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Automatic Detection of Potholes and Humps on Roads to Aid Drivers

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***Abstract*— Nowadays potholes and humps on the roads be the major problems in developing countries. The loss of human life due to accident is to be avoided Well maintained road contribute a major portion of the country's economy. Identification of pavement distress such as potholes and humps not only helps to drivers to avoid accidents or vehicle damages but also helps authorities to maintain roads.**

In exiting method we can get knowledge about pothole location using GPS, GSM and Ultrasonic sensor. It detect the pothole and hump to alert the driver but in our proposed system to detect the pothole and humps and also reduce the vehicle speed, the accident and vehicle damage. In our vehicle contain one database server & the database server collect the information about the pothole and humps and the information are passing to government authorities through the TCP protocol. Well maintained roads contribute a major portion of the country's economy.

***Index Terms*— Arduino, GSM SIM900, GPS, Ultrasonic sensor, Android application, ATMEGA328**

I. INTRODUCTION

A **pothole** is a type of failure in an asphalt pavement, caused by the presence of water in the underlying soil structure and the presence of traffic passing over the affected area. Introduction of water to the underlying soil structure first weakens the supporting soil. Traffic then fatigues and breaks the poorly supported asphalt surface in the affected area. Continued traffic action ejects both asphalt and the underlying soil material to create a hole in the pavement. There are not many works that have been done until now, related to the pothole classification. Potholes in Unites States are classified into 3 levels; low (< 25mm deep), moderate (25mm to 50mm deep), and high (> 50mm deep) . Pothole depth is the maximum depth below pavement surface. We describe the design, implementation, and experimental evaluation of Pothole Patrol (P2), a mobile sensor computing system to monitor and assess road surface conditions. P2 uses three-axis acceleration sensors and GPS devices deployed on embedded computers in cars, relying on the inherent mobility of cars to traverse the roads being monitored.

Fig.1 condition of roads with pothole

This opportunistic mobility is well suited to the application at hand for three reasons. First, it is cost effective when deployed on taxis, garbage trucks, postal vehicles, volunteers" cars, etc. Second, it achieves high spatial coverage with even a small number of cars (in our data, 7 cabs are able to cover 2492 distinct kilometers during their normal driving in 10 days). Third, it is more systematic and reliable than previous approaches to the problem (§6) because it assesses the conditions of any road segment using multiple drives from multiple collaborating cars.

II. RELATED WORK

Sudish surandharan et al [2] has proposed a potholes and pitfalls spotter. In this method the sensor which is used to record the vertical and horizontal accelerations experienced by the vehicle on its route while a GPS device seperately logs its corresponding GPS coordinates. The collected data can be then processed to locate potholes along the path traversed earlier by the vehicle. Amurtha S Raibagi[3] have proposed a Ultrasonic anti crashing system for automobiles. This project focuses on building an user-friendly device that specializes in detecting intrusions besides doing close range obstacle detection. Automobile safety can be improved by anticipating a crash before it occurs and thereby providing additional time to deploy safety technologies Warnings can be like buzzer if the driver is approaching a pothole or any obstruction, driver may be warned in advanced regarding what the road entails. Mr.S.Iyappan[4] have proposed a automatic accident

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detection and ambulance rescue with intelligent traffic light system. The idea behind this scheme is to implement ITLS (Intelligent Traffic Light system) which would control mechanically the traffic lights in the path of the ambulance. The ambulance is controlled by the control unit which furnishes adequate route to the ambulance and also controls the traffic light according to the ambulance location and thus reaching the hospital safely. The controller identifies the location of the accident spot through the sensor systems in the vehicle which determined the accident and thus the controller walks through the ambulance to the spot. Shreyas Balakuntala [5] has proposed An intelligent system to detect, avoid and maintain potholes. This system propose a comprises a laser sensor and pressure sensors in shock absorbers to detect and quantify the intensity of a pothole, a centralized server which maintains a database of locations of all the potholes which can be accessed by another unit inside the vehicle. A point to point connection device is also installed in vehicles so that, when a vehicle detects a new pothole, all the vehicles within a range of 20 meters are warned about the pothole. We propose an algorithm which computes a route with least number of potholes which is nearest to the desired destination. If the destination is unknown, then the system will check for potholes in the current road stretch and displays the level of damage. Varsha Goud[6] have proposed a vehicle accident automatic detection and remote alarm device. Our project will provide an optimum solution to this draw back. An accelerometer can be used in a car.

