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Pot-Hole Detection and Levelling Robot

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ABSTRACT: In the proposed system our main aim is to detect the pot holes and automatic levelling of the detected pot holes. The ultrasonic sensor measures the depth of the potholes and the normal road and compares between them. Once vehicle detects the potholes ,the levelling mechanism gets activated and it will levels the pot holes with the normal road. The movement of the model can be controlled both manually and automatically by the user through the android application. This system provides the more accurate results and helps in avoiding the accidents. Upon detec-tion of pot holes, an autonomous robotic system is deployed to fill the identified cavities promptly. The robotic system is equipped with a dispensing mechanism capable of dispensing appropriate filling materials, such as asphalt or concrete, to repair the pot holes efficiently. Furthermore, the system incorporates machine learning techniques to adaptively optimize the filling process based on factors such as road conditions and traffic flow Field tests conducted on various road surfaces demonstrate the effectiveness and efficiency of the proposed system in detecting and repairing pot holes. The system offers significant advantages over conven- tional methods, including reduced maintenance costs, minimized traffic disruptions, and improved road safety. Additionally, the scalability and flexibility of the system make it suitable for deployment in diverse urban and rural environments...

KEYWORDS: Pot hole detection, filling, levelling, Sensor, Road maintenance, Filling materials.

I. INTRODUCTION

Path-holes are a common problem on roads worldwide, causing inconvenience, damage to vehicles, and posing safety hazards to drivers. Detecting and repairing potholes promptly can significantly improve road quality and safety. Pothole detection systems aim to address this issue by leveraging technology to identify and locate potholes on roads efficiently. These systems typically utilize a combination of sensors, data processing algorithms, and communication networks to detect and report potholes in real-time. India, the second most populous Country in the World and a fast-growing economy, is known to have a very big network of roads. Roads are the dominant means of transportation in India today. Typically caused by the combination of weather conditions, traffic, and time, potholes appear as small to large depressions in the road pavement. These holes can vary in size and depth, posing a hazard to motorists and pedestrians by causing damage to vehicles and presenting a safety risk. Potholes are a prevalent issue on many roadways and can lead to costly repairs and accidents if left unattended. It is crucial for authorities to address potholes promptly to ensure the safety and integrity of the road network. 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 . “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.

II. METHODOLOGY

To implement this project we are using ultrasonic sensor. We need two ultrasonic sensor one for pothole detection and another one for object detection. Detection of Pot-hole is done using Ultrasonic Sensors. The HC-SR04 module includes ultrasonic transmitter, receiver and control circuit. It measures distance between two objects and this distance are 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, then it automatically calculates the amount of depth of the Pothole. Filling of pothole is done using, the Microcontroller which sends the command to the servo feeder to turn ON for a specific time as per the depth of the Pothole. After dispensing the Cement, the Robot will move ahead in the forward direction and the

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Cement dispensed on the road will be levelled up by the passive Roller which is attached at the backside of the Robot.

BLOCK DIAGRAM

Block diagram of the implemented system in shown in fig.1

HARDWARE DESCRIPTION

The following hardwares were used in the implemented system:

1) ARDUINO UNO
2) L293D MOTOR DRIVER
3) DC MOTOR
4) BLUETOOTH MODULE HC-05
5) ESP32 AI Thinker CAM
6) ULTRASONIC SENSOR

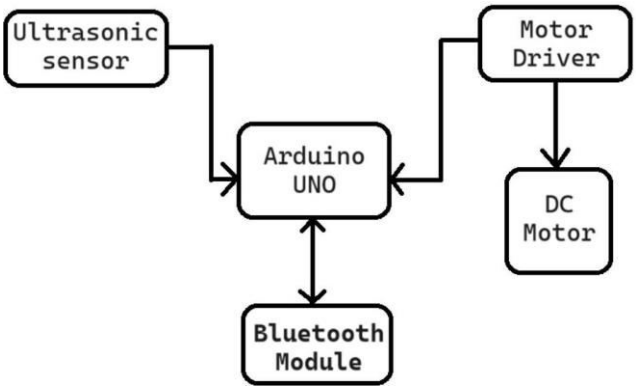

Fig. 1. Block diagram of pot hole detection

these patches. It starts filling the target region from the highest priority patch by finding the best match patch. This procedure is repeated until entire target region is inpainted.

