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Tracking of Potholes and Measurement of Noise and Illumination Level in Roadways

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Abstract*: *In country like India, Pothole detection is very important. Potholes on Indian roads are dry or water filled. Vehicle travelers choose best road to reach their destination. Due to pothole on roads many accidents take place. For avoiding accidents and traffic, there are lot of techniques are being used. This paper proposes pothole detection by using Google map and Blynk application. In this approach, Arduino Uno recognizes the pothole and maps on to the Google map. Blynk application is used to get desired output. This setup contain ultrasonic sensor and force sensing resistor. Ultrasonic sensor measures distance of the object by sound wave. Force sensing resistor is used to identify the presence of pothole. When the vehicle is forced to jerk then pressure sensor value goes to high and at the same time ultrasonic sensor value is checked. When the pressure sensor value is high and ultrasonic sensor is remains stable then it is identified as pothole. This information is send to the user end and pothole is plotted over the desired location.

Keywords* : *Arudino UNO, Blynk application, Force sensing resistor, Ultra sonic sensor.

I. INTRODUCTION

In India, transportation is mainly depends on roadways. But Indian roads in cities, towns and villages are in poor condition. Due to this condition, road surface monitoring is essential for municipal cooperation for quick detection and maintenance. Potholes are blow-shaped opening in the road that can be up to 10 inches deep and are caused by wear-and-tear and weathering of the roads [1].when the top layer of the road, the asphalt, has worn away and exposed to concrete base, pothole occur..

Due to the expansion and contraction of groundwater after the water enter into the ground under the pavement. In day time, the sun warms the roadways causing it to expand a small amount while night time cooling causes to contract and this leads to increase in pothole. The potholes on Indian roads are dry or water filled [7]. The figure 1 represents the pothole on Indian roads. The pothole detection is very important to avoid accidents and smooth travelling

As per latest figures by several state governments, potholes across the country claimed 3,597 lives in 2017, a more than 50 pc rise in the toll 2016.

In India, potholes claimed six lives every day. According to the data shared by states with the centre, highest number of pothole death (987) is recorded in Uttar Pradesh. In Maharashtra, the number of death due to pothole is doubled. In Delhi, 8 people dead due to pothole related accidents in 2017. The same city had seen zero deaths in 2016 [4]. Andhra Pradesh, Kerala, Odissa and West Bengal are there among the top 10 states in deaths related to potholes in the country. In 2018, the Supreme Court in New Delhi termed as “unacceptable” the death of nearly 15,000 people in road accidents caused by potholes in the last five year [5]. Many countries identify the bad condition of the roads indicating the significance of road maintenance programs. The American Society of Civil Engineers have given a D grade to the US roads (ASCE 2013), with A being the best [10]. This gives a clear picture of how potholes are becoming a dangerous for many people.

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Fig. 1 Water filled and dry road Potholes

The continuous inspection and assessment of physical and functional condition of civil infrastructure is crucial for safety, serviceability and ride ability. Currently, the manual visual inspection at regular intervals is the main form of conditions assessment in most countries [2]. But manual pothole inspection is difficult so automatic pothole detection method is used now-a-days. Existing automatic method for pothole detection can be divided as vibration based method, vision based method, 3D construction based. Vibration-based methods could provide wrong results that joints of road can be detected as potholes and potholes in the centre of a lane cannot be detected using accelerometers due to no hit by any of the vehicle's wheels [3]. Another method of detecting pothole is 3D reconstruction using laser scanning systems. The cost of laser scanning equipment is high. Although the vision based using RGB color space image segmentation is less accurate and not an end user application. In vision based pothole detection with image processing and spectral clustering has 81% accuracy of pothole detection which is less when compared to other system [9]. Spectral clustering may be little bit complex. Pothole detection method using smart phones is more accurate and less cost [11]. But the drawback is, it would be more convenient if the mobile device was not fixed to the vehicle, but rather allowed to be placed in the pocket of the user. Detection of pothole and speed breaker using android phone has been tested only by keeping the phone in a four wheeler not two wheeler [6]. Pothole detection using autonomous robot contain blog section features can be added like blob moment, shape features [8].

This paper discusses about the detection of pothole using Google map and Blynk application. The proposed system consists of Arduino Uno, Ultrasonic sensor and force sensing device. First, the ultrasonic sensor value is detected using ultrasonic wave and pressure sensor value is measured using force sensing device.

These values are analyzed in this method and result is send to user and pothole is plotted in maps. This method is sufficient to estimate the road quality and avoiding traffic congestion and collision by giving prior knowledge about the travel. This method has high degree of accuracy compared with previous work.