Alarm application so that dangerous driving can be detected. It can be used as a crash or rollover detector of the vehicle during and after a crash. With signals from an accelerometer, a severe accident can be recognized. According to this project when a vehicle meets with an accident immediately Vibration sensor will detect the signal or if a car rolls over, and Micro electro mechanical system (MEMS) sensor will detects the signal and sends it to ARM controller. Microcontroller sends the alert message through the GSM MODEM including the location to police control room or a rescue team. So the police can immediately trace the location through the GPS MODEM, after receiving the information. Christo Ananth et al. [7] has proposed to make the system more intelligent and advanced it is required to introduce some important developments that can help to promote not only the luxurious but also safety drive to the owner.

The purpose of this paper is to develop a guideline of pothole classification for supporting a decision-making system of pothole repair. In this study, first we review the existing criteria. Next, we collect images of potholes through video recording on a moving vehicle, present a guideline for pothole classification, and apply the guideline to the collected images and pothole 2D DB. Christo Ananth et al. [8] have proposed a System in which an eye blinking sensor is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller.

This system, that we call the Pothole Detection System, uses Accelerometer Sensor of Android Smartphone for detection of potholes and *GPS* for plotting the location of potholes on Google Maps. Using a simple machine-learning approach, we show that we are able to identify the potholes from accelerometer data. The pothole detection algorithm detects the potholes in real-time. A runtime graph has been shown with the help of a charting software library „A Chart Engine". Christo Ananth et al. [8] have proposed a an eye blinking sensor which is used to sense the blinking of the eye. spO2 sensor checks the pulse rate of the patient. Both are connected to micro controller. These methods range from those that measure spectral shape to those that measure similarity in brightness, and hybrids that combine the two. In addition, Classification and Regression Tree (CART) algorithms are used. The CART algorithms produce the best results, with classification accuracies of approximately 68%. Classification methods that incorporate brightness are next best (~50% accuracies), while spectral shape based methods perform poorly (~38%). The mediocre results are attributed to the extremely similar spectral characteristics of the mapped materials, all of which are some variation of asphalt.Cracks in roads comprise only a tiny fraction of pixels they reside within, making their detection difficult. Jakob Eriksson [9] have proposed a The Pothole Patrol: Using a Mobile Sensor Network for Road Surface Monitoring. This system, which we call the Pothole Patrol (P2), uses the inherent mobility of the participating vehicles, opportunistically gathering data from vibration and GPS sensors, and processing the data to assess road surface conditions. We have deployed P2 on 7 taxis running in the Boston area. Using a simple machine-learning approach, we show that we are able to identify potholes and other severe road surface anomalies from accelerometer data. Sudarshan S Rode[4] have proposed a Pothole Detection and Warning System using Wireless Sensor Networks .

This position paper aims at proposing a novel Pothole Detection System which assists the driver in avoiding potholes on the roads, by giving prior warnings. The architectural design further proposes a low response time, low maintenance and deployment cost solution to this problem. Interest in Intelligent Vehicle Systems comes from the problems caused by traffic congestion worldwide and a synergy of new information technologies for simulation, real-time control and communications networks. Xu Li†, Wei Shu[10] have proposed a Vehicle-based Sensor Networks for Traffic Monitoring. In this paper, we are interested in understanding what performance for traffic monitoring we might expect from such vehicle-based mobile sensor networks providing sparse and incomplete information. This is a fundamental

Problem need to be solved. A performance evaluation study has been carried out in Shanghai by utilizing the sensors installed on 4000 taxis. Two types of traffic status estimation

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algorithms, the link-based and the vehicle-based, are introduced based on such data basis. Taehyeong Kim[11] have proposed a Review and Analysis of Pothole Detection Methods. In this paper, we investigate and analyze pothole detection methods which have developed and propose a potential direction of developing a pothole detection method to accurately and efficiently detect potholes.

III. MATERIALS

In this method to detect the pothole and humps and also reduce the vehicle speed, accident and vehicle damage. Components used in this method are as follow.

A. *Ultrasonic Sensor:*

Ultrasonic transducers are transducers that convert ultrasound waves to electrical signals or vice versa. Those that both transmit and receive may also be called **ultrasound transceivers**; many **ultrasound sensors** besides being sensors are indeed transceivers because they can both sense and transmit. These devices work on a principle similar to that of transducers used in radar and sonar systems, which evaluate attributes of a target by interpreting the echoes from radio or sound waves, respectively. Active ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions, convert it to an electrical signal, and report it to a computer. This technology can be used for measuring wind speed and direction (anemometer), tank or channel fluid level, and speed through air or water.