A. ARDUINO UNO

The Arduino Uno is shown in above fig. 2 and it is one of the most popular and widely used microcontroller boards in the Arduino ecosystem as shown in figure 2. It is based on the ATmega328P microcontroller and provides a versatile platform for prototyping and creating a wide range of electronics projects. Here are some key features and characteristics of the Arduino Uno:

1) Microcontroller: The Arduino Uno is powered by the ATmega328P microcontroller, which has 32KB of flash memory for storing program code, 2KB of SRAM for variables, and 1KB of EEPROM for data storage.
2) Digital and Analog I/O: The Uno features 14 digital input/output pins, with 6 of these pins capable of pro- viding PWM (Pulse Width Modulation) output. It also has 6 analog input pins for reading analog sensor values.

Fig. 2. Arduino UNO

1) Power Supply: The board can be powered via USB connection, a DC power jack, or an external power source. The

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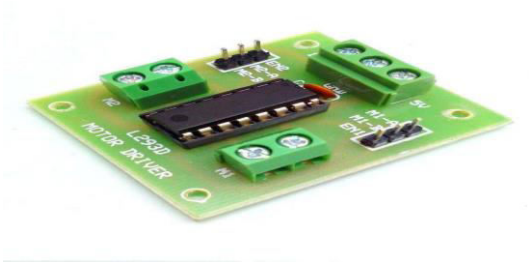
recommended operating voltage is 5V, and it can accept input voltages ranging from 7V to 12V.

2) USB Interface: The Uno has a built-in USB interface, which is used for uploading sketches (programs) to the board and for serial communication with the computer.
3) Programming: The Arduino Uno is programmed using the Arduino IDE, a user-friendly software development environment that simplifies the process of writing, com- piling, and uploading code to the board



A. Fig. 3. L293D MOTOR

B. L293D MOTOR DRIVER

The L293D IC is shown in above fig. 3

1. Motor Control: The L293D IC has two H-bridge circuits, which allow it to control the direction of the connected motors. An H-bridge is a circuit that enables a motor to be driven forward or backward. In the case of the L293D, one H-bridge is used to control one motor, and the other H-bridge is used to control another motor.
2. Input Signals: The L293D requires input signals to control the direction and speed of the motors. By sending specific signals to the input pins of the L293D IC, you can control the rotation direction (clockwise or counterclockwise) and speed of the connected motors.
3. Enable Pins: The L293D has enable pins (often labeled as EN1 and EN2) that allow you to enable or disable the outputs of the motor driver. When the enable pin is set to HIGH, the motor is enabled, and it will respond to the input signals. When the enable pin is set to LOW, the motor is disabled.
4. Power Supply: The L293D IC requires a separate power supply for the motors (often labeled as VCC1 andVCC2). Make sure to connect an appropriate power supply to power the motors connected to the L293D.
5. Output Connections: The L293D has output pins (often labeled as OUT1, OUT2, OUT3, and OUT4) that are connected to the motors. By setting the appropriate input signals to the control pins, you can control the direction and speed of the motors connected to these output pins.

DC MOTOR

Fig. 4. DC MOTOR

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Simple Construction: DC motors have a relatively simple construction, typically consisting of a rotor (armature) and a stator (field), making them easy to understand and maintain.

Speed Control: DC motors offer easy speed control through varying the voltage or current supplied to the motor. This flexibility in speed adjustment makes them versatile and adaptable to different operating conditions.

Quick Acceleration: DC motors have the ability to provide rapid acceleration and deceleration.

