Automatic Detection of Potholes and Speed Breakers

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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. The proposed system that have been developed and proposed a cost effective solution to identify potholes and humps on roads and provide timely alerts to drivers to avoid accidents or vehicle damages.IR sensor is used to detect the obstacles and hence avoid the accidents. Ultrasonic sensors are used to identify potholes and humps and also to measure their depth and height respectively. The system captures the geographical location coordinates of potholes and humps using GPS receiver. The sensed-data includes pothole depth, height of hump and geographical location. This serves as a valuable source of information to the Government authorities and to vehicle drivers. An android application is used to alert drivers so that precautionary measures can be taken to evade accidents. Alerts are given in the from a flash message with a audio beep.

Keywords -Flash messages, GPS receiver, Geographical location, Pothole detection, Ultrasonic sensors

I. INTRODUCTION

India, the second most populated 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. 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. 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. This system makes attempts to endorse drivers to ward off the accidents caused due to potholes and raised humps.

II. WORKING PRINCIPLE

The block diagram proposed system is shown in figure 1. It consists of two parts microcontroller 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 mobile phone. Mobile phone receives information from the microcontroller module and provides timely alerts to the driver.

Microcontroller module consists of 5 components, namely, Arm-7 microcontroller, ultrasonic sensors, IR sensor, GPS receiver and GSM modem. IR sensor is used to detect the obstacles such as vehicles by transmitting and receiving the light rays to avoid accidents. Ultrasonic sensors are used to measure the distance between the vehicle body and the road surface and this data is received by the microcontroller. The distance between vehicle 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

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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.

Mobile application 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. 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.
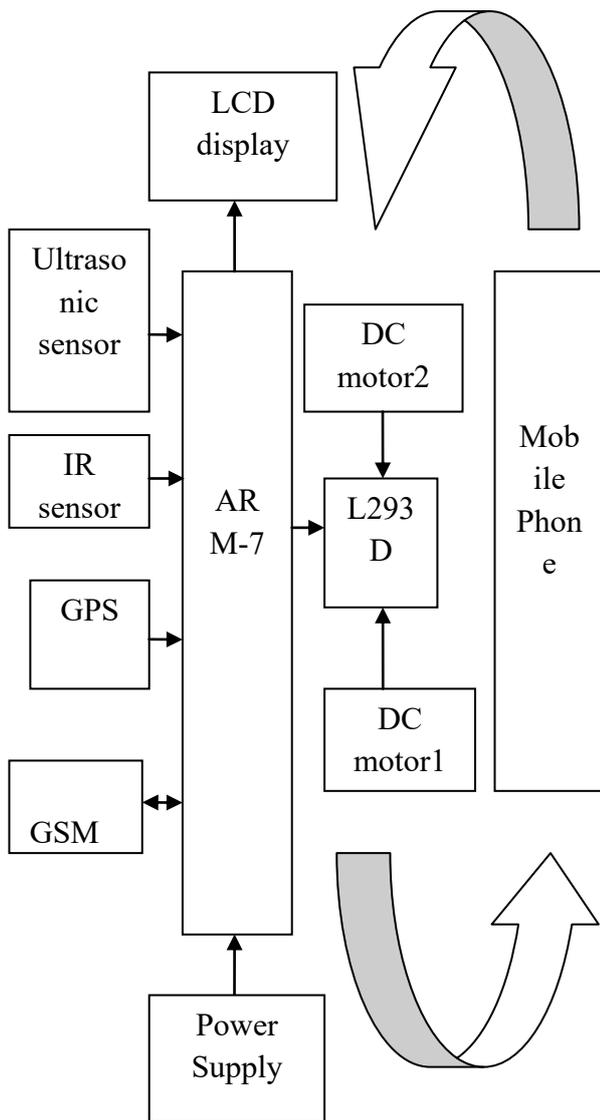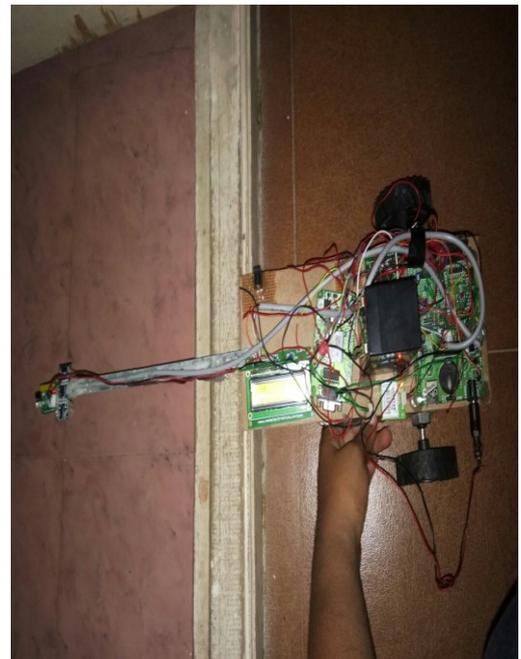

