Pothole Detection System Using IOT

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Abstract— Potholes are a nuisance that has been responsible for over a hundred thousand accidents in our country every year, accounting for an average of five thousand deaths annually. On lesser but significant damages, potholes can also generate injuries like pneumatic tire and wheel damage, impact and injury on the lower part of a vehicle, sudden braking and steering wheel operation, and can prove to be fatal for everyone on the road. Keeping in mind their affinity for damage and their constant threat, this paper was designed to explore and venture if an effective, economical and commercial product can be designed making use of the pre-existing technology in an innovative way to detect the potholes and warning a commuter of their presence. Potholes have been a major problem in Mumbai roads for a long time. In this project, we are trying to study the identification of potholes and their distribution on the roads of Mumbai. With the help of ultra-sonic sensors and GPS modules, we shall collect data on potholes (their location, their severity, etc.). And look for a probability density function of potholes dependent on the distance between two potholes. With statistical tools, we would like to map our results to the entire city. This could prove highly useful in avoiding potholes and could also be further used by authorities to fix the situation at hand.

Keywords: Potholes, Accidents, Detect Potholes, Roads of Mumbai, Ultrasonic Sensor, GPS Module, Avoid Potholes

I. INTRODUCTION

A pothole is defined as a bowl-shaped depression in the pavement surface whose minimum plane dimension is around 150 mm. Potholes can generate various damages such as flat tire and wheel damage, impact and damage to the lower part of a vehicle, and more seriously and frequently, cause fatal accidents. Given the degradation of the quality of roads in many areas of the country, more specifically, Mumbai city, the need for a detection system is on the rise.

For our project we have adopted and are pursuing the following Methodology:

1) To Detect Potholes and Ultrasonic sensor is used and data is collected (their depth and size).
2) We are using Data Processing to detect potholes and give their severity.
3) We are using a GPS module for mapping their location.
4) To display Pothole intensity and Location Google maps is used.
5) Android App is used to give access to user

II. GENERAL DESCRIPTION

A. Block Diagram

A Raspberry model 3B+ is used in this project. It is the heart of the pothole detection system. Ultrasonic sensor (HR-SC04) and GPS module (Neo-6m) are interfaced with the Raspberry pi through input output pins. Data collected from the GPS module and the ultrasonic sensor is passed to the raspberry pi which is then stored into the database for further processing. This data is mapped into the google map using in.000webhost.com.

The mapped data and the pre-existing data sets are then made accessible to the user through the application, where provisions for user interaction are made available. This coherent combination makes the application user friendly, hardware accurate and the experience refreshing and helpful.

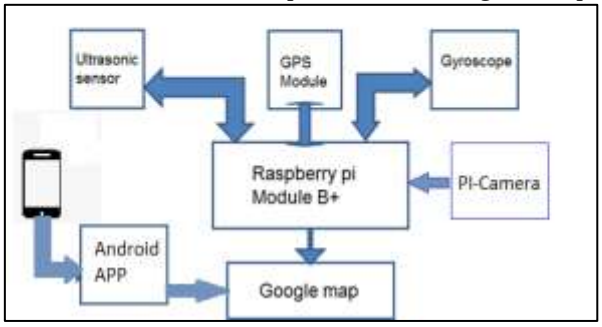

Fig. 1: Block Diagram

B. Circuit Diagram

Raspberry pi uses GPIO pins to communicate with the ultrasonic sensor and GPS module. Two pins are used by the ultrasonic sensors for triggers and echo respectively. By calculating the time taken for the wave to return we obtain the distance. To communicate with GPS module Raspberry Pi uses UART (Universal Asynchronous Receiver Transmitter) which is a computer hardware device used for synchronous serial communication. The transmission rate and data format are flexible. Ultrasonic sensor is interfaced with the Raspberry pi. It has +5v Vcc. Trigger is the input pin that remains high for 10 µs to initialize the measurement. It then sends the ultrasonic wave. The echo pin gives the output reading. GPS module operates between 3.3 to 5V. It works at the baud rate of 9600. It has a built in EPROM and an antenna. The ground pin is connected to the ground of the raspberry pi and Vcc to the 5V of raspberry pi. TX and RX are connected to the IO pins to get the data.

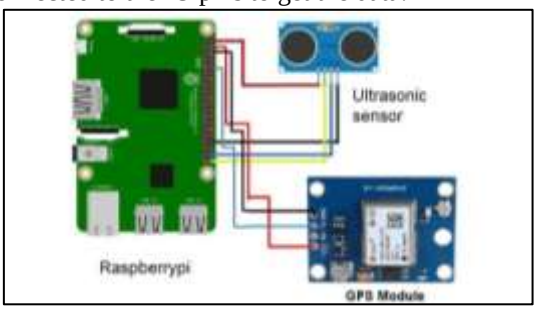

Fig.2 Circuit Diagram

Components Used:

1) Raspberry Pi (model 3b+)
2) Ultrasonic Sensor (HR-SC04)
3) Neo-6m GPS Module

C. Software Implementation

The software follows a particular flow to initialize the entire machine at work. The program first initializes all the ultrasonic sensors. This is necessary to calibrate them and avoid errors. Once the sensors are calibrated they constantly keep measuring the distance and send it to the raspberry pi. The reading is compared to a predetermined threshold and if it exceeds it then it calls the GPS () function. The GPS () function sends the raspberry pi longitude and latitude degrees. The UART port is accurate up to 5 decimals. The pi then stores both the depths and co-ordinate in a file. The function then sleeps (delay) for 200 milliseconds to prevent measurement of the same pothole again. It then loops back to the start.

