Automatic Detection of Potholes and Humps on Roads to Aid Driver

Prof.R.M.Sahu[1], Mayank Kher[2], Nurul Hasan[3], Laxmi Panchal[4]

[1]*Professor, Electronic Engineering, PDEACOEM, Maharashtra, India*
[2] *Student , Electronic Engineering, PDEACOEM, Maharashtra, India*
[3]*Student, Electronic Engineering, PDEACOEM, Maharashtra, India*
[4]*Student, Electronic Engineering, PDEACOEM, Maharashtra, India*

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. The sensed-data includes pothole depth, height of hump, and geographic location, which is stored in the database (cloud). This serves as a valuable source of information to the government authorities and vehicle drivers. An android application is used to update the pics of location on the android application named "meri sadak" so that measures can be taken to evade accidents. Alerts are given to the driver and simultaneously pics are updated on application.

Keyword : - *Android Application, GSM SIM 900,GPS,Raspberry Pi*

1. INTRODUCTION

INDIA, the second most populous Country in World with fast growing economy, is known to have a gigantic network of roads. Roads are the dominant means of transportation in India today carrying 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 without maintenance. No matter where you are in India, driving is a breath-holding, multi-mirror involving, potentially life threatening affair. Over last two decades, there has been a tremendous increase in the vehicle population leading to problems such as traffic congestion and increase in number of road accidents. Pathetic condition of roads is a boosting factor for traffic congestion and accident. Researchers are working in the area of traffic congestion control , an integral part of vehicular area networks, being need of hour today. Roads in India normally have 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. 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.

1.1. Literature Survey

Potholes Detection is the intriguing topic of research and researchers have been working on the same to detect it automatically with many techniques they have already developed the detection of Potholes and Humps using various techniques like IR sensor.

We have tried something different i.e. using the camera with Raspberry Pi so that the process is simple and fast as simultaneously we are using government developed android application for sending the captures images of potholes and humps on the server so that necessary actions will be taken as soon as possible and the potholes will get repaired by the help of "Meri Sadak" android application interface.

Moazzam have proposed a low cost model for analysing 3D pavement distress images of potholes. It makes use of a low cost Kinect sensor ,which gives the direct depth measurements, thereby reducing computing costs. The Kinectic sensor consists of a RGB camera and an IR camera, and these cameras capture RGB images and depth images. These images are analysed using MATLAB environment, by extracting metrological and characteristic features, to determine the depth of potholes. Youquan developed a model to detect the three-dimensional cross section of pavement pothole. The method makes use of LED linear light and two CCD (Charge Coupled Device) cameras to capture pavement image. It then employs various digital image processing technologies including image pre-processing, binarization, thinning, three dimensional reconstruction, error analysis and compensation to get the depth of potholes.

Rode , have proposed a system in which, Wi-Fi equipped vehicles collect information about the road surface and pass it to the Wi-Fi access point. The access point then broadcasts this information to other vehicles in the vicinity in the form of warnings. However, the system turns out to be an expensive one as all vehicles should be installed with Wi-Fi stations and more number of access points have to be set up. Venkatesh have proposed an intelligent system that has made use of laser line striper and a camera to detect and avoid potholes. This system maintains a centralized database of the location of potholes. It also sends warning messages to the nearby vehicles about the occurrence of potholes using Dedicated Short Range Communication protocol. Hegdeet , have proposed an intelligent transport system to detect potholes. It makes use of ultrasonic sensors to detect the presence of potholes. This system also sends warning messages to all the vehicles in the range of 100 meters using Zigbee module. However, the system provides warnings after detecting the potholes which does not effectively help drivers to avoid potential accidents

Our system detects the potholes and humps on the basis of image processing and it detects the colour of the potholes i.e. balck to fader black or grey as the colour of roads and process the image on the basis of the same and simultaneously uploads the image detected by the camera attached to the Raspberry Pi .This will help the driver to get alert of upcoming potholes or humps as well as this will help government to maintain the beauty of roads. Hence this proposed application will be helpful for a common man as well as Government.

