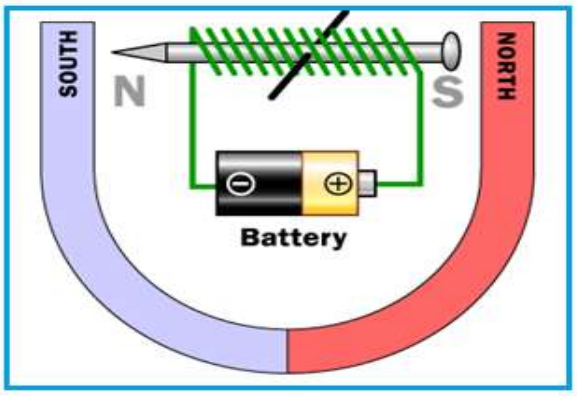


Figure 4.6: Electromagnet in horse magnet

This is half-turn of motion is simply due to the way magnets naturally attract and repel one another. The key to an electric motor is to then go one step further so that, at the moment that this half-turn of motion completes, the field of the electromagnet flips. The flip causes the electromagnet to complete another half-turn of motion. it flips the magnetic field just by changing the direction of the electrons flowing in the wire. If the field of the electromagnet were flipped at precisely the right moment at the end of each half-turn of motion, the electric motor would spin freely.

ARMATURE, COMMUTATOR AND BRUSHES

Consider the image shown below. The **armature** takes the place of the nail in an electric motor. The armature is an electromagnet made by coiling thin wire around two or more poles of a metal core.

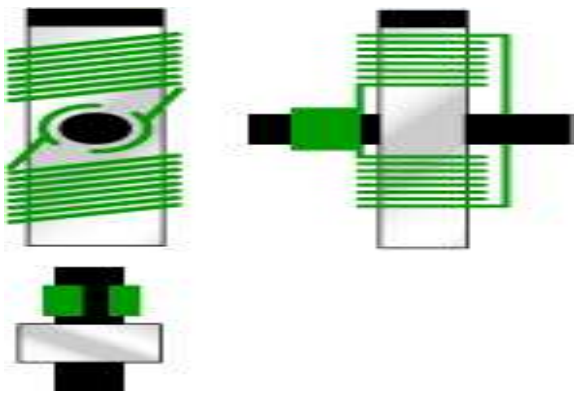


Figure 4.7: Armature

The armature has an axle, and the commutator is attached to the axle. In the diagram to the right, can see three different views of the same armature: front, side and end-on. In the end-on view, the winding is eliminated to make the commutator more obvious. It shows that the commutator is simply a pair of plates attached to the axle. These plates provide the two connections for the coil of the electromagnet.

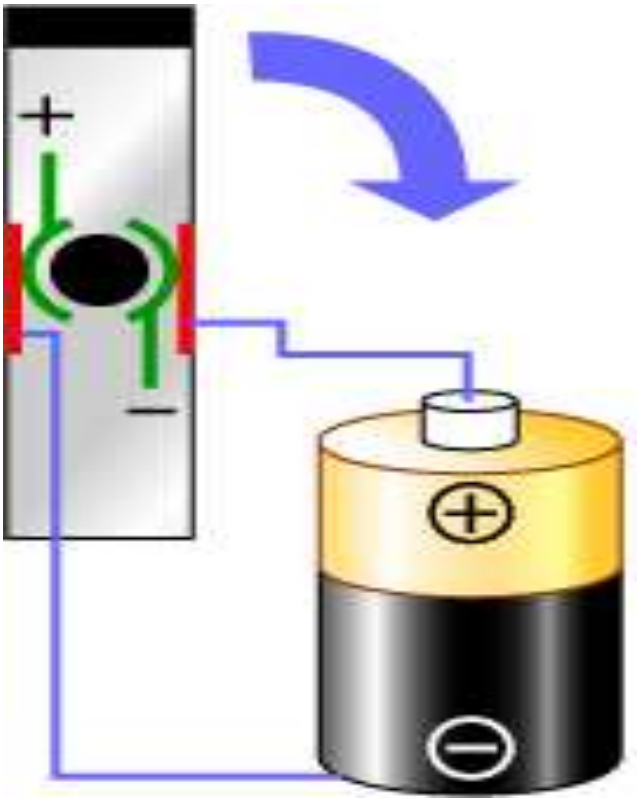


Figure 3.8: Brushes and commutator

The "flipping the electric field" part of an electric motor is accomplished by two parts: the **commutator** and the **brushes**.

