Automatic Detection of Potholes and Humps with Complaint Registration and Notification System

Gouravi Tandel
Atharva College of EngineeringMalad, Mumbai, India

Pranali Sawant
Atharva College of Engineering Malad, Mumbai, India

Mandar Ghadi
Atharva College of Engineering, Malad, Mumbai, India

Shubham Jain
Atharva College of Engineering Malad, Mumbai, India

Poonam Joshi
Assistant Professor
Atharva College of Engineering Malad, Mumbai, India

Abstract:-**The major problem faced by almost all the countries is the critical conditions of the roads that has led to lots of accidents, may it be the big sized potholes or even humps, these problems has taken lots of innocent lives. As the maintenance of the roads is considered as the responsibility of government, sometimes government lacks the resources to locate the areas that need to be repaired which leads to various accidents. The proposed system aims to be used by the car drivers to locate upcoming the potholes and humps so that they will be precautious and drive accordingly and help the government to locate the geographic locations of the potholes and humps and repair them. Ultrasonic sensors are used to identify the potholes and humps and also to measure their depth and height, respectively. The GPS (Global Positioning System) Receiver is used to capture the current location of the device. The received data is stored onto a server database which can be used to inform government authorities about the location of the potholes and humps and send an alert message to the registered users and simultaneously a complaint will be registered on the website which will administered by a government official. The website is used to send alert messages to the users and help the users to register for getting the device installed. The website can also be used to generate timely reports about the maintenance of roads.**

Keywords—GPS, ultrasonic sensor, database, web application, GSM.

I. INTRODUCTION

India is the fastest developing country in the world. Although there are many features that contribute to the growth and development of India, there are few factors that leads to the downfall of the development. One of the major factors is the roads and their infrastructure. Roads have the powerful impact on the transportation in India today. According to the survey of 2013, India has a road network of around 4,689,842 kilometers which makes it the second largest network in the world. However, most of the roads in India are in poor conditions that are full of potholes and uneven humps that needs to be maintained. Since the transportation in heavy vehicles has increased quite a few in last few decades, this has also led to the increase in number of accidents that takes place on these roads.

As per the latest reports, over 11,000 people were killed due to potholes and uneven humps in the last year. Various states have varying number of victims falling prey to the poor conditions of roads. Last year 11,400 people died in such case where Uttar Pradesh was the leading state having the maximum number of accidents whereas Maharashtra had 368 deaths due to potholes and uneven humps. This list also consists of states like Madhya Pradesh, Tamil Nadu, Bihar, West Bengal.

Potholes in India are mostly formed due to ignorance in the construction of roads, lack of skilled labors and poor quality of materials used in the construction. The following figure shows number of accidents in corresponding years.

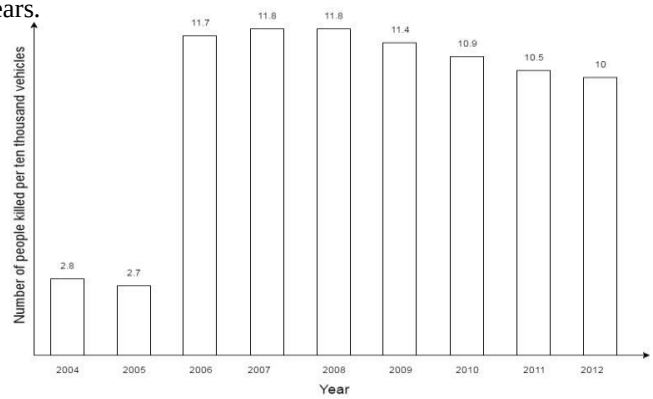

Fig. 1.Number of people killed due to road accidents.

II. RELATED WORK

Detection of pothole is an important topic of research and various researchers have been working on different pothole detection techniques. This section gives a brief description about the existing solution for detecting potholes and humps on roads.

Moazzam et al. [1] have proposed a model which makes use of low cost kinetic sensors and it gives the direct depth measurements which reduces the computing cost. This model is used for analyzing 3D distress images. This sensor consists of two cameras – RGB camera and IR camera wherein they capture RGB images and depth images. A MATLAB environment is used to analyze these images to determine the actual depth of potholes by extracting various characteristics of image and the approximate volume of pothole is calculated using trapezoidal rule on area-depth curves through pavement image analysis.