II. EXISTING METHOD

Pothole occurrence is rapidly increased due to abnormal weather conditions like heavy rain in summer and snowfall. It produces many social issues and social cost because of vehicle breakage and accidents. So, automatic pothole detection is studied to avoid these damages. Pothole detection model is shown in figure 2. Light Detections and Ranging gives the distance information about the time when the infrared ray comes back from the object. Laser measurement plays a major role in various fields like autonomous vehicles, global environment observations, atmospheric analysis etc. LiDAR based-three dimensional mapping technology has been actively studied. For video based pothole detection Open Source Computer vision (OpenCV) is used .It is a real-time Computer imaging programs. 2D LiDAR and camera based pothole detection method is used in the existing system.

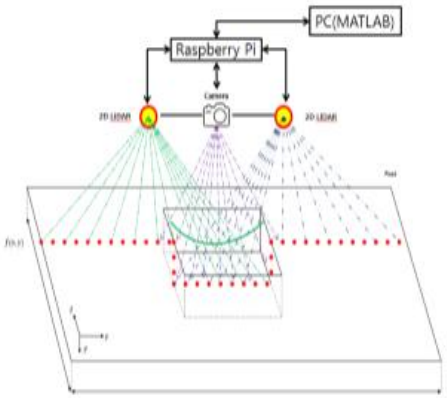

Fig. 2 Pothole detection model

The figure 3 shows the flow chart of the existing pothole detection system. After obtaining LiDAR information, proposed pothole algorithm is performed using MATLAB. Pothole information like width and depth of the pothole is compared with the actual information of the pothole. The error rates of the pothole detection maintain low enough even though the position of the pothole is moved away from the center. Then there is a square zone produced or the object as the region of interest. This existing system is very complexity. It is degraded at high sun angles and reflection. This is not an end user application.

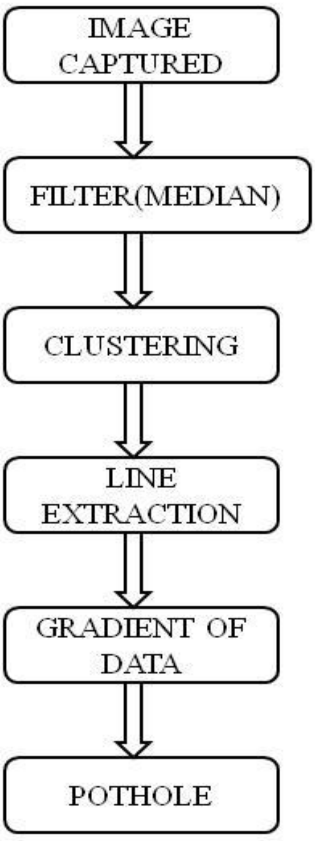

Fig. 3 Flow chart of existing pothole detection system

III. PROPOSED POTHOLE DETECTION SYSTEM

In our system, sensors and microcontroller is used to identify potholes and located on Google maps. This setup is placed on bumper of the vehicle. The proposed system consists of ultrasonic sensor, force sensing resistor and Arduino Uno. This setup is set with standard height above the ground position. The sensors are connected with Arduino Uno. Ultrasonic sensor and pressure sensor are correlated to get the output. Arduino Uno is an open source microcontroller used in the monitoring and detection of potholes.

The first component of this system is ultrasonic sensor. Initially, the ultrasonic sensor sends a ultrasonic waves at regular interval of time. It has two opening, one opening for transmitting the wave and other opening receives them. The threshold value is the reference to the normal ground position level. The ultrasonic sensor sends the high frequency sound wave from one end and other end receives the reflecting echo, then the time taken by two pulses is calculated. We know that speed of the sound is 343m/s.

Distance= Speed*Time

The measured distance is returned to Arduino. It indicates the presence of speed breakers on the roads. The second component is force sensing resistor which is used to identify the presence of pothole. This sensor is placed in suspension type. Whenever the vehicle forced to jerk, the pressure sensor value goes high. It establishes the two cases. When both the sensor values are higher than the threshold value, then it is detected as speed breakers. If pressure sensor value is high and ultrasonic sensor is stable, then it is indicate the presence of pothole. This data is send to user end and pothole is plotted in desired location on google map using Blynk application.