B. *Arduino:*

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. The Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort. Many of the pictures and drawings in this guide were taken from the documentation on the Arduino site, the place to turn if you need more information. The Arduino section covers more on interfacing the Arduino to the real world.

C. *GSM Sim900*

GSM/GPRS Modem-RS232 is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT command. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet act through simple AT commands This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications.

IV. ARCHITECTURE AND IMPLEMENTATION

Our proposed system contains 2 major parts.

- Microcontroller module,
- Mobile application module

The ultrasonic sensor can be used to measure the distance between the vehicle and pothole and also measure the depth and height of the pothole and humps. The Arduino controller can read the digital values only but the value measured by the ultrasonic sensor may be a analog value so that we need Analog to Digital Converter (ADC) to convert the analog value into digital value. The power supply is a device that supplies electrical power to electrical load. Lagrange Polynomial.

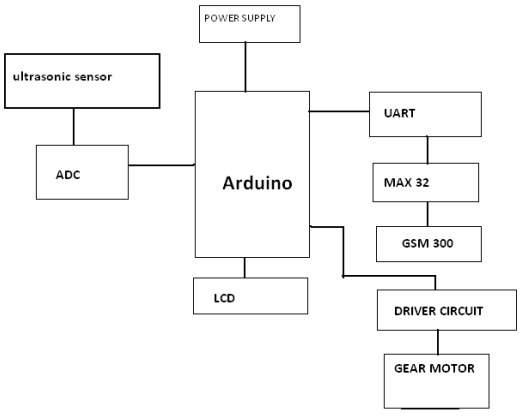

Fig.2 Block diagram of proposed system

The Liquid Crystal Display (LCD) is used to display the details about the pothole and humps. The Global System Mobile communication (GSM) can't directly communicate with the Arduino controller so we have to use Universal Asynchronous Receiver and Transmitter (UART).The MAX232 is used to serial communication purpose.

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Initially the information will be stored and then the stored information will be transmitting to the vehicle driver and Government authority through the GSM.

V. 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 ultrasonic sensor. 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 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.1 Information about detected potholes and humps

Sl No	Obstacle Type	Height/Depth in cms	Latitude	Longitude
1	P	19.35	13.8532	78.5455
2	H	3.1	13.8406	78.5571
3	H	3.8	13.8421	78.5578
4	P	13.2	13.8434	78.5579
5	P	8.7	13.8411	78.5564
6	P	6.3	13.8423	78.5560
7	H	2.3	13.8517	78.5659
8	P	15.8	13.8555	78.5679
9	H	3.1	13.8502	78.5569
10	P	18.2	13.8532	78.5670

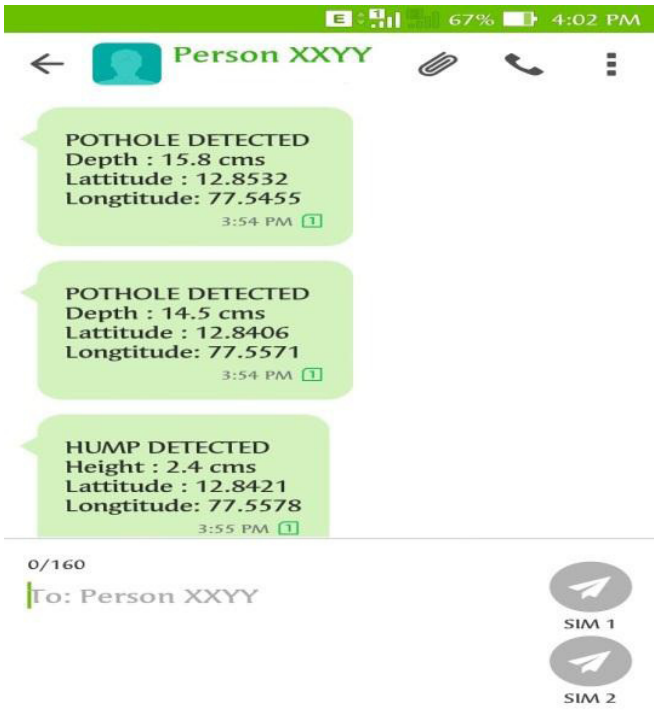

Fig.4 Message sent to the vehicle driver about the detected pothole.

VI. Conclusions

In this project model is, Automatic detection of pothole and humps and alerting vehicle drivers, to reduce the vehicle speed and then avoid potential 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.

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