2. Block Diagram and Descriptions

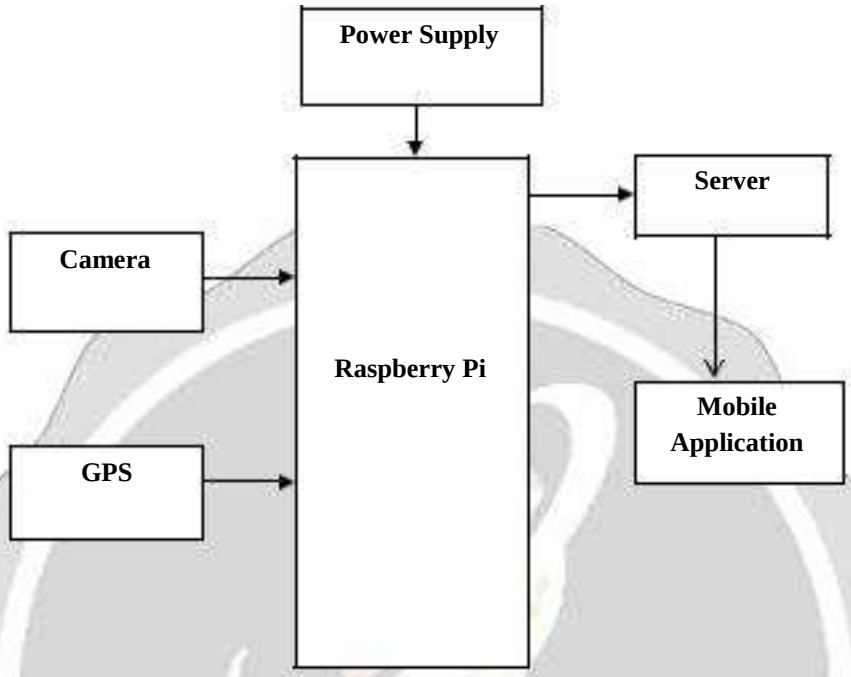

Fig.1.(a) Block Diagram of Potholes and Humps using Raspberry Pi via Camera

Components used in the proposed work are as follows:

RASPBERRY PI :

The Raspberry Pi 2 delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte

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 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 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 thatvfunctions 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

CAMERA:

Now adays we see a lot of advanced cameras that are used to capture motion as well as images from a very far distance. During the time of its invention images could be taken only in a room and could not be portable. The instrument should be kept in a dark chamber or box and the room should function as a real-time imaging system. Thus the camera was earlier called "camera-obscura" which meant "dark chamber". But this apparatus was very huge and could be portable only as a tent. For this instrument to work the light was passed onto it through a convex lens. Thus an image consisting of external objects would be formed which was subjected to the surface of a paper or glass, placed at the focus of the lens.

Fig.2.(a) Proposed model fixed on two wheeler bike for testing.(b) Detection of hump. (c) Detection of pothole

2.1 ARCHITECTURE AND IMPLEMENTATION

The architecture of the proposed system consists of 3 parts; Raspberry pi, server module and the mobile application module.

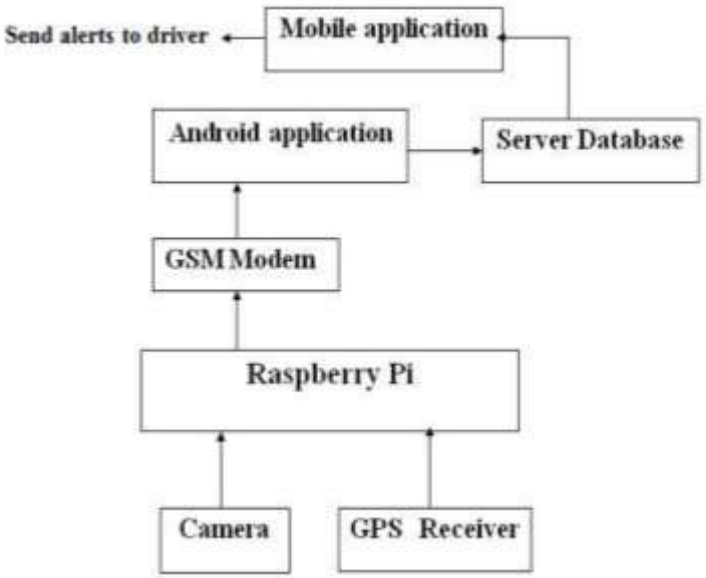

Fig.3. Architecture and Implementation Diagram

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.