Reliability: DC motors are known for their reliability and durability, providing consistent performance over extended periods when properly maintained. DC motor is shown in above fig. 3

A. Bluetooth Module HC-05

The Bluetooth HC05 shown in fig. 5 uses the Bluetooth 2.0 protocol and can be used to establish a wire- less connection between microcontrollers, computers, or smartphones. The HC05 module features a range of up to 10 meters and has a data transfer rate of up to 2.1 Mbps.

It can be easily configured using AT commands

Bluetooth version: Bluetooth 2.0 (supports EDR - En- hanced Data Rate)

Operating voltage: 3.6V to 6V

Default baud rate: 9600 bps

Operating modes: master and slave

Communication interface: UART

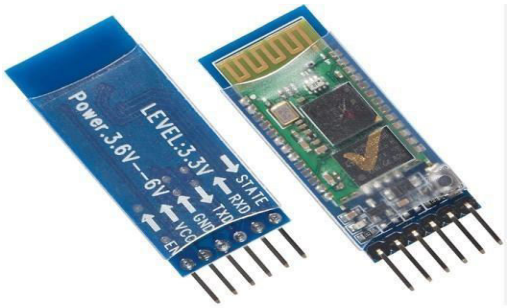

Fig. 5. Bluetooth Module

1) Range: Typically around 10 meters, but can be extended with the use of an external antenna
2) Easy to use and configure
3) Widely supported by various microcontrollers and de- velopment platforms

B. ESP32 AI Thinker CAM

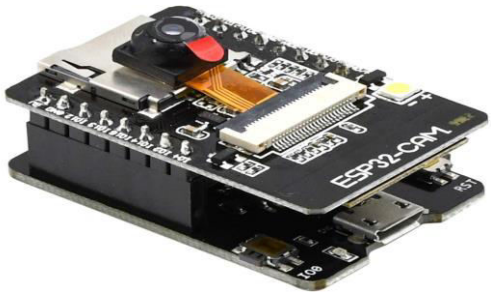

Fig. 6. ESP32 CAM Module

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- The ESP32 AI Thinker CAM shown in fig. 6 is a small size, low power consumption camera module.
- It comes with a 2MP OV2640 camera that can capture video at 60frames per second.
- It has built-in Wi-fi and Bluetooth connectivity.
- It also has slot for micro-SD card and USB port.
- It is compact yet offers high performance for computer
- vision and image processing applications.

C. ULTRASONIC SENSOR

1) Operating Principle: Ultrasonic sensors shown in fig. 7 work on the principle of sending and receiving ultrasonic sound waves to measure distance or detect objects.
2) Distance Range: Ultrasonic sensors can typically detect objects within a range of a few centimeters to several meters, depending on the sensor model.
3) Environmental Adaptability: Ultrasonic sensors can op- erate effectively in various environmental conditions, including lighting variations, temperature changes, and even in dusty or humid environments.
4) Easy Integration: Ultrasonic sensors are easy to integrate into different systems and projects, making them popular in robotics, automation, and industrial applications.

SOFTWARE IMPLEMENTATION

Arduino IDE

The Arduino Integrated Development Environment (IDE) is a user-friendly software application that is used for pro- gramming and developing code for Arduino microcontroller- based projects. It provides a simple and intuitive platform for writing, compiling, and uploading code to Arduino boards. The Arduino IDE is open-source and can be easily downloaded and installed on various operating systems, making it widely accessible to hobbyists, students, and professionals alike.

One of the key features of the Arduino IDE is its simplicity, which makes it ideal for beginners who are just getting started with programming and electronics. The IDE uses a simplified version of the C and C++ programming languages, making it easy to learn and use for creating projects and prototypes. Users can write code in the Arduino IDE using a text editor, and the IDE provides built-in functions and libraries that simplify common tasks such as reading sensor data, controlling outputs, and communicating with other devices.

The Arduino IDE also includes a serial monitor feature, which allows users to easily debug and monitor their projects by displaying output messages and data sent from the Ar- duino board. Additionally, the IDE supports a wide range of Arduino-compatible boards, allowing users to select their specific board model and port before uploading their code.

