*IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)*
*e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 17, Issue 2, Ser. I (Mar. – Apr. 2022), PP 57-65*
*www.iosrjournals.org*

# Automatic Pothole Detection and Uploading Data to Cloud Servers

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***Abstract*—***This project aims to assist the driver in avoiding potholes on the roads, by giving the buzzer alert and also levels holes. This robot automatically detects potholes based on distance using an Ultrasonic sensor while traveling. Leveling the detected hole is to be done using Servo motors. The robot is controlled using android based smartphones through Bluetooth. Based on the commands given by the user the robot moves accordingly. At the receiver end, there are two motors interfaced with the microcontroller for robot movement. This system uses an ultrasonic sensor to sense the potholes and humps and which quantity the height and deepness of the potholes based on the acknowledged signals. Hence, this work can make accidents or mishaps reduction and aid in traffic control.*

***Keywords*—** *Raspberry pi, ultrasonic sensor, cloud, Global Positioning System, Pothole.*

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Date of Submission: 11-04-2022 Date of Acceptance: 27-04-2022

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## I. Introduction

Roads are the dominant means of transportation in India today. Over the last two decades, there has been a tremendous increase in the vehicle population. This proliferation of vehicles has led to several problems. Potholes are formed due to heavy rains and the movement of vehicles. The government said a total of 4,775 and 3,564 accidents occurred in the years 2019 and 2020, respectively, due to potholes. Ministry of Road Transport and Highways says 4,775 and 3,564 accidents occurred in the years 2019 & 2020, respectively, due to potholes. Potholes are formed due to heavy load vehicles passing on the weak surface roads, softness caused to the absorption of rainwater by the surfaces [illustrated as shown in Fig. 1(a), Fig. 1(b)]. To address the above-mentioned problems, a cost-effective solution is needed that collects information about the severity of potholes and also helps drivers drive safely. With the proposed system an attempt has been made to endorse drivers to avoid the accidents caused due to potholes.

(a)

(b)

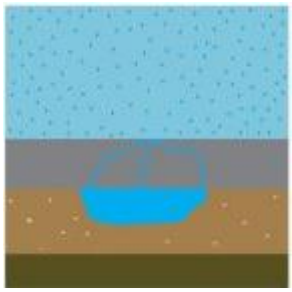


Fig. 1(a) Cracks formed on road from repeated traffic loading, sub-base weaknesses, or poor asphalt quality
Fig. 1(b) Water seeps through the cracks due to rainfall softening the road base

## II. Proposed System

The proposed real-time pothole detection approach can be used to improve the safety of traffic for transport. Here we are placing Ultrasonic Sensor which detects the potholes on road and the location is uploaded to Cloud using Raspberry Pi to alert the people who are working with the Roads construction department. The location can be traced by using GPS. The image is taken when the path hole is detected by using Web Camera. As represented in the below diagram [Fig. 2] the data will be received from the pothole detected will be captured and uploaded to the cloud server.

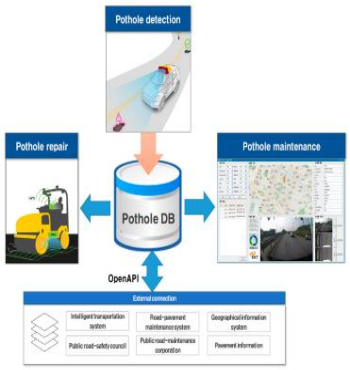



Fig.2 Pictorial Representation of the proposed system

## III. Block Diagram

Here is the block diagram of the proposed system [Fig. 3], where we can get through the input and output components used in the system.

We have used two ultrasonic sensors for detecting the pothole, Global Positioning System for identifying the particular location, web camera for capturing the images as the input components for the system. The output will be determined with the assistance of the process happening internally. It can be observed through the actuators. Here we have used Motor Driver IC which operates on the wheels of the vehicle, s that it can change the direction when a pothole is detected.

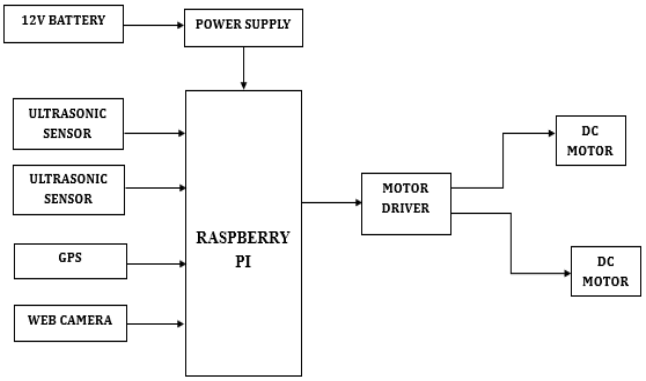



Fig.3 Block Diagram of the proposed system

## IV. Hardware Requirements

1. Raspberry Pi:

The Raspberry Pi 3B+ [Fig.4(a)] is simply the best value in Single Board Computers (SBCs). This version comes with a 1.4 GHz Broadcom CPU, 1 GB RAM, Wi-Fi, Bluetooth, HDMI Audio-Video out, Composite Audio-Video out, Gigabit Ethernet (delivers about 300 Mbps).