Image Processing will analyze and manipulate the digital image captured by the camera connected to the processor. Using Mathematical calculations by using any form of signal processing for which the input will be an image and the output of image processing may be either an image or set of characters or parameters related to the image. Server module receives information from raspberry pi module, processes and stores in the database. Mobile application module uses information stored in the server database and provides timely alerts to the driver

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. Figure 4 shows the workflow of this application. 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 messages.

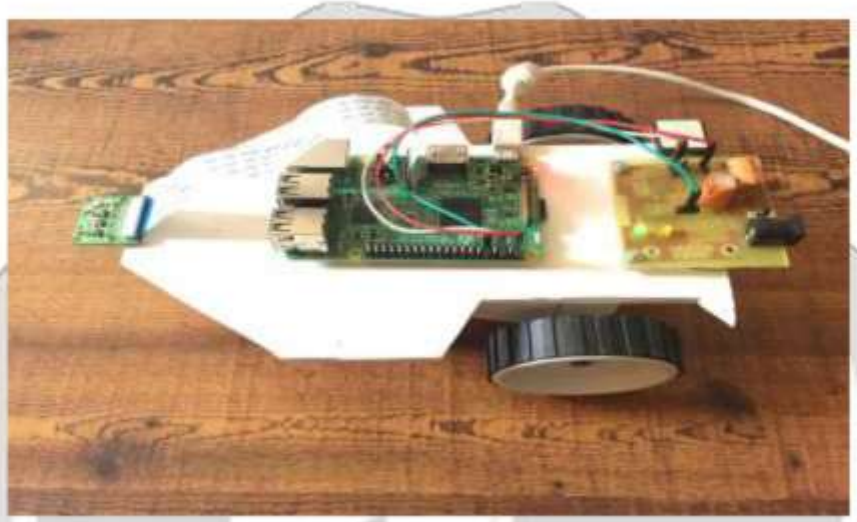

Fig -4. Working model of the proposed system

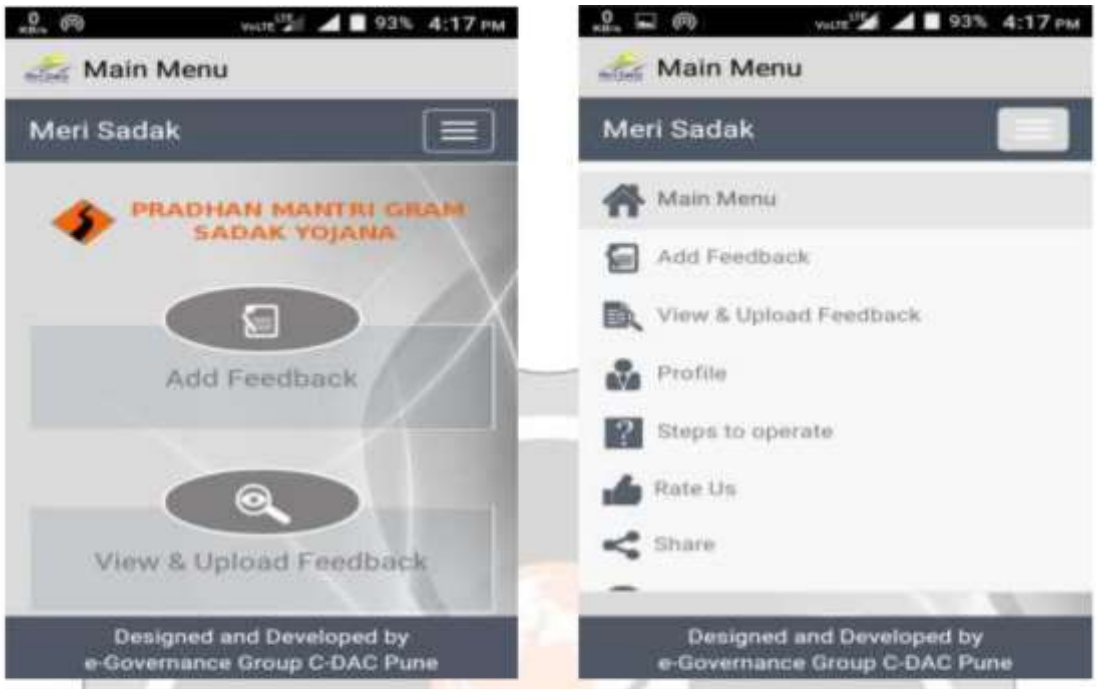

Fig. 5. Potholes alert sent via Android application

3. EXPERIMENTAL RESULTS

It was tested in a simulated environment with artificial potholes and humps. Tests were carried out in two phases. In the first phase, information about potholes and humps was received by the 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.

In second phase, alerts were generated based on pothole and hump information were given to the driver through GSM. While testing in the simulated environment, the module was fixed on a toy-car and the threshold value was configured to 5 cm. During the tests it was found that the module worked as expected to identify potholes and humps.

Sr.No	Obstacle Type	Place Where Detected(Using Google maps)	Latitude	Longitude
1	H	Pdea college	1831.7564	07358.8251
2	P	Pdea college	1831.1546	07358.1894
3	P	Dhankawdi	1828.0360	07351.5161
4	H	Dhankawdi	1828.0557	07351.4983
5	P	Shivajinagar	1853.0823	07384.7465
6	H	Shivajinagar	1875.6589	07654.9456
7	P	Hadapsar	1850.8957	07392.6065

Table. 1. Information about potholes and humps collected in simulated test environment

4. CONCLUSIONS

In this paper, we have proposed system which will detect the potholes on the road and save the information in the server. Due to the rains and oil spills potholes are generated which will cause the accidents. The potholes are detected and its height, depth and size are measured using ultrasonic sensor. The GPS is used to find the location of pothole. All the information is saved in the database. This timely information