Mednis et al. [2] has proposed a model which makes use of smartphone along with accelerometer to detect the potholes. The smartphone consists of built-in accelerometer which is used to sense the movement and vibrations and detect potholes. Various algorithms are used to measure the difference between the amplitude value like Z-thresh and STDEV(Z) finds out the standard deviation of vertical axes acceleration and G-Zero are used to identify potholes.

Venkatesh et al. [3] have proposed a model that consists a laser detector and transmitting device attaches under the carriage. It makes use of laser technology to detect the depth of pothole. A 3D laser scanner is used to scan the area in two dimensions. So at each pixel it measures the time that it takes to leave from the laser beam to strike the other surface and bounce back. It also measures the energy by which the beam has left the instrument and the energy at which it comes back. So these two parameters are used to identify the depth of the pothole.

Kanza Azhar et al. [4] have proposed a system that is used to detect potholes on various roads and highways. It considers different images that are captured using computer vision. Considering the appearance-shape based nature of the potholes, Histograms of oriented gradients (HOG) features are computed for the input images. It uses a Naïve Bayes classifier technique to differentiate between a pothole and a non-pothole image. To identify the location of potholes, normalized graph cut segmentation scheme is used and it is tested on various datasets that includes broad range of pavement images.

Geetha Kiran A. and Murali S. have proposed a system to identify various humps on roads and avoid road accidents. The system works in two phases. The first phase includes, the development of an algorithm to detect hump from a single image captured from the camera fixed at low height to the moving vehicle. In the second phase, we generate the 3D views automatically to view the details on the road. The images have to be captured at a constant time period. The idea is to save memory by storing images instead of the video stream. Added to this, an automatic 3D view generation up to the detected hump can be visualized to know the details of the road before reaching the hump by generating the frames from the captured image. This is achieved in a four step process: First, the input image is processed to estimate the vanishing point. Second, the hump is detected using the dilation and erosion process. Third, the distance to the hump from the view point is computed, depending on which the speed of the vehicle can be reduced. Finally, the frames are automatically generated up to the detected hump to view the details on the road and act accordingly before reaching the hump using a novel approach. The proposed method is presented by comparing it with the results of the depth of the hump computed manually. Also, the efficiency of the 3D view generation is shown by comparing the first frame with other frames resulting with the corresponding mean values of the difference.

III. COMPONENTS USED IN THE PROPOSED SYSTEM

The proposed system consists of four components for the detection of pothole and for notifying the driver with the details of the pothole. The components in the proposed system are as follows:

PIC 16F877A Microcontroller: Peripheral Interface Control (PIC 16F887A) is a 40 pin microcontroller with 8k program memory. A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Microcontroller is the heart of the proposed system. It is the component on which other components are attached and the tasks of them like getting the details of pothole to notifying the driver is done.

Ultrasonic sensor HC-SR04: Ultrasonic sensor HC-SR04 is very affordable sensor used to avoid any object which is in its way by determining the distance between them. In the proposed system the sensor is used to determine the distance between the device and the pothole. Figure 2 shows working of ultrasonic sensor. It consists of a transmitter and a receiver. The transmitter transmits high frequency sound waves and reflects from the pothole or humps and is received back by the receiver. The time taken to receive the waves is used to measure the distance.

GPS receiver: Global positioning system is a navigation system which provides the geolocation and the time. In the proposed system the GPS is used to determine the location of the pothole.It provides the latitude and the longitude of the pothole to determine the exact location of the pothole.

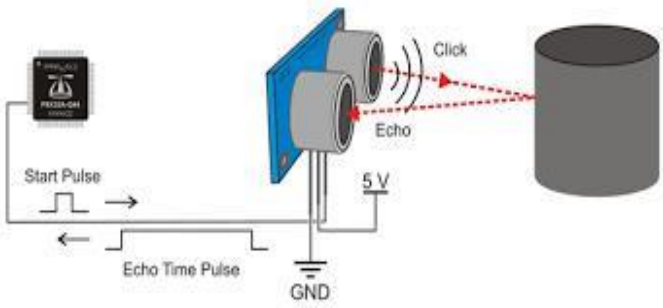

Fig. 2: Working principle of ultrasonic sensor

GSM SIM 900: A global standard for mobile communication is a set of standard for cellular networks. In the proposed system this sim is used to send the notification message to the user.When the driver with the system installed in the vehicle comes in a range of pothole/hump the he/she get a notification message.

