



POTHOLE DETECTION USING RASPBERRY PI

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Manuscript History

Number: IRJCS/RS/Vol.06/Issue06/JNCS10093

Received: 29, May 2019

Final Correction: 30, May 2019

Final Accepted: 02, June 2019

Published: June 2019

doi://10.26562/IRJCS.2019.JNCS10093

Editor: Dr.A.Arul L.S, Chief Editor, IRJCS, AM Publications, India

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ABSTRACT: One of the emerging problem roads faces is worsened road condition. Many physical conditions like rains, oil falls, road calamities or wear and tear make the road problematic to drive. Also while driving in the darkness just the headlights might not be enough support for driver. Unpredicted hurdles on road may cause more accidents. Also due to worse road environments, fuel intake of the vehicle exceeds and also causing loss of expensive fuel. All these explanations craving that there is necessary of getting information about such worsen road conditions and collecting this information and distribute this to the vehicles, which in turn can warn the drivers. To address this issue "Pothole detection system using Raspberry Pi" has been proposed. The system alarms the user by informing about potholes on the roads, by giving him/her prior warnings. Warnings can be like Buzzer or voice message. If the user is closer to the pothole, user will be alarmed in advance about the pothole with buzzer sound. The proposed system also stores the information of the detected pothole like geographic location and image of pothole in server. The information stored in the server serves as a valuable source to the concerned Government authorities.

Keywords: Pothole, Raspberry pi.

I. INTRODUCTION

In today's world roads and transport system has become a fundamental part of every human being. Everybody uses road in one or the other way. The current transport system has decreased the distances but on the other hand it has increased the risks of many lives. Every year road crashes result in loss of many lives and damages too. Potholes can cause damages such as damage to tire and wheel, impact and damage on the mechanical part of a vehicle, sudden braking and steering wheel operations, and vehicle crash and major accidents. Heavy rains and movement of heavy vehicles are the main reasons to induce potholes. This also ends up in major painful accidents and loss of human lives. According to the survey of road accidents of India in 2011, a total of more than one lakh people had lost their lives due to disastrous road accidents. To avoid this, an effective and prompt transmission of information well in advance to drivers can definitely reduce the number of traffic accidents. So 'Pothole detection using Raspberry Pi' which aids the driver in avoiding potholes on the roads, by giving him prior alerts. Warnings can be like buzzer if the driver is some meters ahead of a pothole, or driver may be warned in prior concerning which road has how many potholes and also severity of that potholes.

II. METHODOLOGY

The system is divided into different module; in our project we make use of three modules that is ultrasonic sensor module, Arduino module and Raspberry Pi module. Each module will be having different functionalities.

The components used in the system are:

Raspberry Pi Board: The Raspberry pi is a single computer board with palm size that can be used for many tasks that every computer does like games, word processing, spread sheets and also to play HD videos.

The raspberry pi board is a portable and low cost device where everyone can afford. Maximum of the raspberry pi computers is used in smart phones. In the 21st century, the growth of mobile computing technologies is very high, a huge sector of this being compelled by the mobile industries.

SD card: Raspberry PI has no separate in-built storage on board. SD/micro SD Card stores the OS and the required functionality code. The total memory of the SD card is about 8GB.

Power supply: A micro-usb plug that supplies power at least 1A of power is used. It can also run on a battery.

Camera: It captures the image of the pothole and sends the image to the concerned authority mail.