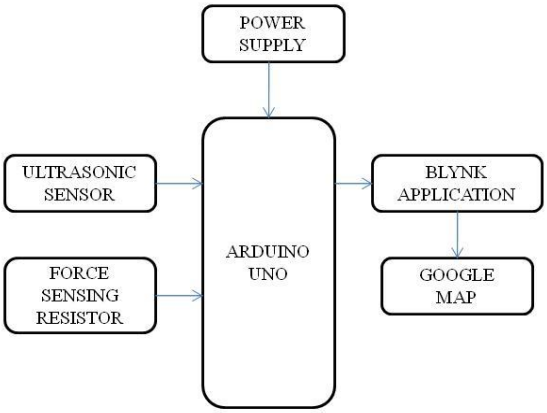

Fig. 4 Block diagram for proposed system

The proposed system consists of Ultrasonic sensor, Force sensing resistor, Blynk application, Google map and Arduino uno. The figure 4 shows the block diagram of proposed pothole detection system.

A. Ultrasonic Sensor

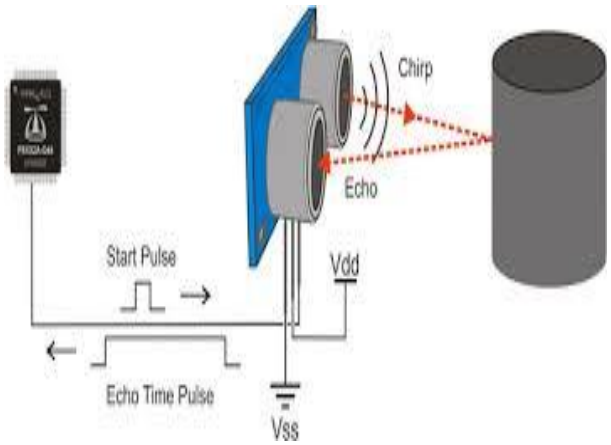

Fig.5 Working of ultrasonic sensor

Ultrasonic sensor is a device which is used to measure the distance between the sensor and the ground by using sound waves. It sends a sound wave at specific frequency and listening for that sound wave to bounce back[12]. By recording the time taken between the sound wave generated and bounce back, it is possible to calculate the distance between the sensor and the ground. The speed of the sound is 343m/S. This value is divided by 2, because the sound travels to object and bounce back. Figure 5 shows the working of ultrasonic sensor.

Distance = (Speed * Time)/2

B. Force Sensing Resistor

Force sensing resistor can be defined as a special type of resistor whose resistance can be varied by varying the pressure or force applied to it. Force sensing resistor is a combination of both resistor and sensor technology.

The force is applied to sensing film, the particles touches the conducting electrode and resistance of the film changes. If the pressure applied to its surface increases, then the resistance of the FSR sensor decreases. Force sensing resistor is called as polymer thick film devices. Force sensing resistor is used to identify the presence of pothole. This sensor is placed in suspension type. The pressure sensor value goes high, when the vehicle forced to jerk. The figure 6 shows the picture of force sensing resistor.

Fig.6 Force Sensing Resistor

C. Blynk Application

Blynk started as a kickstarter campaign, rising just over $49k. It is a new platform that allows us to quickly build interfaces for controlling and monitoring our hardware project. Figure 7 shows the Blynk architecture.

Blynk is an application which is installed in mobile or laptop. It works on internet. It can control hardware remotely, it can display sensor data, it can store data, etc. In Blynk application we can create new project dashboard. It works with of lots of hardware and connection type. The hardware may be Arduino, Raspberry pi, ESP8266 Standalone, NodeMCU, etc. Select the type of hardware and connection type. Using the widgets, we can arrange buttons, sliders, graphs, and other widgets on the screen and also we can turn pins on and off or display data from sensors. Hardware can also be connected to blynk application using USB. Blynk is perfect for interfacing with simple hardware project. Once hardware is connected with blynk application using internet, it blynk libraries and example sketches will get us online, connect to Blynk server and connect with our smart phone.

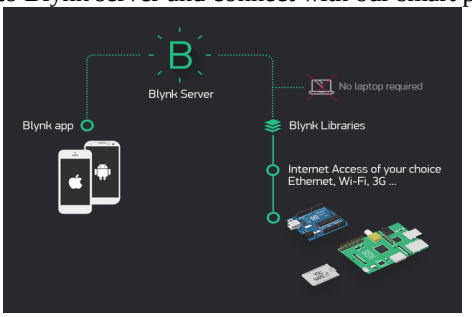

Fig.7 Blynk's architecture.

D. Arduino Uno

Arduino UNO is a microcontroller board and based on ATmega328P. It has 14 input/output digital ports, 6 analog input pins, out of 14 I/O pins, 6 pins used for PWM output, a 16 MHz ceramic resonator, a USB connection, etc. It allows the designer to control and sense the external electronic devices.