Fig.4(a) Raspberry Pi 3b+

2. Ultrasonic Sensor:

Ultrasonic Sensors [Fig.4(b)] measure the distance to the target by measuring the time between the emission and reception. So, the depth of the pothole is measured based on the threshold limit value.

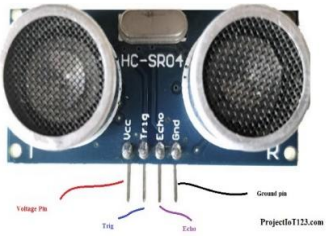



Fig.4(b) Ultrasonic Sensor

3. Global Positioning System:

It is a satellite-based geographical mapping system. [Fig.4(c)] It is used to track the location where a pothole is detected.

Fig.4(c) Global Positioning System

4. Motor Driver:

The L293D Motor driver IC [Fig.4(d)] is designed to provide bidirectional drive currents of up to 600 mA (per channel) at voltages from 4.5 V to 36 V (at pin8). It can control a set of two DC motors simultaneously in any direction.

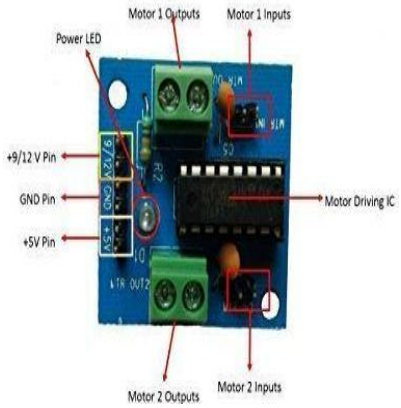



Fig.4(d) L293D Motor Driver IC

5. DC Motor:

A direct current (DC) motor [Fig.4(e)] is a type of electric machine that converts electrical energy into mechanical energy. DC motors take electrical power through direct current and convert this energy into mechanical rotation.

Fig:4(e) DC Motor

6. Web Camera:

A webcam is a digital video device commonly built into a computer. Its main function is to transmit pictures over the internet. It is popularly used with instant messaging services and for recording images.

This system uses the standard High Resolution of 720 p which measures 1280 x 720 pixels. It captures the images of the potholes immediately after they got detected based on the program implemented.

Fig.4(f) Web Camera

7. Power Supply:

A power supply is an electronic circuit that converts the voltage of an alternating current (AC) into a direct current (DC) voltage. In the prototype 12v power supply [Fig.4(g)] is reduced to 5v using a step-down transformer.


Fig.4(g) Battery

## V. Software Requirements

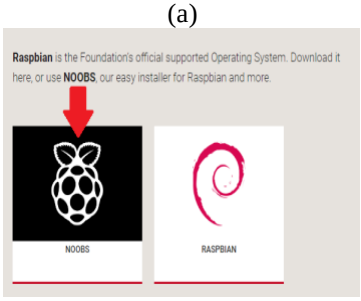
For writing the code and deploying it on the Raspberry Pi's board, we need to follow the below-mentioned steps. Here we are using the Python programming language and before writing the code we need to install the required prerequisites. It can be illustrated in the following steps.

Steps to set up your SD card:

• Format the SD card using SD Formatter 4.0

• Download the NOOBS (New Out of Box Software), as it contains an installer for the Raspbian OS. It provides the ability to alternately select one or another operating system, and download and install other different systems from the internet. [Shown in Fig. 5(a), Fig. 5(b)]

(a)




(b)

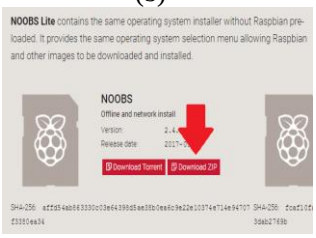



Fig. 5(a) Downloading the Raspbian, Fig.5(b) Downloading NOOBS

• Extract NOOBS from the zip archive

• Copy all the files to the SD card [illustrated in Fig.5(c)] so that they can be interfaced to the memory port of the Raspberry Pi board.

