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Pothole Detection and Levelling Robot

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Abstract: This project aims to assists the driver in avoiding potholes on the roads, by giving buzzer alert and also levels holes. This robot automatically detects pothole based on distance using Ultrasonic sensor while travelling. Leveling the detected hole to be done using Servo motors. The robot is controlled using android based smart phones through Web server. Based on the commands given by the user the robot moves accordingly. At the receiver end there are two motors interfaced with the micro controller for robot movement. Server control application is used for the controlling of robot.

I. INTRODUCTION

The roads in our country due to heavy load, climatic conditions , high population, poor quality of materials in construction causes frequent potholes in the roads. This semi automated pothole detection and levelling robot detects the pot holes in the road as it moves on, then as soon as the porthole is detected in the road it stops moving action, after feeding the cement to the robot the flow sensor after detects the depth of the pothole then opens the valve and fills the pothole with the help of a stepper motor all this process are controlled by using a controller after leveling the pothole, the robot starts moving and made as safe roads .

II. LITERATURE SURVEY

- POT-HOLE DETECTION AND CLEARANCE ROBOT Ripal Patel (2022)

The preservation of roads is one of the most important issues in emerging nations. The economy of the nation is significantly boosted by well-maintained roadways. Finding pavement problems like potholes helps drivers prevent collisions or vehicle damage and also aids in road maintenance. Numerous ongoing efforts in the field of transportation networks aim to give drivers pertinent information about the roads and traffic patterns. Indian secondary roads frequently have potholes, some of which may be wet or dry. Therefore, it is crucial to spot potholes and gauge their depths in both situations to ensure safe driving. In this project, we create a sensor model based on the Raspberry Pi, which allows for such detection and depth estimates utilizing.

- Automatic Detection of Potholes and Humps on the Road Mahesh Jala (2017)

one of the major problems in developing countries is maintenance of roads. Identification of pavement distress such as potholes that helps drivers to avoid accidents and vehicle damages. This project discusses methods that have been developed and proposes a cost effective solution to identify the potholes on roads and provide timely action to avoid accidents or vehicle damages. Ultrasonic sensors are used to identify the potholes and obstacles on the road. When the pothole is detected its depth is displayed on the LCD.

Rohith V L The main objective of the project is to design and fabricate an SemiAutomated Robot,which will detect the Pothole on the road and will discharge the required amount on concrete quantity,which is needed for the detected pothole and to do the levelling process on the discharged concrete

Vadiraj.R.S In this experiment, we are also providing manual control of the robot; if the user does not want to use the automatic, then he can monitor using an android application which has all control of robot applications, like forwarding, backward, left, right, roll, fill.

III. EXISTING SYSTEM

In existing system only pothole detection and alerting are existing. Whenever pothole detected, then robot or vehicle stops. There is NO Manual control of robot in existing system

Drawbacks:

- Levelling potholes is not implemented.
- Manual control is not implemented.

IV. PROPOSED SYSTEM

In proposed system we are using robot which has four wheels to detect the potholes. To detect the pothole Ultrasonic sensor is used. It will detect the pothole depth even after detecting Hole, robot will move forward by filling the hole. Whenever hole is detected then servomotors will activate to fill the Hole. Whenever the pothole detect GSM will send the message to the respective authorities along with pothole location. The robotic vehicle is controlled by NodeMCU through server, we can control the robot from anywhere in world. Based on the commands robot will move right, left, front, back and stop.

