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Real Time Pothole Detection and Road Monitoring System

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ABSTRACT: Traffic congestion and accidents are mainly due to pathetic condition of road. For the proper maintenance of the roads the maintenance departments need to regularly assess the quality of the roads. The paper introduces a system to detect the potholes and to inform the concerned authority about the pothole. Ultrasonic sensor and accelerometer are used to measure the depth of the pothole and jerking respectively. The system captures the geographical location of potholes using GPS module and it is stored in the database (cloud). This serves as a valuable source of information to the vehicle drivers and to the Government authorities. A web server is used for public access, so that precautionary measures can be taken to evade accidents. It is a low cost, economic solution for the continuous road monitoring system.

KEYWORDS: Accelerometer, Arduino Uno, GPS module, NodeMCU, Ultrasonic sensors, XAMPP Server

I. INTRODUCTION

One of the major drawbacks in the developing countries is maintenance of the roads. Detection of potholes not only helps drivers to avoid accidents or vehicle damages but also helps authorities to maintain roads. However, most of the roads in India are congested with poor surface quality and road maintenance needs are not satisfactorily met. The increase in number of vehicles has led to problems such as traffic congestion and increase in the number of roads accidents. Pathetic condition of roads is a reason for traffic congestion and accidents. Potholes, formed due to heavy rains and movement of heavy vehicles is also a reason for accidents and loss of human lives. Maintenance departments need to regularly analyze the quality of the roads in order to properly maintain them. Currently, this is done by yearly inspection or in response to reports from the public. The inspection is done by workers walking along the streets and recording the conditions on paper which is later put into a database. In either case the cost of the monitoring is more.

A cost effective solution is needed to address the above mentioned problems. This collects the information about the severity of potholes and also helps authority to maintain roads well. The proposed system accounts for a better, faster and reliable method in detection, avoidance and maintenance of potholes. The potholes are detected using ultrasonic sensors and accelerometer. The GPS is used to find the location of potholes. All the information is saved in the database. Hence the system will be helpful for the concerned authorities and public. The system uses vehicles that traverse the road network on regular basis such as transit buses that go on their routes several times per day. The data is continuously collected while the vehicle is on its route.

Paper is organized as follows. Section II describes existing works related to pothole detection. The flow chart represents the steps of algorithm. Implementation of hardware, detection of the potholes and software which is given in section III. Section IV presents the experimental results showing results of detection of potholes and seen the location of potholes in Google map. Finally, section V presents the conclusion.

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II. RELATED WORK

Road monitoring is an intriguing topic of research and researchers have been working on pothole detection techniques. This section gives a brief description about the existing solutions for detecting pothole on roads.

1. Kwok Yu Mak, [3] have proposed easily detachable and user friendly pothole detection system which specializes in detecting potholes besides doing close range obstacle detection. The device which consists of two systems, one that is mounted on the front of a vehicle and the other is worn by the user manoeuvring the vehicle. The first system looks for an obstacle and second system warns the user about the obstacle by vibrating and blinking LEDs. Obstacles are detected using two non contact ultrasonic sensors and the device is run by two basic stamp modules. Sensing part is mounted on the lower front part of the vehicle and consists of two distance sensors. Once either of the sensors detects on object, a signal is sent wirelessly through a transmitter to second system which receives it using the wireless receiver of the pair. Second system is worn on the wrist of the user. It has a vibrator motor that starts vibrating once a signal of pothole detection received and two LEDs that light up when the sensor sense the obstacle. This part has two switches that the user can use one to shut down the whole system and the other to only turn off the vibrator if the user wishes to.

2. Christoph Mertz,[2] have designed a system which consist of a structured light sensor and a camera mounted on vehicle that travels in the roads on a regular basis. It makes use of sensors that present on the vehicles like GPS on transit buses. The data is collected from many vehicles and analyze at a central station and the results are to facilitate road maintains operations. The laser sends light that intersects with objects which in turn viewed by a camera. The camera placed at a distance from the laser.

III. PROPOSED SYSTEM

The proposed system makes use of ultrasonic sensors and accelerometer for detection of potholes. The ultrasonic sensor is used to detect the depth of the potholes and the accelerometer detects the jerking of the vehicle. Threshold values are set for both the sensors. When the measured value is greater than the threshold value a pothole is detected. The GPS module sends the location when a pothole is detected. The data from the microcontroller are transmitted to the server (XAMPP). The ultrasonic sensor transmits high frequency waves when it gets a trigger pulse from the Arduino. The trigger pin has to be kept high for 10 μ s to initialize measurement by sending ultrasonic wave. The echo pin goes high for a period of time which will be equal to the time taken for the ultrasonic wave to return back to the sensor. From that duration of time the distance is calculated. If the distance is greater than the threshold value the pothole is detected.