Overall, the Arduino IDE serves as a valuable tool for both beginners and experienced users to develop and experiment with electronics projects. Its user-friendly interface, extensive library support, and compatibility with various Arduino boards make it a versatile and essential tool for creating innovative and interactive projects in the world of physical computing and DIY electronics.The Arduino Integrated Development Environment (IDE) is a user-friendly software application that is used for programming and developing code for Arduino microcontroller-based projects. It provides a simple and in- tuitive platform for writing, compiling, and uploading code to Arduino boards. The Arduino IDE is open-source and can be easily downloaded and installed on various operating systems, making it widely accessible to hobbyists, students, and professionals alike.

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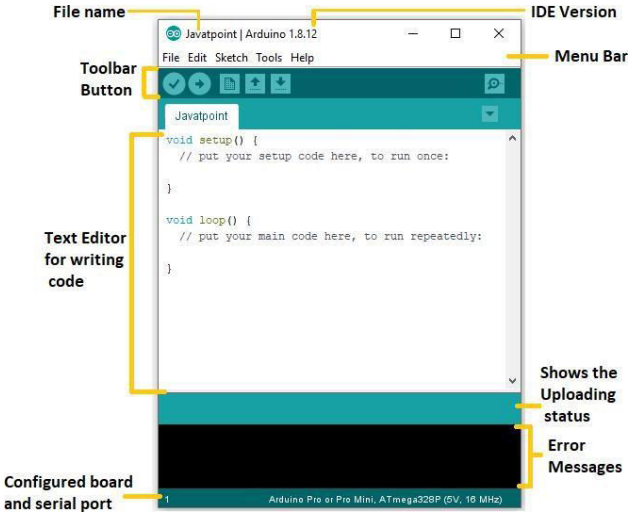

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Overall, the Arduino IDE serves as a valuable tool for both beginners and experienced users to develop and experiment with electronics projects. Its user-friendly interface, extensive library support, and compatibility with various Arduino boards make it a versatile and essential tool for creating innovative and interactive projects in the world of physical computing and DIY electronics.

III. EXPERIMENTAL RESULTS

- POT-hole detection and filling robot is controlled by Mobile app via Bluetooth and front view and top view

Fig. 7. GRAPH

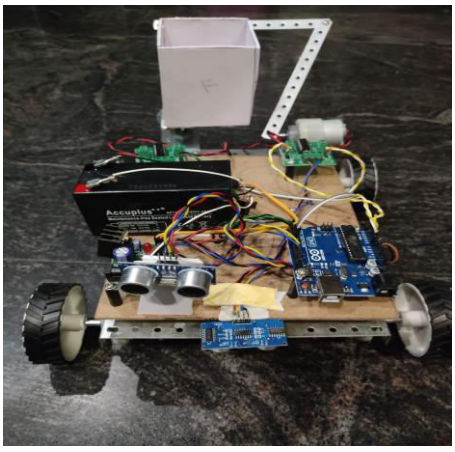

Fig. 8. Top view of the Robot

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DEPTH DISTANCE (cm)	POT-HOLE FILLED\NOT FILLED
3	NO
5	NO
7	NO
9.5	YES
10	YES
14	YES

- Ultrasonic sensor can sense pot holes around 10cm above range as shown in fig.12
- The Robot can move in all four directions i.e., front, back, right, left.
- Camera of 2MP in the anterior part of rover captures the surroundings and it is live streamed in a Web Server with a resolution of 1200-1600. This enables remote access to the robot by connecting any device via Wi-Fi.