Arduino module

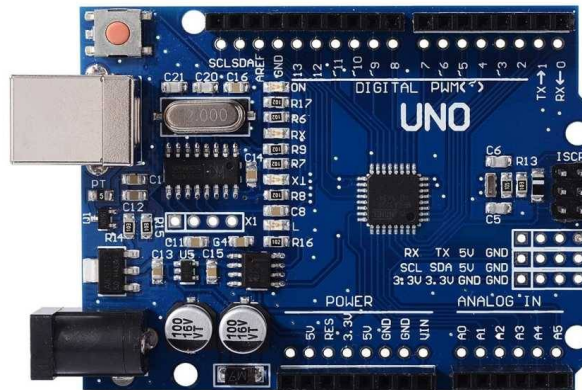


Figure 1: Arduino board

- **Power USB:** Arduino board can be powered by using the USB cable from power socket.
- **Power (Barrel Jack):** Arduino boards can be directly power-driven from the Alternate Current mains by fixing it to the Barrel Jack.
- **Voltage Regulator:** Voltage regulator in Arduino board is used to control the voltages provided to the Arduino board and stabilize the Direct Current voltages used by the processor and other elements.
- **Crystal Oscillator:** The crystal oscillator in Arduino is used to deal with time issues. It tells us that the frequency is 16,000,000 Hertz or 16 MHz or not.
- **Arduino Reset:** To start the compilation of the program embedded from first reset button on Arduino can be used.
- **Pins:** 3.3V (6th pin) – Supply 3.3 output volt, 5V (7th pin) – Supply 5 output volt, GND (8th pin) - (Ground) – There are several GND pins on the Arduino, any of which can be used to ground the circuit, Vin (9th pin) – This pin is also used to supply power externally to Arduino board, like Alternate Current mains power supply. 3.3V and 5V are the default voltages with which all the components used with Arduino board works reasonable.
- **Analog pins:** In Arduino UNO board pins from A0 to A5 these six pins are analog pins. These pins read the analog signal from analog sensors (ultrasonic sensor, humidity sensor or temperature sensor) and converts that to the digital value which can be read by any microprocessors.
- **Power LED indicator:** In Arduino board there is LED which indicates whether the power supply plug is properly connected. If the connection is proper the LED light glows. If there is any problem with the connecting the plug, then the LED will be in off mode.
- **TX and RX LEDs:** TX (transmit) and RX (receive), The TX led glows when transmitting serial data. RX led glows when receiving the serial data.
- **Digital I/O:** In Arduino UNO board from 0 to 13th are digital I/O pins in which 6 of them are Pulse Width Modulation output.

Raspberry Pi Module



Figure 2: Raspberry Pi

- **Memory:** The raspberry pi model board is inbuilt with 256MB of SDRAM and model B is inbuilt with 16GB. The normal PCs RAM memory is available in GBs. RAM memory in raspberry pi comes with more than 512MB.
- **CPU (Central Processing Unit):** In raspberry pi board, Central processing unit is the primary component which works as brain of the raspberry pi board. Logical and mathematical operations are carried out to execute the instructions.
- **GPU (Graphics Processing Unit):** In the raspberry pi board, Graphics processing unit is a specific electronic circuit designed to maximize the speed of image operations. Graphics processing unit are efficient at computer graphics manipulation and processing of image.
- **Ethernet Port:** The additional devices can be communicated with raspberry pi using Ethernet port. Internet can be accessed by plugging home router to Ethernet port.
- **GPIO Pins:** To associate with other electronic circuits the general purpose input & output pins are used in the raspberry pi. The general purpose input and output pins will accept input commands and provide output based on the programming instructions in raspberry pi. The raspberry pi has inbuilt with digital general purpose input and output pins. These pins are used to attach different electronic components. For example, we can connect raspberry pi to the ultrasonic sensor to transmit digital data.
- **ZigBee Socket:** In raspberry pi for wireless communication the ZigBee socket is used.
- **Power Source Connector:** The power source cable is a minute switch, which is placed on side of the shield. To enable an external power supply the power source connector is used.
- **UART:** The Universal Asynchronous Receiver/ Transmitter is a serial input & output port. That can be used to transfer the serial data in the form of text and it is useful for converting the debugging code.
- **Display:** To connect raspberry pi to laptop HDMI display is only required to run the programs present in raspberry pi and view results in laptop.