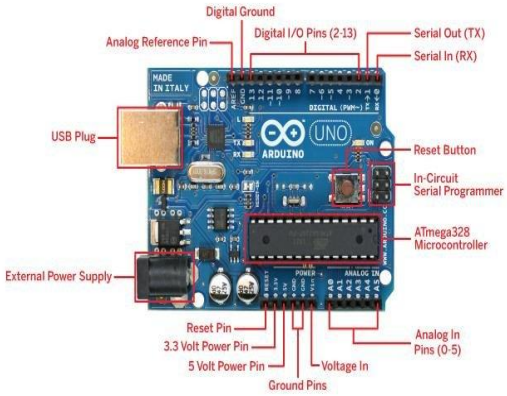

Fig.8 Arduino Uno

Figure 8 shows the diagram of Arduino Uno. The proposed system uses Arduino uno R3 shown in Fig. 8 It provides 7-12v supply with inbuilt ADC to provide digital data [13]. It can be connected with computer using USB cable. The length and width of the Arduino Uno R3 is 68.6 mm and 53.4 mm. the clock speed of Arduino uno is 16MHz. The ATmega328 has 32 KB memory and it also has 2 KB of SRAM and 1 KB of EEPROM.

Initially Ultrasonic sensor is used to measure the distance. Force sensing resistor value is obtained when vehicle is forced to jerk. If the value of distance is greater than the 50, then it identified as a speed breaker. If the ultrasonic sensor value is low and force sensing resistor value is greater than the 300, then it identified as pothole. This information is send to the used end using Blynk application and plotted over desired location on Google map. Blynk application works on the internet. The figure 9 shows the flow chart of proposed pothole detection system.

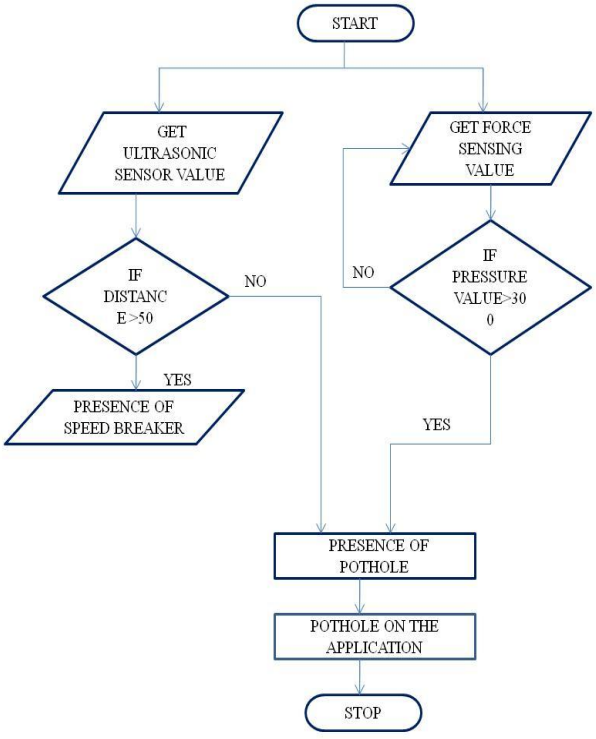

Fig. 9 Flow chart of proposed system

IV. SIMULATION ANALYSIS

The control of the proposed pothole detection system is monitored by the Arduino IDE. The values from the sensors are taken and checked for the two cases. If the ultrasonic sensor value and the pressure sensor value is above the threshold value, then it is identified as the speed breaker. If the ultrasonic sensor value is low and the pressure sensor value is above the threshold then it is identified as the pothole. This message is sent to the user end the pothole is plotted over the desired location. The Blynk application is used for the display of the desired output. It is connected to the Arduino IDE by the self-generated authentication ID. The ID once generated for a specified user is included on the code over the Arduino platform.

The application also helps as a platform to detect the location by the mobile GPS. The detected pothole is mapped on to the Google map by means of the application. Figure 10 shows the pothole detection on Google map.

