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Automatic Detection and Notification of Potholes and Humps on Roads Using IoT

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ABSTRACT

One of the major problems in developing countries is maintenance of roads. Well maintained roads contribute a Major portion to the country's economy. Identification of pavement Distress such as potholes and humps not only helps drivers to avoid accidents or vehicle damages, but also helps authorities to Maintain roads. This paper discusses previous pothole detection methods that have been developed and proposes a cost-effective solution to identify the potholes and humps on roads and provide timely alerts to drivers to avoid accidents or vehicle damages. Ultrasonic sensors are used to identify the potholes and humps and also to measure their depth and height, respectively. The proposed system captures the geographical location coordinates of the potholes and humps using a global positioning system receiver.

Keywords:-Android application, GSM SIM900, GPS, PIC16F877A, ultrasonic sensors

I.INTRODUCTION

INDIA, the second most populous Country in the World and a fast growing economy, is known to have a gigantic network of roads. Roads are the dominant means of transportation in India today. They carry almost 90 percent of country's passenger traffic and 65 percent of its freight. However, most of the roads in India are narrow and congested with poor surface quality and road maintenance needs are not satisfactorily met. No matter where you are in India, driving

Fig. 1. Condition of roads with potholes.

Is a breath-holding, multi-mirror involving, potentially life threatening affair? Over the last two decades, there has been a tremendous increase in the vehicle population. This proliferation of vehicles has led to problems such as traffic congestion and Increase in the number of road accidents. Pathetic condition of roads is a boosting factor for traffic congestion and accidents.Roads in India normally has speed breakers so that the vehicle's speed can be controlled to avoid accidents. However, these speed breakers are unevenly distributed with uneven and unscientific heights. Potholes, formed due to heavy rains and movement of heavy vehicles, also become a major reason for traumatic accidents and loss of human lives. According to the survey report "Road Accidents in India, 2011", by the ministry of road transport and highways, a total of 1,42,485 people had lost their lives due to fatal road accidents. Of these, nearly 1.5 per cent or nearly 2,200 fatalities were due to poor condition of roads. Figure 1 portrays the condition of roads with killer potholes. To address the above mentioned problems, a cost effective solution is needed that collects the information about the severity of potholes and humps and also helps drivers to drive safely. With the proposed system an attempt has been made to endorse drivers to ward off the accidents caused due to Potholes and raised humps.

II.PRESENT SCENARIO

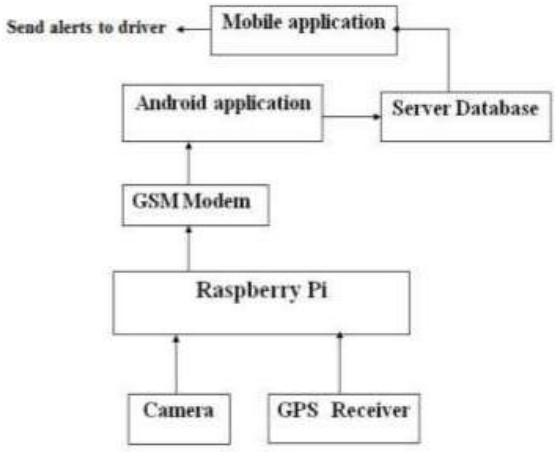

Fig. :-2 Block Diagram of Potholes and Humps using Raspberry Pi via Camera

RASPBERRY PI:

Potholes and Humps on the Road are detected using Image Processing and for that Raspberry PI is used in which a camera is attached to capture the images of the roads and side by side the potholes and humps are detected on the road and the data of the same is uploaded to the server. The GPS used will locate the exact longitudinal and latitudinal margin i.e. the exact longitude and latitude of the potholes and humps detected. Also one Beep will be turning ON whenever the humps of potholes are detected to Aid the driver.

DISADVANTAGES:-

1.High Death Rate

2.Several accident occur due to traffic

3.Blind peoples may suffer

We are designing cost efficient system. Ultrasonic sensors are used to identify the potholes and humps and also to measure their depth and height respectively.

In this proposed system to overcome all the circumstances, ULTRASONIC SENSOR and GPS RECEIVER are placed at the bottom of vehicle were ULTRASONIC SENSOR is used to measure the distance between the road and the sensor and the data is received by the microcontroller. The GPS RECEIVER captures the location of the detected pothole or the hump and sends messages to the registered mobile SIM using GSM modem.