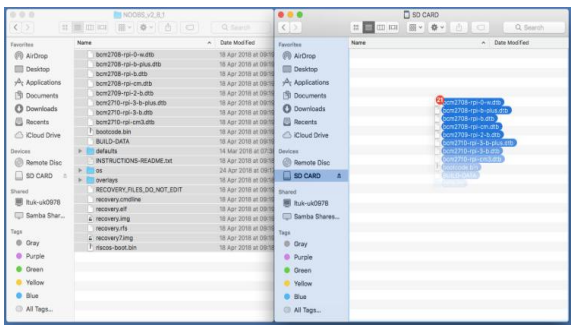


Fig.5(c) Files copying to SD card

• Installing the python IDE and can be used for programming in it as shown in Fig. 5(d)

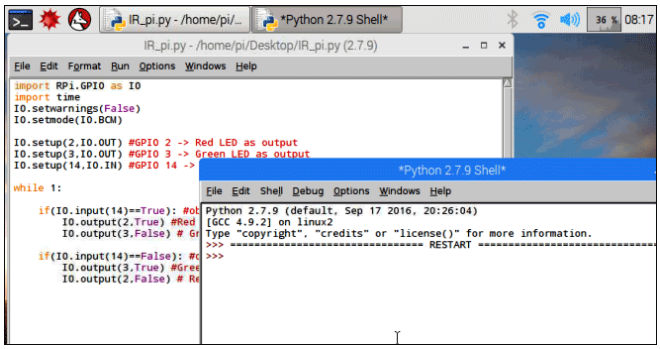



Fig.5(d) Python IDE

## VI. System Implementation

The system consists of a combination of both software and hardware (this is nothing but an embedded system) and these are interfaced over the internet. Hence this system [Fig.6] operates based on the Internet of Things (IoT) technology.

This system (Fig.6) consists of 2 ultrasonic sensors which are connected to either side of the prototype they are used to detect the potholes by sending sonic signals based on the conditions written in the program. And a GPS is used to trace the particular location where the potholes are detected. It will give the latitude and longitude values of that particular location. This raw data (collected from the ultrasonic sensors and GPS) will be sent to ThingSpeak over the internet. It yields the graphical form for the ultrasonic sensor values so that the danger of the pothole can be analyzed. It also shows the location of that particularly detected pothole.

A web camera is also used in this system it is used to take pictures of the potholes detected by the ultrasonic sensors. All these components are interfaced to a raspberry pi. A code written (using python) is deployed into it to control all the actions starting from detecting to storing the respected information in the cloud. A motor driver is used to move the prototype to either side.

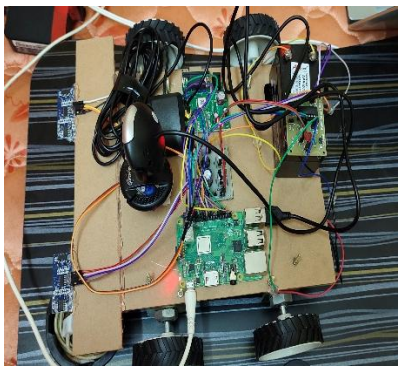


Fig.6 Hardware Prototype

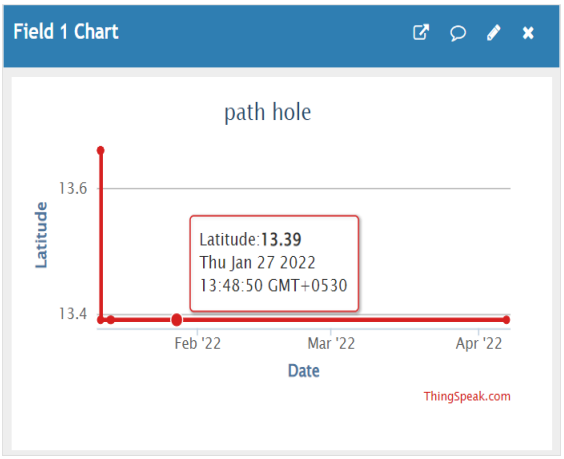
To control and manipulate the hardware prototype we have to install two applications on our pc:

1. Vnc viewer
2. Advanced IP scanner

Advanced IP scanner is used to trace the IP address of our raspberry pi and after detecting the IP address of raspberry pi we have to paste that address into the Vnc viewer it is used to control the raspberry pi and also used to edit the program from our pc. When we run the code, the prototype will automatically start moving and if it detects any pothole in its way, it will stop and take the picture of the pothole and upload those pictures to the cloud along with captured image, distance, latitude, and longitude values. After sending the obtained information to the cloud again the prototype will start moving further. All these processes should work interactively for the effective performance of the system.