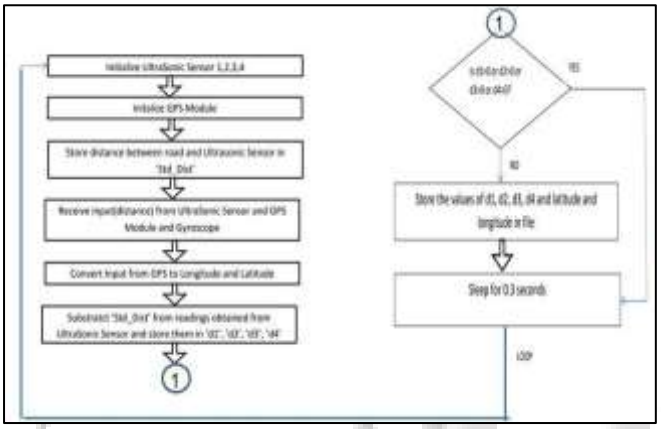

Fig. 3: Software Implementation

Software's used:

1) Python IDLE
2) VNC Viewer
3) FileZilla
4) Android Studio
5) Anaconda Software

III. FLOW DIAGRAM OF THE APP

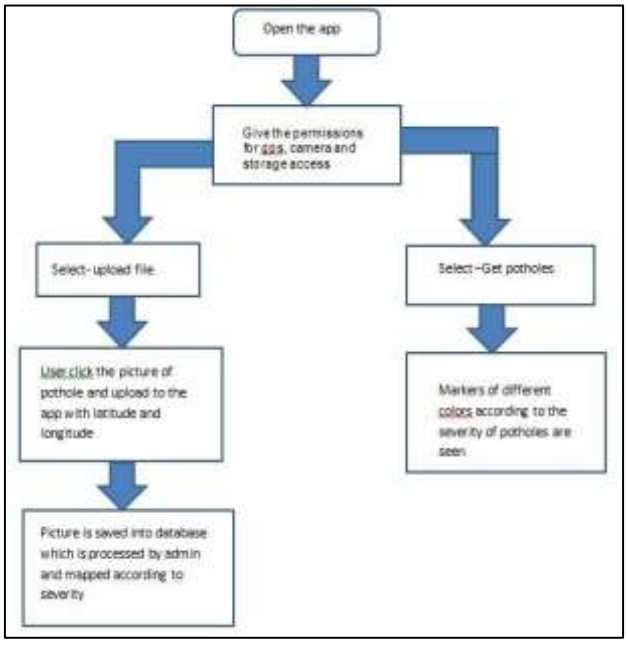

Fig. 4: Flow Chart of App

IV. RESULTS & OUTPUTS

Fig. 5.1: Initial page of the App

Fig. 5.2: Upload option on the App

Fig. 5.3: Location of the Potholes

Latitude	Longitude	Level of Severity
18.92939	72.83108	3
18.9294	72.8310	2
19.2352	72.8418	2
19.1979	72.8265	1
19.2352	72.8418	1
19.2360	72.8428	2

19.2383	72.8425	1
19.2354	72.8420	2
19.1406	72.5026	2
19.2350	72.840991	3
19.238239	72.842379	1
19.2381	72.842341	2

Table.1 Potholes Location & Severity
(3 being the highest severity and 1 being the lowest)

V. APPLICATIONS

The government can use pothole detection by which road maintenance can become easier and cost-efficient corruption in road construction. Thus the road builders will not be able to falsely say that the road was perfectly made because the higher authority as well as all the users can check the roads with the help of their GPS if the road is constructed or not without actually being present at the road. Basically, it will play an important role in the society towards development.

This module is implemented as an android application installed on the driver's mobile phone to provide alerts about the presence of potholes.

VI. CONCLUSION

Accurately detecting potholes has become the most important task for determining proper strategies for pavement maintenance and rehabilitation. The manually detecting and evaluating methods used before were both time consuming and expensive. Thus, several efforts have been made for developing a technology which will automatically detect and recognize potholes. So we investigated and analyzed different pothole detection methods which are developed so far and further propose a possible direction of developing a pothole detection method to accurately and efficiently detect the potholes. The proposed work is more economical as it uses a low-cost ultrasonic sensor, and a GPS module. Also because all the software's used for this project are free of cost.

ACKNOWLEDGEMENT

We would like to thank all the staff members of the Electronic and Telecommunication department of Atharva College of engineering who have provided us with various facilities and guided us in the development of such a sound and effective project idea. Their inputs have invariably helped the project enormously.

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