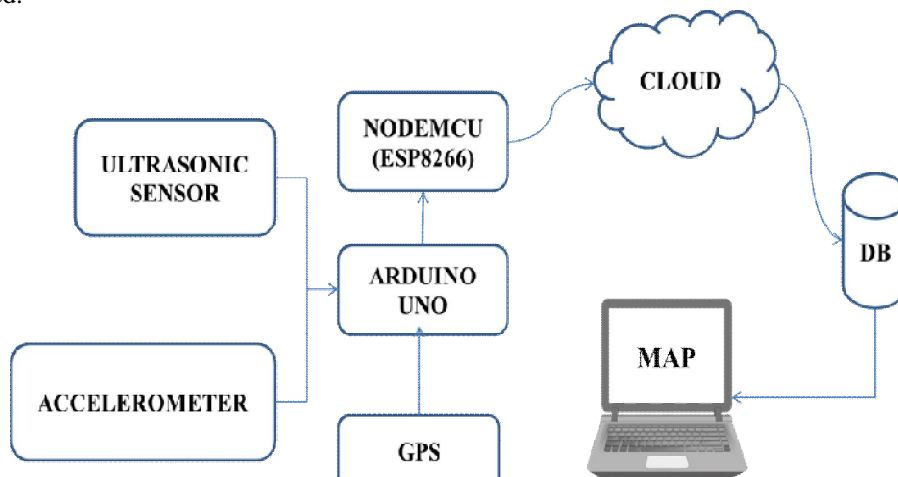


Figure 1: Block diagram of the proposed system

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Accelerometer module used is ADXL335 which has three-axis analog accelerometer IC. When there is jerking, it reads off the X, Y, and Z acceleration or variation in the axes as analog voltages.

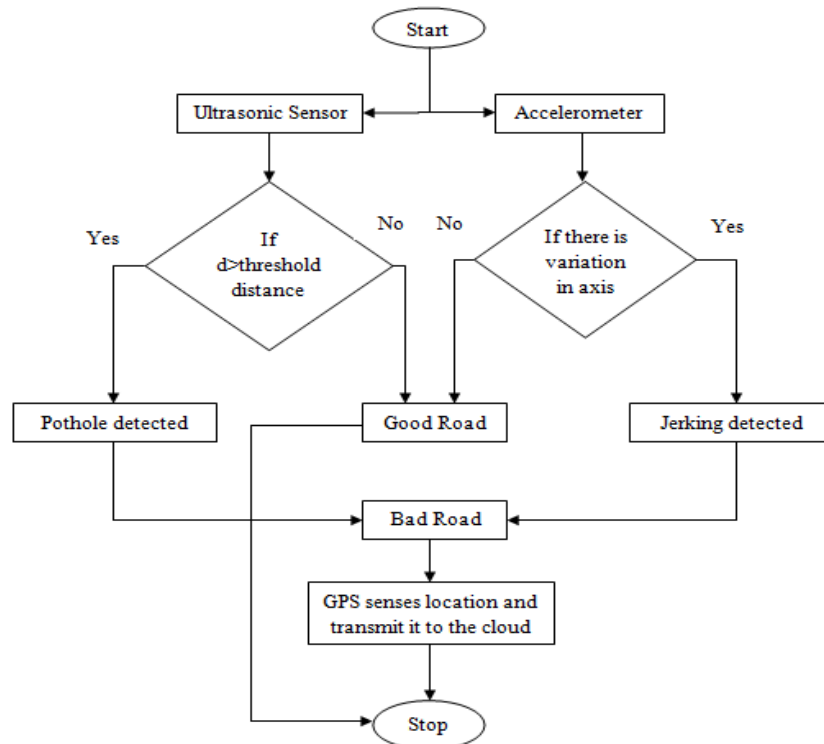


Figure 2: Flowchart of detection side

The ultrasonic sensor senses the distance between the vehicle and the road. If that distance, d is greater than the threshold distance, a pothole is detected and if the distance is lesser than the threshold distance, it is considered as the hump. Threshold distance will be taken as the ground-clearance of the vehicle. Similarly, the accelerometer finds whether there is a jerking or not. It is done by measuring the variation in the axis of accelerometer. If there is a variation, jerking is detected. In both cases, a bad road is found and the GPS senses location and transmit it to the server. Otherwise, the road is good. The better road can be identified from this.

IV. EXPERIMENTAL RESULTS

The model is tested in real time by fixing it on a motor bike (Honda Activa 5g). The hardware section of the system is placed under the footboard area of the test vehicle. For test run 2 km of distance was taken and the test vehicle was sent for the detection of potholes.

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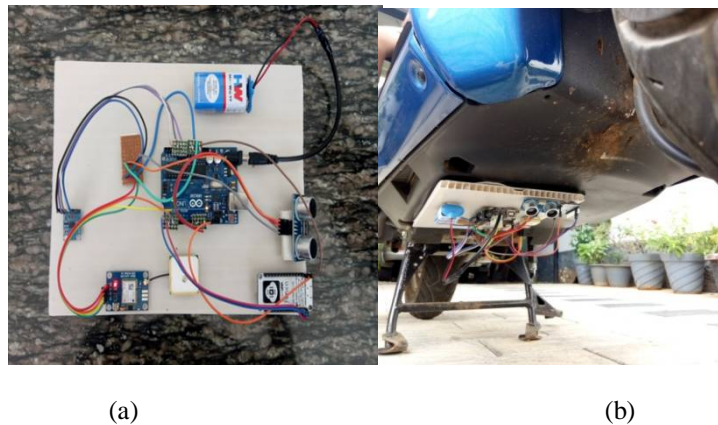


Figure 3: Hardware section of the system

The software section is done in the XAMPP server. The location of the potholes is plotted in the Google map.



Figure 4: Location of potholes plotted in map

The figures shown above are the potholes detected at two different locations. While comparing both, figure (a) shows less number of potholes and figure (b) shows more number of potholes. The user can identify the better roads from this. The authority can also do the maintenance of roads which have pathetic conditions.

V. CONCLUSION

This paper focuses on the real time pothole detection and road monitoring. It describes an economic solution for the detection of dreadful potholes. The information regarding the potholes are aggregated and sent to the cloud. Then it is viewed in XAMPP server. The system helps to create and maintain updated database of potholes detected. This system serves as a helpful approach for the government authority. It reduces the time taken to manual searching and locating potholes.

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