Fig 1.   Block diagram of automatic detection of potholes and speed breaker

III. HARDWARE

A. ARM7(LPC2148):

ARM is family of instruction set architectures for computer processors based on reduced instruction set computing (RISC) architecture developed by British company ARM holdings. A RISC based computer design approach means ARM controller require significantly fewer transistors than typical processors   in average computers .This approach reduces cost ,heat and power use. It is based upon Von-Neumann architecture with 32 bit data bus that carries both instruction and data. Data can be 8 bit,16 bit and 32 bit. It support 7 modes of operation.

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B. GSM module:

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator , just like a mobile phone. when a GSM modem is connected to computer , this allows the computer to use GSM modem to communicate over the mobile network. The GSM net used by cell phones provides a low cost, long range, wireless communication channel for applications that need connectivity rather than high data rates. It is used to send the SMS to mobile phone.

C. DC MOTORS with L293D Driver:

L293D is a typical motor driver IC which allows DC motor to drive on either direction. It is a 16pin IC which can control a set of 2 DC motors simultaneously in any direction.

D. Power Supply:

The power supply is a component that supplies power to atleast one electric load. Typically it converts one type of electric power to another but it may also convert a different form of energy such as solar, mechanical or chemical into electrical energy.

E. GPS:

GPS stands for Global Positioning System. The GPS is used to receive the position data from the vehicles and display on a digital map. It too will have the interface to the communication link. Enhanced feature includes trace mode, vehicle database and network support. It is used to detect location of pothole and humps.

F. LCD:

LCD stands for liquid crystal display. It is a alphanumeric display used to display numbers, characters and graphics. It is used to display parameters of ultrasonic sensors, This is used to display notifications regarding the humps and potholes on roads and alerts the drivers.

G. Ultrasonic sensors:

Ultrasonic sensors are based on measuring properties of sound waves with frequency above the human audible range. This module includes ultrasonic transmitter, receiver and control circuit. It is used to measure distance between two objects and this distance is calculated based on time taken by the ultrasonic pulse to travel a particular distance.

H. IR sensor:

IR sensor work by using a specific light sensor to detect a select light wavelength in a Infra-Red spectrum. By using an LED which produces light at the same wavelength. When an object is close to the sensor, the light from LED bounces off the object and into the light sensor. This results in a large jump in the intensity, that can be detected by using threshold.

IV. TECHNICAL SPECIFICATIONS

- Operating voltage of embedded circuitry is 5v dc.

- Current consumption of device in active mode 200mA.

- Operating frequency of ARM7 is 11.0592MHz

V. APPLICATIONS

- The concept can be implemented in military vehicles.

- It can be used in railways for identification of cracks.

- It can be used in highways in usual transportation of cracks.

- It can be used in bridges and flyovers.

- It can be used by the government authorities to monitor the road conditions effectively

VI. ADVANTAGES

- Accidents due to pothole can be avoided.

- Driver will be intimated about potholes.

- Automatic speed can be controlled if pothole detected.

- GPS tracks the location of pothole and sends it to control room so as to repair the road.

- Enhanced safety and security provided.

VII. DISADVANTAGES

- Power consumption is more.

- Sensors output vary with respective season.

- Sensors range will vary according to vehicle movement.

VIII. CONCLUSION

The proposed system basically serves two purposes it automatically detects the humps and potholes and sends the information regarding this to the vehicle drivers so that they can avoid accidents. This is the cost effective solution for detection of humps and potholes. This system helps us to avoid dreadful potholes and humps and hence to avoid any tragic accidents due to bad road conditions. The information can also be used by the government authorities for the maintenance. The system can be further improved by providing voice messages to alert the driver.

IX. FUTURE WORK

In future this project could be implemented in each and every vehicle. Phased array ultrasonic sensors can be used to obtain better results and accuracy. It is an advanced form of ultrasonic testing. The data in the central server can be exploited by concerned authorities for remedial actions on the potholes. The verification of the remedial action can also be taken by detecting the presence of

potholes in the particular location. It can be further implemented by using IOT technique.

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