IV. ARCHITECTURE & IMPLEMENTATION

The architecture of the proposed system is shown in figure 3. It consists of 3 parts: microcontroller module, server module and the web application module.

Microcontroller Module: This module consists of 4 components, namely, PIC 16F877A 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. Sensors keeps emitting frequency waves, and if those frequency waves collides with obstacle and returns back to the device thereby indicating the presence of pothole or a hump.

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. The messages sent include information about depth of the pothole or height of the hump and its location coordinates.

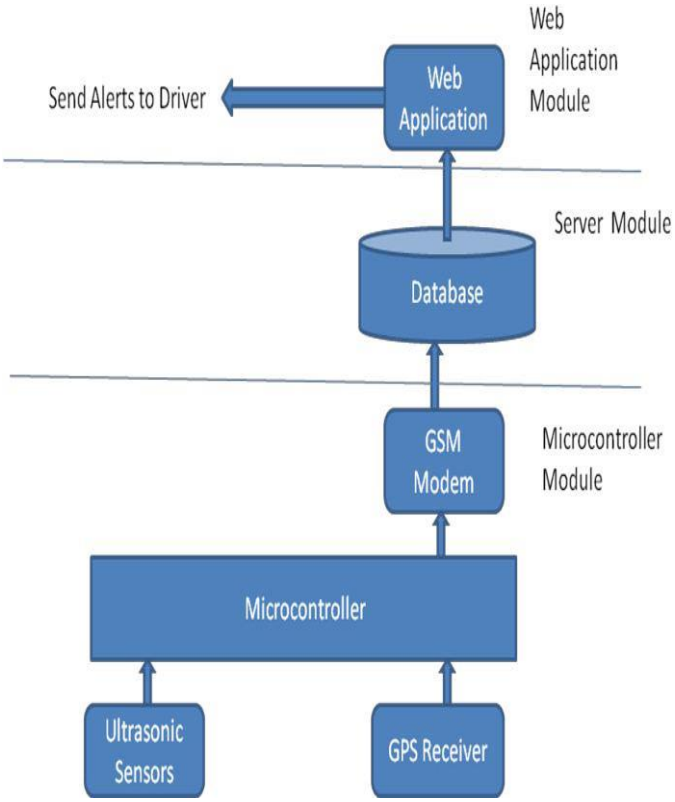

Fig. 3: System Block Diagram

Server Module: This module consists of database. It acts as an intermediary layer between the microcontroller module and the web application module. The server module is implemented as a website that 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. Contents of message means the information received from GPS receiver i.e. depth of the pothole or height of the hump.

Web Application Module: This module provides timely alerts about the presence of potholes and humps. Figure 4 shows the workflow of web application module. It first captures the current geographic location of the vehicle and then compare it with 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 desired range(for example 50 meters), an alert message pops up on the mobile screen.