Ultrasonic Sensor Module



Figure 3: Ultrasonic sensor

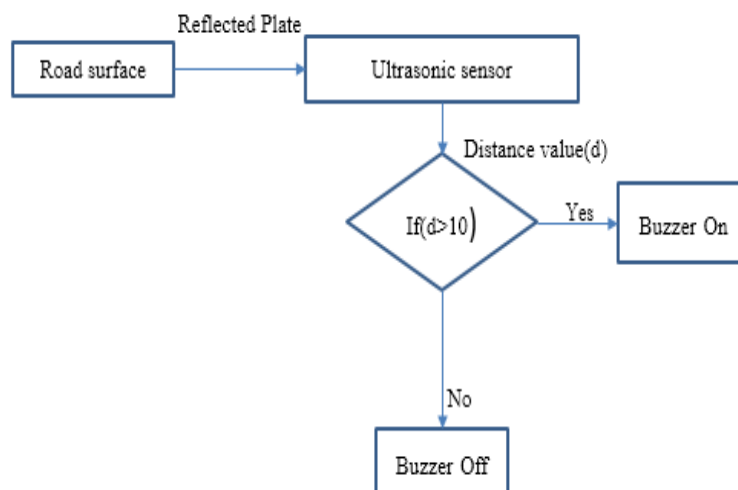


Figure 4: Working of Ultrasonic Sensor

Table 1: Ultrasonic sensor pins functionality

Pin Number	Pin Name	Description
1	VCC	The VCC pin powers the sensor, typically with +5V.
2	Trigger	Trigger pin is an input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.

3	Echo	Trigger pin is an input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
4	Ground	This pin is connected to the ground of the system.

The pothole can be detected using Ultrasonic sensor has been used, which works on the principle of reflected sound waves to measure distance between vehicle and road surface. Pothole is detected when measured value is greater than threshold value (10 cm) otherwise the road surface is clear. As soon as pothole is detected buzzer will be ON and server will be updated with the pothole data like pothole images and location. This procedure is summarized visually in flow chart Figure 5.

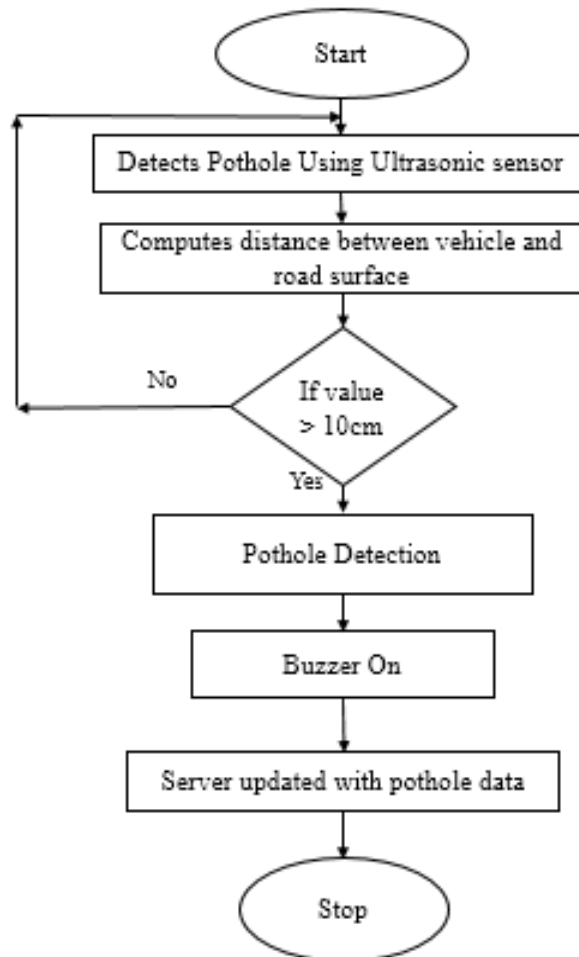


Figure 5: Flow chart of pothole detection system

The potholes information where latitude and longitude of the location is sent to the Thing Speak platform. In order to connect with Thing Speak platform for each particular device unique API key is generated. Arduino is used to control the DC motors where specific conditions are present in the code. H Bridge is the interface between the Arduino and DC motor which allows DC motors to run forward or backward. Raspberry Pi is mini Central Processing Unit. Code required for all operations on Raspberry Pi is stored in SD card. Raspberry Pi is installed with raspbian operating system which is Linux based operating system. Camera captures image of pothole and sends the image to the Raspberry Pi.

Pothole detection system consists of different modules Camera, Raspberry Pi, ultrasonic sensor and Wi-Fi module. To check the distance of pothole from the vehicle initially threshold value should be calculated. Threshold value is measured by determining distance between vehicle and road surface. The computed distance is compared with the threshold value to detect the pothole. If the measured distance which has been calculated by sensor is greater than the threshold value, then it is considered to be a pothole. When pothole is detected, the camera captures the image of the pothole and sends pothole images to the authorized people mails in order to check for the severity. In the authorized people mails geographical data of potholes and also link is provided where by clicking on it it redirects to the Google maps to see the location of pothole. To reduce the accidents on roads, pothole detection system provides prior warnings to drivers.