V. BLOCK DIAGRAM

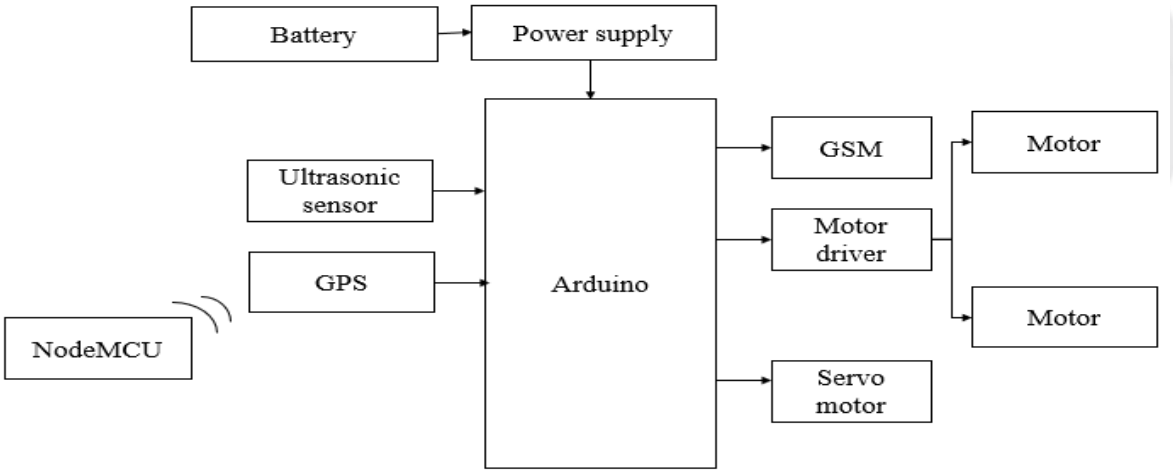

Fig 1: Block diagram of proposed system

VI. HARDWARE ARCHITECTURE DISCRIPTION

Arduino uno:

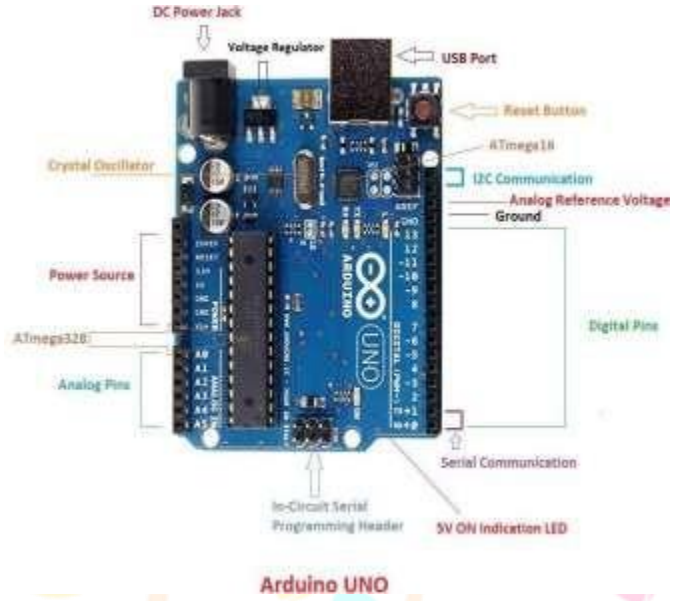

Fig 2: Arduino uno

The Arduino uno board is a popular open-source microcontroller board that is designed to be easy to use for beginners in electronics and programming. The board is based on the Atmega328p microcontroller chip and has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, and a power jack. The digital pins can be used for digital input/output, pulse width modulation (PWM), and communication with other devices via protocol such as SPI, I2C, and UART, Additionally, the analog inputs can be used to measure voltages within rages of 0 to 5 volts.
13KB of flash memory is used to store the number of instructions in the form of code. The board is powered up in three ways i.e USB, Vin pin the board or DC power jack. Arduino uno comes with built-in LED providing HIGH value when it gets turned ON and LOW when it gets turned OFF. Serial communication is carried out through two pins called pin 0(Rx) and pin (Tx). Here Rx pin for receiving data and Tx pin for transmitting the data.