Figure 4.5 shows how the commutator and brushes work together to let current flow to the electromagnet, and also to flip the direction that the electrons are flowing at just the right moment. The contacts of the commutator are attached to the axle of the electromagnet, so they spin with the magnet. The brushes are just two pieces of springy metal or carbon that make contact with the contacts of the commutator.

PARTS OF MOTOR PUT TOGETHER

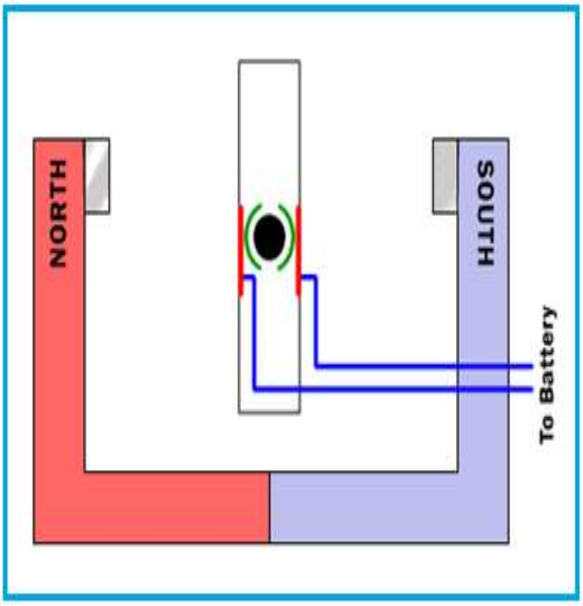


Figure 4.9: Commutator action

In the figure 4.5, the armature winding has been left out so that it is easier to see the commutator in action. The key thing to notice is that as the armature passes through the horizontal position, the poles of the electromagnet flip. Because of the flip, the north pole of the electromagnet is always above the axle so it can repel the field magnet's North Pole and attract the field magnet's South Pole.

If ever have the chance to take apart a small electric motor, will find that it contains the same pieces described above: two small permanent magnets, a commutator, two brushes, and an electromagnet made by winding wire around a piece of metal. Almost always, however, the rotor will have three poles rather than the two poles as shown in this article. There are two good reasons for a motor to have three poles:

It causes the motor to have better dynamics. In a two-pole motor, if the electromagnet is at the balance point, perfectly horizontal between the two poles of the field magnet when the motor starts, imagine that the armature getting "stuck" there. That never happens in a three-pole motor.

Each time the commutator hits the point where it flips the field in a two-pole motor, the commutator shorts out the battery (directly connects the positive and negative terminals) for a moment. This shorting waste energy and drains the battery needlessly. A three-pole motor solves this problem as well.

BATTERY

Figure 4.24: 12V battery

4.3.5.1 THE BATTERY (DRY CELL)

The common battery (dry cell) is a device that changes chemical energy to electrical energy. Dry cells are widely used in toys, flashlights, portable radios, cameras, hearing aids, and other devices in common use.

A battery consists of an outer case made of zinc (the negative electrode), a carbon rod in the centre of the cell (the positive electrode), and the space between them is filled with an electrolyte paste. In operation the electrolyte, consisting of ground carbon, Manganese dioxide, Sal ammoniac, and zinc chloride causes the electrons to flow and produce electricity.

Battery is used for store the solar energy which can be further converted into electrical energy. The battery should require following properties,

(1) Long life

(2) High reliability

(3) Low cost

(4) High overall efficiency

ULTRASONIC SENSOR:

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent range accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders are. Similar in performance to the SRF005 but with the low-price of a Sharp infrared

sensor.

Power Supply :5V DC
Quiescent Current: <2mA
Effectual Angle: <15°
Ranging Distance: 2cm – 500 cm/1" - 16ft
Resolution: 0.3 cm

Application:

- Applications ranging occasions;
- measuring the distance between objects:
- Programmable car obstacle avoidance:
- robot obstacle avoidance:
- teaching apparatus;
- security, industrial control.

ESP8266 WIFI Module

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espresso if system. It is mostly used for development of IoT (Internet of Things) embedded applications.