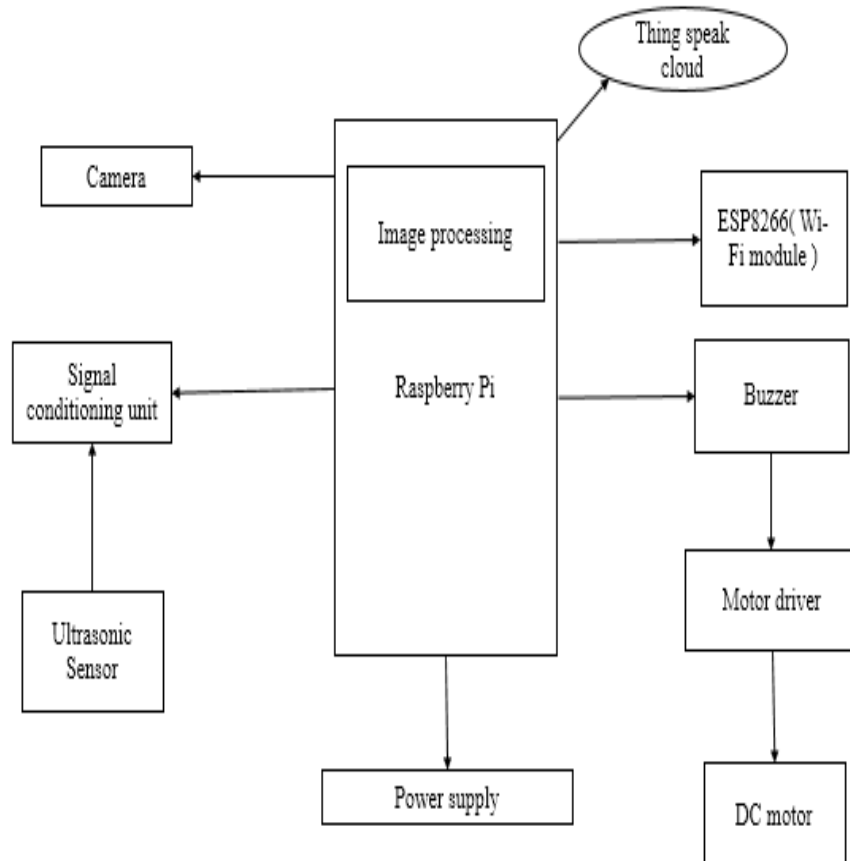


Figure 6: Block diagram of pothole detection system

Warnings can be like buzzer if the driver is approaching a pothole by doing so people lives can be saved and also accidents can be minimized. Our proposed method is designed to provide a low cost system, for pothole and drowsiness detection.