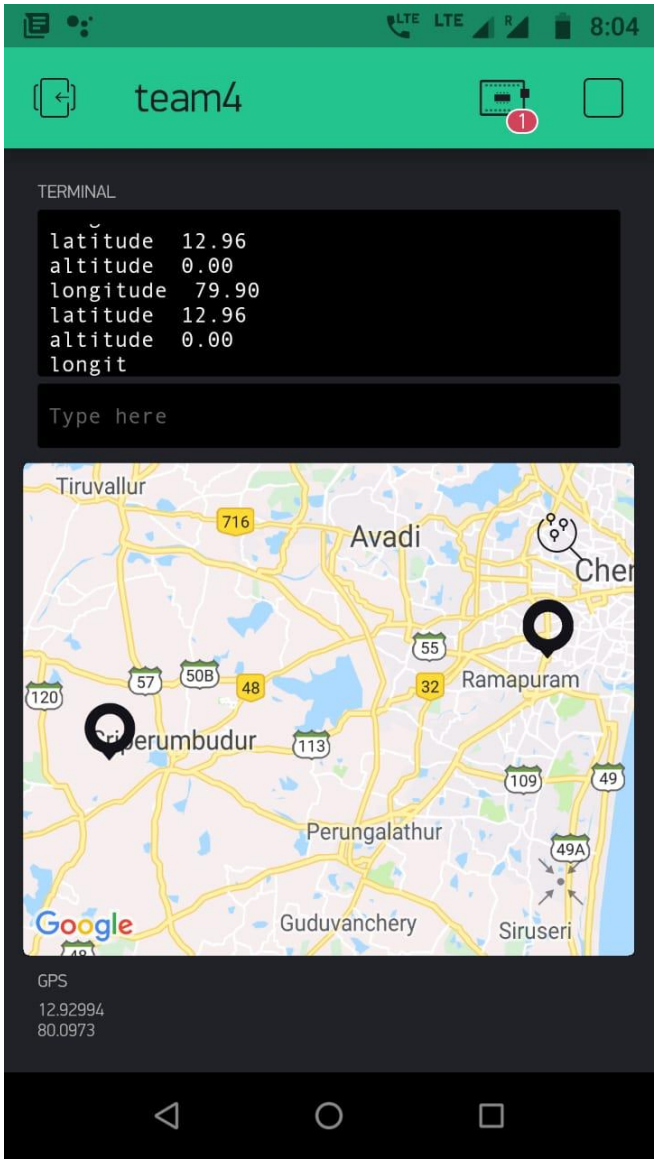

Fig.10 Google map for pothole detection

V. HARDWARE IMPLEMENTATION

The components used in the system are connected with Arduino Uno. The pothole detection system consist of two sensors are interrelated to get the output. The ultrasonic sensor and the pressure sensor are correlated to get the desire output. The first major component used in this project is ultrasonic sensor. Initially the ultrasonic sensor ends the ultrasonic waves at regular interval of time. The general purpose of ultrasonic sensor in here is to continuously monitor the road and to check the level of the ground position. It intimates the presence of the speed breakers on the road. The second major component used in the project is the Force sensing device. This device is the essential component used in the setup to identify the presence of pothole. The sensor is placed on the suspension system. Every time when the system is forced to a jerk then the value of the pressure sensor goes high. At times when the pressure sensor value goes high, the value of the ultrasonic values are high, then that is not a pothole. Then pressure sensor value is high and the ultrasonic maintains the value at the standard level then the pothole is present. The experiment was successfully performed and the values are checked over the Arduino platform. Figure 11 represents the hardware design of proposed pothole detection system.

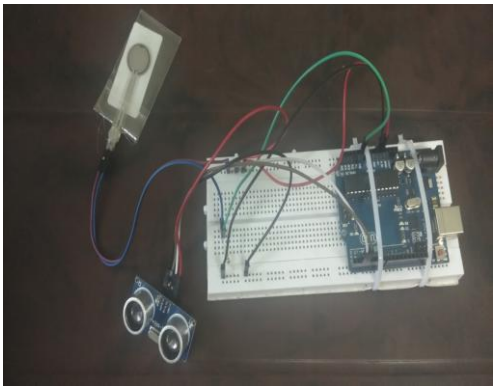

Fig. 11 Hardware setup

VI. CONCLUSION

The proposed system is given by a detailed study on the existing system for the detection of potholes. The proposed system conveys an easy and affordable method of detecting the potholes over the road. This simple method is sufficient for the estimation of road quality. This avoids the traffic congestion and collision by giving the prior knowledge about the travel. This approach proves to be a great advantage for all drivers to maintain a safe travel especially during night time when roads are not visible properly. The method dealt in this work is a smart way of identifying the potholes without much effect .This method has a high degree of accuracy when compare with the previous method. The enhancement in the technology and high reliability in mapping have proven to help the works as an added advantage .Although we can culminate that an elementary paradigmatic presented may be enough to estimate the quality of the road .But then there are still many issues that are to be addressed in our future works to deal with the problem more efficiently.

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