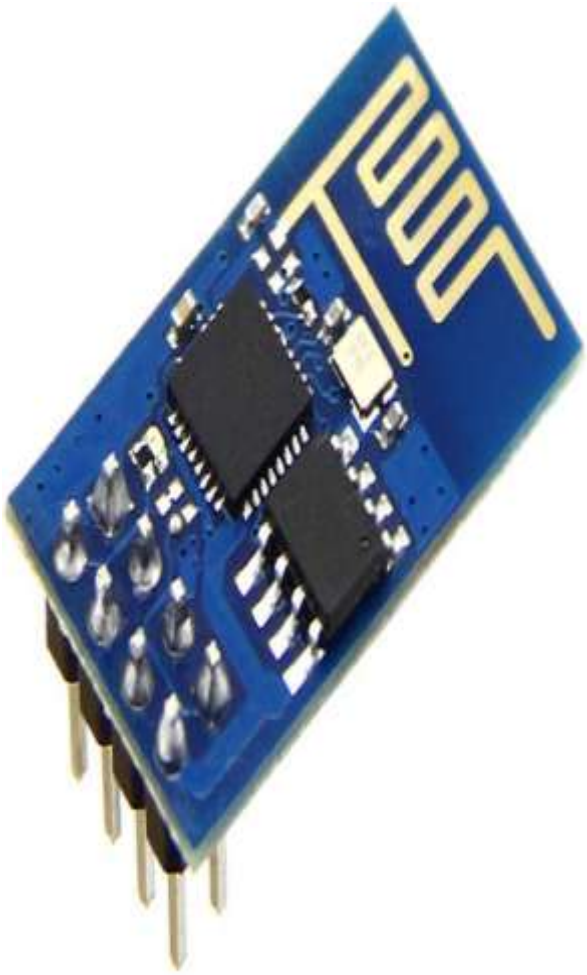


Figure 4.25: ESP8266-01 WIFI Module

Implementation Details:

This system will make a record of all the locations of potholes which were came in the way of the vehicle having this system. This record of potholes will help the road maintenance department to locate these bad roads. This can help to make maintenance work faster. In this System the driver of the vehicle will be able to avoid the pothole as he/she can get alert 10 sec before, when the vehicle speed will be medium i.e. 30 kmph. If speed of vehicle will be less, then alert time will be earlier and vice versa. The architecture of proposed system consists of 3 i.e. parts: sensing unit, server unit and user unit.

ULTRASONIC SENSOR:

Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the audio range. The HC-SR04 module includes ultrasonic transmitter, receiver and control circuit. It measures distance between two objects and this distance is calculated depending upon the time taken by the ultrasonic pulse to travel a particular distance. The module sends a 40 kHz square wave and detect the received pulse signal automatically. The distance is calculated based on the time taken by the transmitted signal to return.

In this system there is a Arduino based sensing module and android based user interface. The low-cost modules are placed on the vehicles so its efficient for users as they don't have to have an external sensing function when they get on or off the vehicles. System can be divided into two parts first the Arduino part and second one android part. The Arduino part as to take the raw data form the ultrasonic sensors. Arduino process the ultrasonic sensor data received. If the Value received is more than threshold value, System considers it as pothole and intimation will be sent through WIFI.

Results

The pot hole robot will be using a chassis as a base to connect and assemble everything on it will be consisting of four motors. Two of which are toy motors and the other being gear motors. The robot is capable of doing three separate functions.

- Automated and Manual Movement

- Sensing the Pothole
- Automated pothole filling
- Intimation

PROJECT PHOTO

Components for the Real Time Implementation

- Arduino should be replaced with Raspberry Pi for camera-based implementation for better accuracy.
- Ultrasonic sensor should be replaced with sonar sensor for better accuracy.
- High Torque motors are used.
- Mechanical Fabrication Module.

Conclusion

A significant step towards addressing the issue of road safety and maintenance through innovative technological solutions. By developing an Arduino-based sensing model for automatic detection and filling of potholes, the project offers a practical and efficient approach to enhancing road infrastructure and reducing the risk of accidents caused by poor road conditions.

The system's ability to detect potholes, estimate their depths, and initiate the filling process not only improves road safety but also contributes to the overall well-being of society by preventing accidents and minimizing disruptions to transportation networks. The cost-efficient nature of the proposed system, coupled with its potential for reducing labor work and power consumption, underscores its value in promoting sustainable road maintenance practices.

As we look at the future, the project paves the way for further advancements in road maintenance technology, including the integration of real-time data updates, enhanced communication systems, and predictive maintenance capabilities. By continuing to innovate and refine the Pot Hole Detection Robot system, we can strive towards creating safer, more resilient road networks that benefit communities and economies alike. And for the future works the Google maps and Satellite Navigation System (SATNAV) can also be integrated to the project to improve the user experience.

Future Scope

The proposed system considers the presence of potholes. However, it does not consider the fact that potholes or humps get repaired by concerned authorities periodically. This system can be further improved to consider the above fact and update server database accordingly. Also, Google maps and SATNAV can be integrated in the proposed system to improve user experience.

The proposed system can be further improved to display alerts such as ‘Bad road ahead’ in order to help the driver be more alert while driving/riding on such roads.

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