III. RESULTS

The working model of the proposed system is shown in the Figure 7

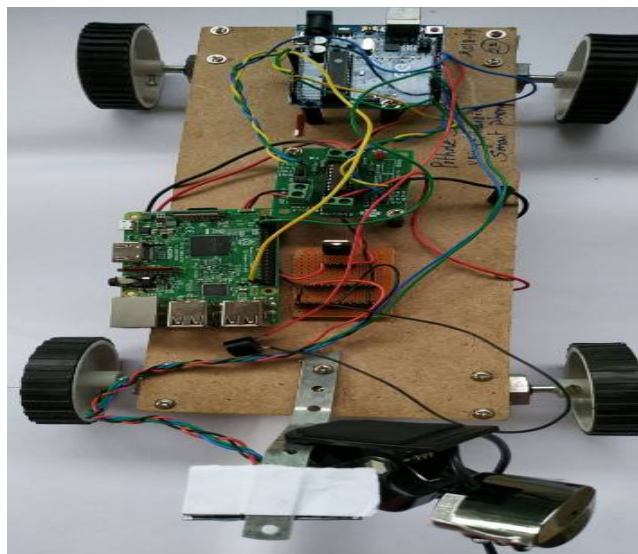


Figure 7: Proposed System

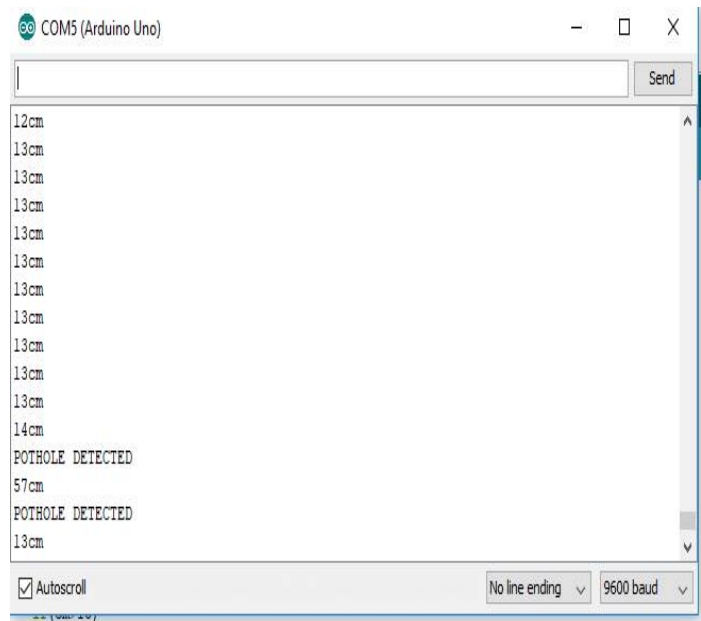


Figure 8: Serial Monitor

Figure 8 shows the snapshot of serial monitor of Arduino IDE. Pothole is detected by ultrasonic sensor by computing the distance between the road surface and vehicle. The threshold distance between the vehicle and road surface is 13cm. If the distance measured by ultrasonic sensor is above threshold, then it indicates that pothole is detected vehicle stops and captures image and also the location's latitude and longitude will be stored in things speak server then vehicle moves.

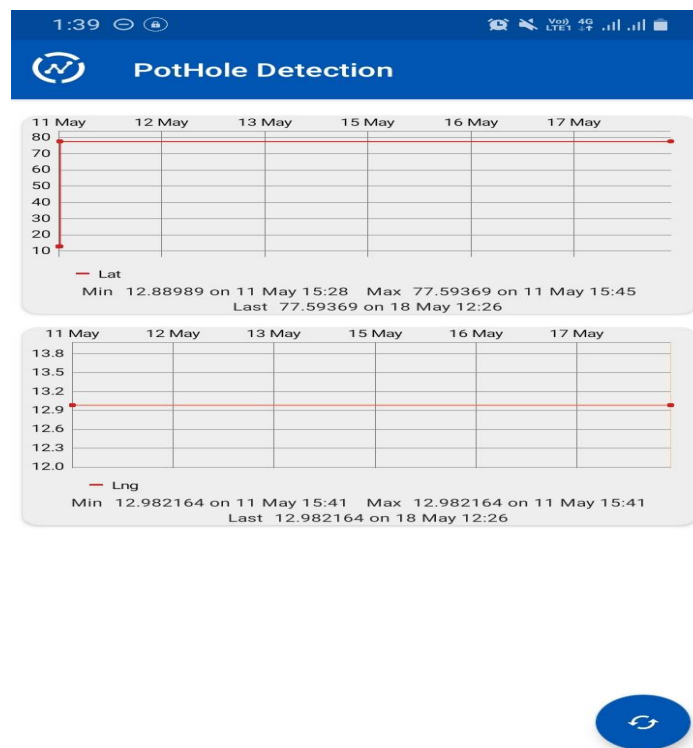


Figure 9: Geographic data of potholes

Figure 9 shows the snapshot of thing speak application which shows geographic location that is latitude and longitude in the graph format of potholes detected.

IV. CONCLUSION

The proposed system mainly serves two purposes. Firstly it automatically detects the potholes using ultrasonic sensor and when the pothole is detected buzzer will be on to alarm the driver about the pothole. When pothole is detected the vehicle stops and captures image of the pothole detected by camera.



The image captured and the geographic location that is longitude and latitude of the pothole detected will be sent to the concerned government authorities mail. The authorities can see the image and if they click on the link sent through mail they can check out the location of the pothole detected in the google maps. Also the longitude and latitude of the pothole detected is updated in the things speak platform application in graphical form. Authorized people can open the things speak app by providing the unique API key.

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