Ultrasonic sensor:

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e., the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

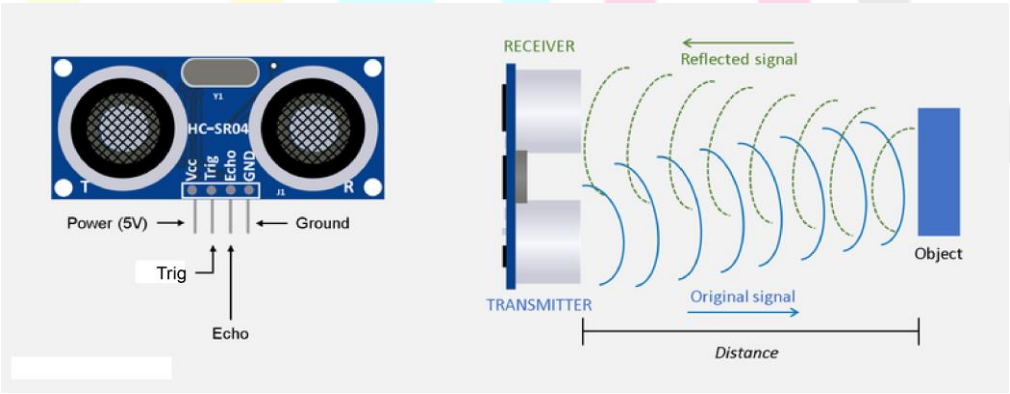

Fig 3: Ultrasonic sensor

HC-SR04 Ultrasonic Sensor - Working

As shown above the HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor

Node Mcu:

NodeMCU is an open-source firmware and development kit that plays a vital role in designing your own IoT product using a few Lua script lines.

Multiple GPIO pins on the board allow you to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.

The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module.
The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects you with a well-known developer community.

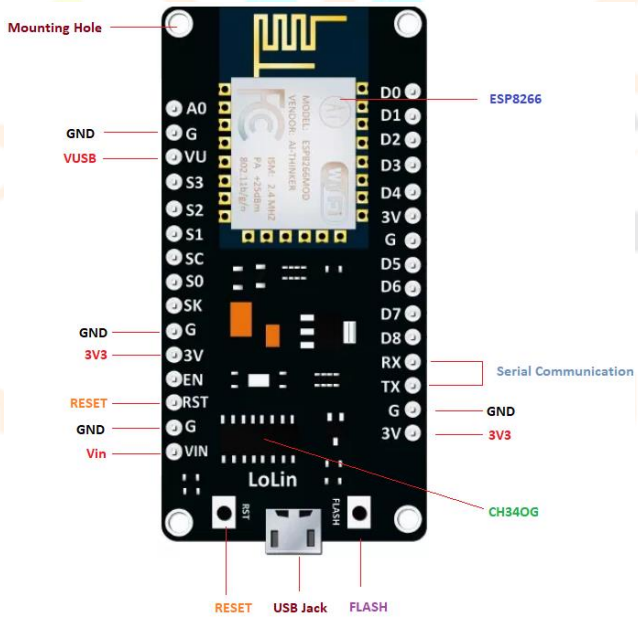

Fig4: Node Mcu

And open source firmware gives you the flexibility to edit, modify and rebuilt the existing module and keep changing the entire interface until you succeed in optimizing the module as per requirements
USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication.

Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.

Servomotor:

A servomotor is an electromechanical device that is used to control the position of an object. It is a rotary actuator that uses acontrol signal to precisely control the speed and position of its output shaft. The servomotor consists of a motor, a gearbox, acontrol circuit, and a feedback mechanism.

Fig 5: Servomotor

The control circuit of a servomotor receives a signal from a microcontroller or other control device, which determines the position and speed of the output shaft. The feedback mechanism, which is usually a potentiometer, provides information about the actual position of the shaft to the control circuit. The control circuit compares the desired position with the actual position and adjusts the output signal to the motor to achieve the desired position.

Servomotors are used in a wide range of applications, such as robotics, industrial automation, aerospace, and automotive industries. They are known for their high accuracy, precision, and repeatability, making them ideal for applications where precise control of position and speed is required.

GPS:

GPS (Global Positioning System) is a satellite-based navigation system that provides accurate location and time information. It is widely used in embedded systems for various applications, such as vehicle tracking, asset tracking, and navigation systems.
GPS works by receiving signals from multiple satellites in orbit around the Earth. The GPS receiver calculates its position based on the time it takes for the signals to reach it from the satellites. The accuracy of GPS depends on the number and position of the satellites that are in view of the receiver.