Thus a fully functional robot is developed and we can conclude that greater the range slower response of the robo and range around 10cm and above pot holes are filled

IV. CONCLUSION

In conclusion, the pot hole detection and leveling robot designed using ultrasonic sensors, L293D motor driver, Blue- tooth sensors, and Arduino IDE successfully addressed the challenge of automatically detecting and filling potholes on the road. The ultrasonic sensors were utilized to detect the presence of potholes, while the L293D motor driver facilitated the movement and control of the robot. The Bluetooth sensors enabled wireless communication and control of the robot.
The integration of these components with Arduino IDE pro- vided a versatile and user-friendly platform for programming and controlling the robot's actions. This project demonstrates the potential of combining technology and automation to improve road maintenance processes and enhance safety for drivers and vehicles.

Further enhancements and optimizations could be imple- mented to improve the efficiency and accuracy of the pot hole detection and leveling robot, such as incorporating additional sensors for better detection accuracy, optimizing the control algorithm for smoother operation, and fine-tuning the robot's mechanics for more precise leveling of potholes.

Overall, this project serves as a promising example of how robotics and automation technologies can be leveraged to address real-world challenges and improve infrastructure maintenance activities.

The pot hole detection and leveling robot project has great potential for future enhancements and applications. Some potential future scope areas include:

1) Advanced Sensor Integration: Incorporating advanced sensors such as cameras, LiDAR, or radar for improved accuracy and efficiency in detecting potholes and ana- lyzing road conditions.
2) AI and Machine Learning: Implementing AI and ma- chine learning algorithms to enable the robot to learn and adapt its behavior based on different road conditions and pothole types. This could enhance its ability to detect and respond to potholes effectively.
3) Autonomous Operation: Developing the robot to op- erate autonomously without human intervention, using advanced navigation and path planning algorithms. This could enable it to accurately navigate roads and au- tonomously detect and repair potholes.
4) Remote Monitoring and Control: Integrating remote monitoring and control capabilities using IoT technol- ogy, allowing operators to track the robot's progress, receive real-time data on road conditions, and remotely control its operations.

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5) Collaborative Fleet Management: Building a fleet of pot hole detection and leveling robots that can work collaboratively to cover larger areas efficiently and effectively. Coordinating the operations of multiple robots could significantly improve road maintenance activities.

REFERENCES

[1] Taehyeong Kim, Seung-Ki Ryu, "A Guideline for Pothole Classifica- tion", International Journal of Engineering and Technology (IJET), Vol. 4, No. 10, October 2014.
[2] K. Vigneshwar and B. H. Kumar, "Detection and counting of pothole using image processing techniques", IEEE Int. Conf. on Computational Intelligence and Computing Research (ICCIC), pp. 1-4, 2016.
[3] Samyak Kathane, Vaibhav Kambli, Tanil Patel and Rohan Kapadia, "Real Time Potholes Detection and Vehicle Accident Detection and Reporting System and Anti-theft (Wireless)", IJETT, Vol. 21, No. 4, March 2015.
[4] K. E. An, S. W. Lee, S. K. Ryu and D. Seo, "Detecting a pothole using deep convolutional neural network models for an adaptive shock observing in a vehicle driving", IEEE Int. Conf. Consumer Electronics (ICCE), pp. 1-2, 2018.
[5] "Pothole Detection System using Machine Learning on Android" Aniket Kulkarni1, Nitish Mhalgi2, Sagar Gurnani3, Dr. Nupur Giri4 (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 7, July
[6] 2014)
[7] "Identifying and Reporting of Potholes and Humps using IoT" Smita Saitwadekar1, Dr. Payel saha2International Research Journal of Engi- neering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 02 — Feb 2019 .
[8] Ashish Gaikwad, Yashwant Belhekar, Mandar Dangre, Ankit Chaud- hary" Path hole Detection System: Using Wireless Sensor Network" International Engineering Research Journal (IERJ), Volume 2 Issue 12 Page 4643-4646, 2018 ISSN 2395-1621
[9] GPS[Online]Available:https://www.electroschematics.com/neo-6m-gps- module
[10] D. Santani et al., "Communisense: Crowdsourcing road hazards in nairobi", Proc. Int. Conf. Hum.-Comput. Interact. Mobile Devices Ser- vices, pp. 445-456, Aug. 2015.

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