III. BLOCK DIAGRAM

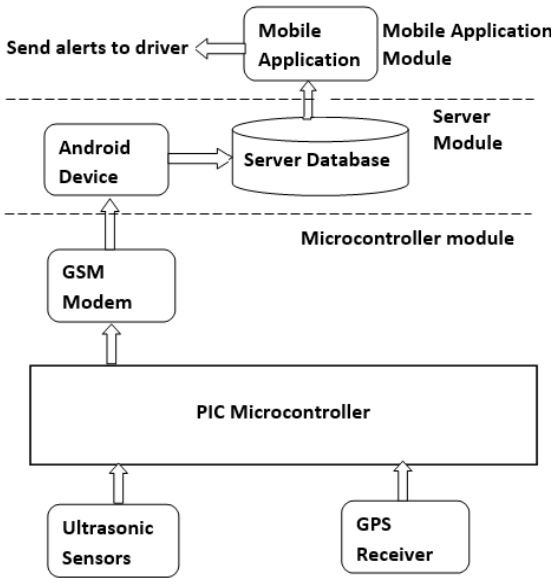

Fig. 3. Architecture of the proposed system.

The architecture of the proposed system is shown in figure 2.It consists of 3 parts; microcontroller module, server module and the mobile application module. Microcontroller module is used to gather information about potholes and humps and their geographical locations and this information is sent to the server. Server module receives information from the microcontroller module, processes and stores in the database. Mobile application module uses information stored in the server database and provides timely alerts to the driver.

Microcontroller Module*:* This module consists of four components namely PIC16F877A microcontroller, ultrasonic sensors, GPS receiver and GSM modem. Ultrasonic sensors are used to measure the distance between the car body and the road surface and this data is received by the microcontroller. The distance between car

body and the ground, on a smooth road surface, is the threshold distance. Threshold value depends on the ground clearance of vehicles and can be configured accordingly. If the distance measured by ultrasonic sensor is greater than the threshold, it is a pothole, if it is smaller, it is a hump otherwise it is a smooth road. The GPS receiver captures the location coordinates of the detected pothole or the hump and sends messages to the registered mobile SIM using GSM modem. This registered mobile SIM is present on the android device that acts as server. The messages sent include information about depth of the pothole or height of the hump and its location coordinates.

Server Module: This module consists of two parts; the android device and the database. It acts as an intermediary layer between the microcontroller module and the mobile application. The server module is implemented as an android application that runs on a device and is responsible for reading messages sent by the registered mobile SIM present In the microcontroller module. It processes the contents of this message and stores it in the database (cloud). Integrating sensor networks with cloud and Internet of Things, it is possible to allow broader access to sensor data.

Mobile Application Module*:* This module is implemented as an android application that is installed on the vehicle driver's mobile phone to provide timely alerts about the presence of potholes and humps. The application continuously runs in the phone background. It first captures the current geographic location of the vehicle and then accesses the locations of potholes and humps stored in the server database. The distance between the vehicle location and the pothole location stored in database is computed. If the distance between the two is within 100 meters, an alert message pops up on the mobile screen. This message is accompanied with an audio beep so that the driver can differentiate it from other flash message.

IV.FLOW CHART

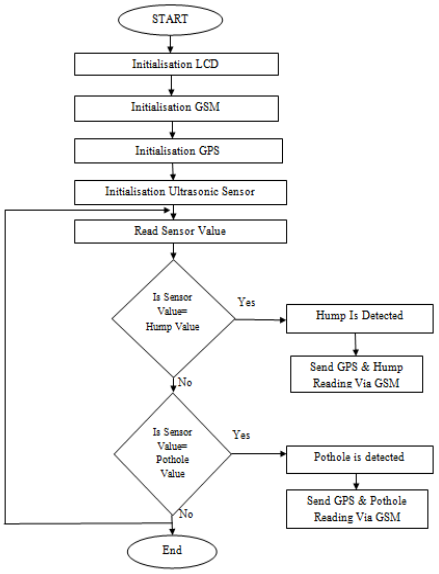

Fig 4. Workflow of proposed System

V.COMPONENTS USED IN THE PROPOSED SYSTEM

The proposed system offers a cost effective solution for detecting potholes and humps on roads and notifying drivers about their presence. Components used in the proposed work are as follows:

PIC 16F877A Microcontroller*:* Peripheral Interface Control (PIC 16F887A) is a 40 pin microcontroller with 8k program memory. It is widely used due to its low cost, high application support and wide availability. Microcontroller is the heart of the proposed system and is responsible for performing various tasks starting form processing all the sensor inputs to alerting the driver.

Ultrasonic Sensors HC-SR04: The HC-SR04 is an active ultrasonic sensor and contains a transmitter and a receiver. It is used to measure distance at which, objects are placed in front of it. The ultrasonic sensor transmits high frequency sound waves and waits for the reflected wave to hit the receiver. The distance is calculated based on the time taken by the ultrasonic pulse to travel a particular distance. There are different types of ultrasonic sensors with different transmission ranges and angles of detection. The HC-SR04 sensor work at frequency of 40 KHz and can measure distances of the objects in the range 2 to 400 cm with a 15° angle of detection.