Fig6: GPS

In embedded systems, GPS is typically used in combination with other sensors, such as accelerometers and gyroscopes, to provide more accurate and reliable navigation information. The GPS receiver provides information about the device's location, while the other sensors provide information about its orientation and movement.
GPS is available in different formats, including modules that can be easily integrated into embedded systems. These modules typically provide a serial interface for communication with the host device and can be programmed to provide different levels of accuracy and functionality.

GSM:

GSM (Global System for Mobile Communications) is a standard for digital cellular communications used for mobile devices. It is widely used in embedded systems for various applications, such as remote monitoring, control, and communication.
GSM works by transmitting data over a cellular network using radio waves. The data is encoded and transmitted over a series of base stations, which are connected to the public switched telephone network (PSTN). The GSM standard includes various features, such as voice communication, text messaging, and data transmission.

In embedded systems, GSM is typically used for remote communication and control. For example, a device with an embedded GSM module can send and receive data over a cellular network, allowing it to be controlled or monitored from a remote location. This is particularly useful for applications such as remote monitoring of industrial equipment, environmental sensors, or security systems.

Fig 7: GSM

GSM modules for embedded systems are available in different formats, including compact modules that can be easily integrated into embedded systems. These modules typically provide a serial interface for communication with the host device and can be programmed to provide different levels of functionality, such as voice communication or data transmission.

Buzzer:

A buzzer is a simple but versatile device used in embedded systems to generate audible alerts or notifications. It is an electro-acoustic transducer that converts electrical signals into sound waves. This makes it easy to use in embedded systems, as it can be driven using simple digital signals from the microcontroller or processor. Buzzer is commonly used in applications such as alarms, timers, and notifications. It can produce a range of sounds, from simple beeps to more complex melodies, depending on the type of circuitry and driver used. Buzzer can also be used in combination with other sensors or modules, such as temperature sensors, to create more sophisticated warning systems. Additionally, buzzer is typically small and lightweight, making it suitable for use in portable or handheld devices. It can be made more versatile by incorporating features such as adjustable volume or tone. Overall, buzzer is a cost-effective and reliable component for adding audible feedback to embedded systems.

Fig 10: Buzzer

VII. WORKING OF PROPOSED SYSTEM

When the Gas level reaches certain low level than the threshold weight of gas cylinder, then we receive a message to the mobile number indicates about the status of gas cylinder is empty. Here load cell is used for measuring the Weightof the gas cylinder continually. If gas is leaked out, then mq2 gas sensor detects the gas leakage and gas valve gets turnedoff automatically with the help of servomotor to regulate the gas leakage from the gas cylinder. GSM send a message toour mobile like gas is leaking. In this system buzzer is used as alarm indicating gas is leaking. Whenever the gas is leakedout fan gets turned on to pump gas leakage towards the outside. It intimates live location to the near fire station wheneverheavy gas leakage is happened.

VIII. RESULTS

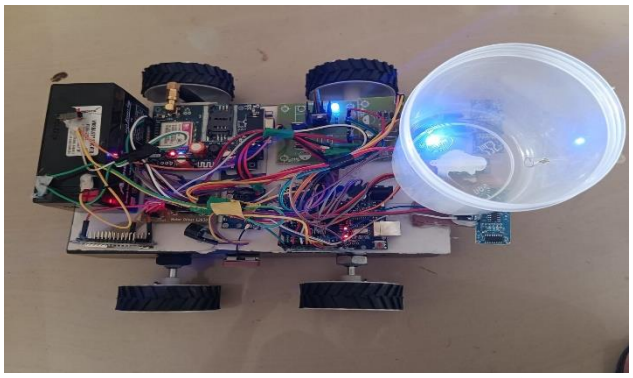

Fig 11: Circuit connections

The above figure shows the connection of the circuit. Whenever a pothole is detected it sends a message to our mobile phone like pothole is detected along with latitude and longitude.

Fig 12: Messages received to our mobile through the GSM

Fig 13: GPS Location

IX. CONCLUSION

The objective of this project work has been framed into chapters for the development of pothole detection and levelling robot. The basic C programming using Arduino and design of robot have been included.

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