can help to recover the road as fast as possible. Hence the system will help to avoid road accidents. The mobile application used in this system is an additional advantage as it provides timely alerts about potholes and humps. This serves as a valuable source of information to the government authorities and to vehicle drivers. It will save many lives and ailing patients who suffer from tragic accidents .Well maintained roads contribute a major portion of the country's economy.

In our project we are using single node. In future it may require one data base server. if we are using n number of nodes we have to make a cloud. It can be integrated in the proposed system to improve user experience. After successful completion of this project we can conclude that, Thus we have successfully made a working model of Automatic Detection and Notification of Potholes and humps on roads to aid drivers. This model is simple and less complex as compared to others it has very vast future development scope.

5. ACKNOWLEDGEMENT

We thank the Department of Electronics Engineering, PDEA's College of engineering manjri ,Savitribai Phule University, Pune, Maharashtra, India for permitting to use the computational facilities by providing us most suitable environment for research and development.

6. REFERENCES

[1] "Automatic detection and notification of potholes and humps on roads to Aid drivers" Rajeshwari Madli, Santosh Hebbar, Praveenraj Pattar, and Varaprasad Golla IEEE SENSOR JOURNAL, VOL. 15,NO. 8 AUGUST 2015

[2] "Automatic detection and notification of potholes and humps on roads to Aid drivers" International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE)" S. Jothi, S. Priyanka, P. Yuvaraj, S. Kalaivani VOL.2,ISSUE 3, March 2016.

[3] "Intelligent Pothole Detection and Notification System" International Journal of Engineering Science and Computing" Nilam kumbhar, Dipali Mhetre, Amarina Mujawar, S.T. Khot VOL.6, ISSUE 4, April 2016.

[4] "Automated Potholes Detection Using Wireless Sensor Motes" Girisha Durrel De Silva RavinSaranga Perera Chamath Keppitiyagama Kasun De Zoysa Nayanajith M. Laxaman Kenneth M. Thilakarathna, University of Colombo school of computing, Sri Lanka.

[5] "Automatic Accident Detection And Ambulance Rescue With Intelligent Traffic Light System" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 4, April 2014