## VII. Result

(a)




(b)

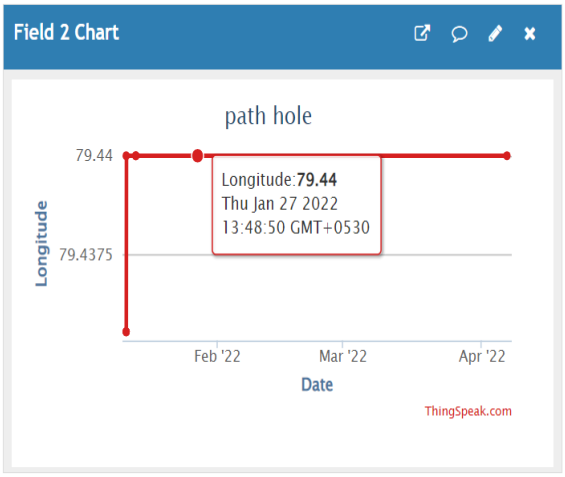
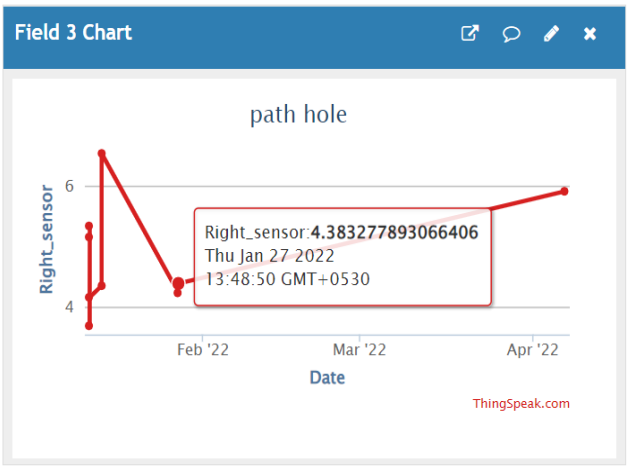



Fig.7(a) Latitude values of the pothole detected
Fig.7(b) Longitude values of the pothole detected

Immediately after detecting the potholes using ultrasonic sensors, the longitude and latitude values will be identified. These are virtually drawn with the help of the Thingspeak cloud server in the form of graphs [Fig.7(a), Fig.7(b)]. With the help of this, the exact location can find out easily. These details will be sent to the authority's mail.

(c)



(d)


Fig.7(c) Potholes detected using left sensor
Fig.7(d) Potholes detected using right sensor

There will be two ultrasonic sensors fixed at the front wheels in the prototype. This will detect the potholes under the conditions provided. The left sensors and right sensors[Fig.7(c), Fig. 7(d)] will detect the pothole and update the information to cloud servers.

The details shared to the authority's mail can be shown in Fig.7(e). With the help of received data, the authority can be able to find the danger that can be caused by the pothole detected. All these are shared with the help of a cloud server. We need to choose the cloud account that should be implemented at the development stage. We can change according to the requirements.

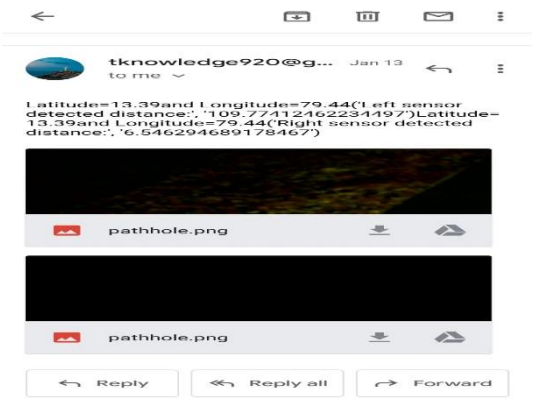



Fig.7(e) Details shared to the authority's mail

## VIII. Conclusion

In this project, we have proposed a system that will detect the potholes on the road and send data to corresponding persons using Cloud. Due to the rains and oil spills, potholes are generated which will cause accidents. After immediate identification of potholes, it will be processed based on the conditions. This information is sent to the Authority's cloud account. This timely information can help to repair the potholes on the road as fast as possible.

## Acknowledgement

This research was supported by Dr. R Gomalavalli. We thank our colleagues from Siddharth Institute of Engineering and Technology, who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations of this paper.

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Dr. R Gomalavalli, et. al. "Automatic Pothole Detection and Uploading Data to Cloud Servers." *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)* 17(2), (2022): pp 57-65.