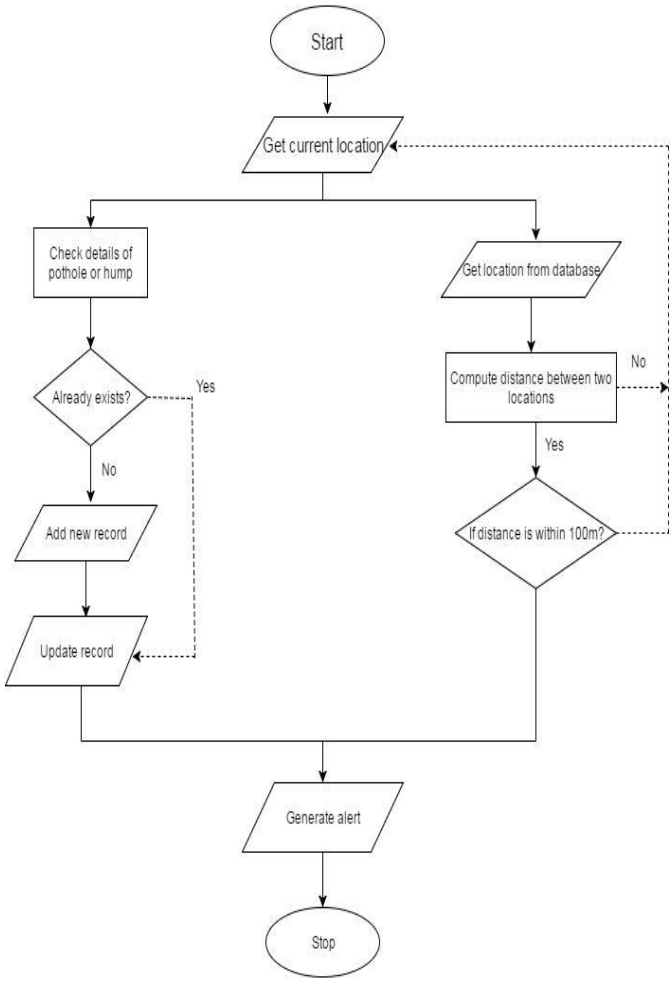

Fig. 4: Workflow of Web application module

TABLE 1

INFORMATION ABOUT POTHOLES AND HUMPS STORED IN DATABASE

S. No.	Pothole/ Hump	Depth/Height in cms.	Latitude	Longitude
1	Hump	15.33	16.2355	87.3524
2	Hump	5.84	34.2342	76.4584
3	Pothole	8.4	13.7453	76.5336
4	Hump	5.32	26.6524	78.4635
5	Hump	19.75	11.6752	45.6533
6	Pothole	7.32	21.7634	78.7353
7	Pothole	17.8	15.5433	76.4654
8	Hump	11.79	33.3231	64.4785
9	Pothole	7.89	23.6533	76.6453

V. CONCLUSION AND FUTURE RESEARCH WORK A

system is developed that will be placed at the base of any two wheeler/three wheeler/four wheeler vehicle. The system will consist of two sensors i.e. ultrasonic sensor and GPS receiver. The ultrasonic sensor will detect the presence of pothole/hump and the GPS receiver will capture the locations of the pothole/hump and store the coordinates in the database maintained at the portal. With the help of the stored coordinates of the pothole/hump, the registered will be notified with an alert message and simultaneously a complaint will be registered at the portal maintained by an administrator. But the system does not consider the fact that potholes and humps get repaired by concerned authorities periodically. The system is more useful in rainy season as the potholes and humps get covered with water.

In future, a camera can be included in device to click a picture of detected pothole or hump. Also, a tracker can be included in device so as to improve security measurements.

ACKNOWLEDGEMENT

We would also like to express our appreciation and gratitude to Atharva College of Engineering authority for helping us to develop this paper.

REFERENCES

[1] I. Moazzam, K. Kamal, S. Mathavan, S. Usman, and M. Rahman, **"Metrology and visualization o**f potholes using the microsoft kinect **sensor," in Proc. 16th Int. IEEE Conf. Intell. Transp. Syst., Oct. 2013,** pp. 1284–1291.

[2] **A. Mednis, G. Strazdins, R. Zviedris, G. Kanonirs, and L. Selavo, "Rea**l time pothole detection using a**ndroid smartphones with accelerometers,"** in Proc. Int. Conf. Distrib. Comput. Sensor Syst. Workshops, Jun. 2011, pp. 1–6.

[3] S. Venkatesh, E. Abhiram, S. Rajarajeswari, K. M. Sunil Kumar, S. **Balakuntala, and N. Jagadish, "An intelligent system to detect, avoid and maintain potholes: A graph theoretic approach," in Proc. 7th Int. Conf.** Mobile Comput. Ubiquitous Netw., 2014, p. 80.

[4] Kanza Azhar, Fiza Murtaza, Muhammad Haroon Yousaf**,** "Computer vision based detection and localization of potholes in asphalt pavement images**"**, Electrical and Computer Engineering (CCECE), 2016 IEEE Canadian Conference on 15-18 MAY 2016.

[5] Geetha Kiran A. and Murali S**., "**Automatic hump detection and 3D view generation from a single road image**",** Advances in Computing,