GPS Receiver: Global Positioning System (GPS) is a satellite navigation system and is used to capture geographic location and time, irrespective of the weather conditions. It is maintained by the U.S. Government and is freely available to anyone who has a GPS receiver. It obtains the GPS information from satellites in National Marine Electronics Association (NMEA) format. The NMEA has defined a standard format for the GPS information. This is followed by all the satellites. The standard defines various codes such as Fig. 2. Architecture of the proposed system. GLL-Latitude/Longitude data, GSV–Detailed satellite data and RMC-Minimum Recommended Data.

GSM SIM 900: Global Standards for Mobile Communication (GSM) is a set of standards for Second Generation (2G) cellular networks. The GSM SIM 900 module uses any network provider's SIM to cover too per communicate over the telecommunication network. This modem can be used to send and receive text messages and to make and receive voice calls. GSM SIM 900 is a quad-band GSM modem that functions at 850, 900, 1800 and 1900 MHz frequencies. This modem also supports features like transferring voice data, integrated support for GPRS and TCP/IP stack.

VI. EXPERIMENTAL RESULTS

The working model of the proposed system is shown in figure 5. It was tested in a simulated environment with artificial potholes and humps. The model was also tested in real time by fixing it on a motor bike (Honda Activa).

Tests were carried out in two phases. In the first phase, information about potholes and humps was recorded and stored in the server database. In second phase, alerts were generated based on pothole and hump information stored in database.

While testing in the simulated environment the microcontroller module was fixed on a toy-car and the Threshold value was configured to 5 cm. During the tests it was found that the microcontroller module worked as Expected to identify potholes and humps. Table I shows a set of potholes and humps identified by the system in the simulated environment. Information about potholes and humps was successfully sent to the android device (server). The snapshot of these messages can be seen in figure 6. The server processed the messages received and stored in the database.

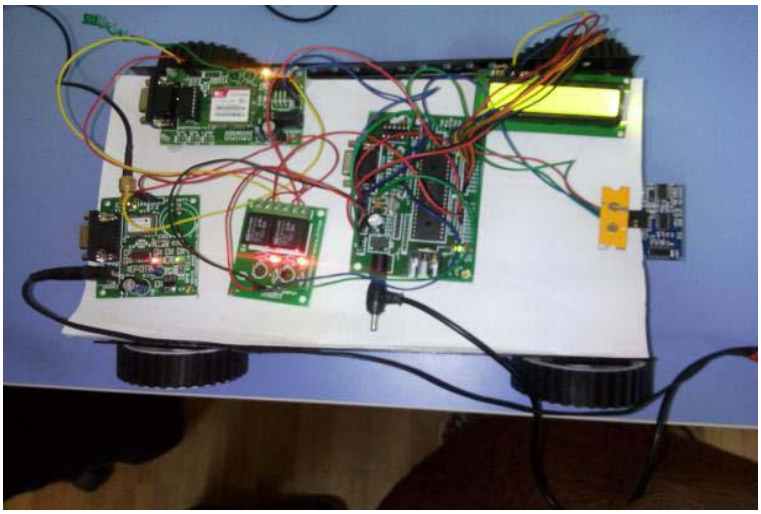

Fig. 5. Working model of the proposed system.

Sr.No.	Obstacle Type	Height/Depth in cms	Latitude	Longitude
1	P	19.35	12.9563	77.5544
2	H	3.1	12.9406	77.5661
3	H	3.8	12.9421	77.5668
4	P	13.2	12.9434	77.5669
5	P	8.7	12.9411	77.5654

Fig.6:-formation about Potholes and Humps collected in Simulated Test Environment

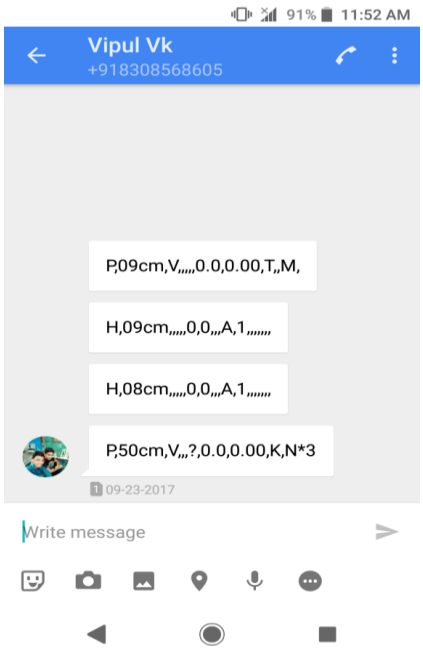

Fig 7: - Pothole alert displayed on the mobile phone.

VII.CONCLUSION

The model proposed in this paper serves 2 important purposes; automatic detection of potholes and humps and alerting vehicle drivers to evade potential accidents. The proposed approach is an economic solution for detection of dreadful potholes and uneven humps, as it uses low cost ultrasonic sensors. The mobile application used in this system is an additional advantage as it provides timely alerts about potholes and humps. The solution also works in rainy season when potholes are filled with muddy water as alerts are generated using the information stored in the database. We feel that the solution provided in this paper can save many lives and ailing patients who suffer from tragic accidents.

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