Intelligent Monitoring System for Smart Road Environment

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Abstract: One of the major problems in developing countries is maintaining of roads. Well maintained roads contribute a major portion to the country’s economy. Identification of pavement distress such as potholes 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 on roads and provide timely alerts to drivers to avoid accidents or vehicle damages and also to the responsible department which is responsible for the maintaining of the roads. 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 using a global positioning system receiver. The sensed-data includes pothole depth and geographic location, which is stored in the database. This serves as a valuable source of information to the government authorities and vehicle drivers. A website is used to update the latitude and longitude of location on the webpage so that measures can be taken to evade accidents. Also, the locations will be able to see in the form of maps. Alerts are given to the driver and simultaneously location is updated on webpage.

Keywords: Webpage, GSM, GPS, Ultrasonic Sensor, ARM Microcontroller (LPC2148).

1. 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 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. Researchers are working in the area of traffic congestion control, an integral part of vehicular area networks, which is the need of the 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.

Fig 1. Conditions of roads

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.

2. Literature Survey

Several efforts have been made for developing a method which can automatically detect and recognize potholes. Aging roads and poor road maintenance systems result in a large number of potholes, whose number increase over time. Potholes jeopardize road safety and transportation efficiency. In this survey, we analyze the systems of pothole detection previously implemented or proposed, ultimately aiming at improving road conditions. In India, many accidents happen due to poor road
conditions. The various pothole detection systems are mentioned below.

Rajeswari Madly, Santosh Hebbar, Praveenraj from Bangalore proposed low cost model where they used PIC microcontroller. Ultrasonic sensor detects the depth of the pothole and GSP traces its location in the form of latitude and longitude. This information is being send to a mobile application through GSM modem which will send alerts to the drivers who is driving the vehicle. 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.

Moazzam's proposal who proposed a high cost model for analyzing 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 Kinect sensor consists of an RGB camera and an IR camera, and these cameras capture RGB images and depth images. These images are analyzed 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 a greater number of access points have to be set up. Venkatesh have proposed an intelligent system that has made use of laser line stripers 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.

By observing and scrutinizing the above models on pothole detection we have proposed to use ultrasonic sensor for pothole detection. The ultrasonic sensor will detect the pothole including its size, width and location and we will be able to access its location on our website which will be available to all end users that means anyone in this world would be able to see the potholes. This system is durable and accurate. It can also be used over a wide range. The overall cost is cheap and the size is also conventionally small.

3. Block Diagram and Description

A. Power supply
Power supply of 12V for motor drive, 5V for sensors and 3.3V for Microcontroller respectively.

B. ARM Microcontroller (LPC2148)
The ARM 7TDML-S is a general purpose 32-bit microprocessor, which offers high performance at low power consumption. This architecture is based on RISC principles and instruction set and delayed mechanism are simpler than those of microprogrammed Complex Instruction Set computers.

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C. Ultrasonic Sensor
This sensor will be used for measuring the length and depth of the potholes. It will measure the distance in analog format which will then be converted to ADC and transfer the data to PIC microcontroller.

D. GPS
It will be used to capture live geographic location and time irrespective of the weather conditions. It is maintained by the United States government and is accessible to anyone with a GPS receiver.
E. GSM

It is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

F. Webpage

The viewer will be able to access the location and position of the pothole on the webpage and all the data for eg: length, width and exact location of the pothole will be displayed on this page using IoT.

4. Working

This module works in a go where first when you will start the module initialization of all the sensors and all will be done. Then once it is on the ultrasonic sensor will start detecting the pothole. There will be a reference value given to the ultrasonic sensor, if the ultrasonic sensor reads a value more than that reference value it will detect a pothole. The potholes GPS position will be read and will be uploaded to the webpage via the GSM. This is how the pothole will be detected and will be visible to all the end users using this webpage to see the pothole.

Conclusion

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 is measured using ultrasonic sensor. The GPS is used to find the location of pothole. All the information is saved in the database and is send to the webpage which will be seen by all the others as well. This timely information can help to recover the road as fast as possible. Hence the system will help to avoid road accidents. This serves as a valuable source of information to the government authorities to take a recovery action against it 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 model. In future if we use this kind of device in the government authorities who are responsible for the repairing of roads will help them in a very good way and also will help the people to keep a track on the roads which are supposed to be repaired. 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 Intelligent road monitoring system for smart road environment. This model is simple and less complex as compared to others it has very vast future development scope.

5. Results

The below figure shows the diagram of how the potholes will be shown in the form of locations by markings on maps. This map will be be accessible through the webpage to all the end-users and the people will use this for tracking the potholes on the way. They will also be able to keep a track on the recovery of the potholes being done by the respective government body.

6. Conclusion

This paper presented an overview on intelligent monitoring system for smart road environment.

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References