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Automatic Pothole detection while driving

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Abstract

Today one of the major problem faced by the developing countries are the maintenance of the road conditions. Every year we lose more than one lakh lives on the Indian roads due to the accidents and the proportion of these accidents due to pot holes on the road is quite significant. The potholes are caused due to the poor quality and bad maintenance of the roads. The constant movement of the overweight vehicles like trucks is also responsible for these ill roads. If these pot holes can be detected in real time while driving, it will benefit the riders by avoiding it. The main aim of this paper is to analyze a real-time pothole detection system for the riders using iot. The system uses various sensors in real time to notify the riders. The sensors are mounted on the front side of the vehicle at the bottom level with the angle such that it can detect the potholes appearing the riders route. The important task performed by these system is pothole detection and the hump detection. The tasks of the detection utilizes the ultrasonic sensors to alert the user of the potholes and humps i.e. the obstacles appearing in their route and notify them using the feedback in the form of a buzzer. The proposed system is a cost effective system as well as it is detachable system and it can be use on any type of vehicle either two wheeler ,three wheeler, four wheeler or with trucks also. And the system requires a small space with low maintenance.

Index Terms: obstacle detection , real-time system , ultrasonic sensors..

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1. INTRODUCTION

Everyone carry on their day to day work by travelling from one place to another using road networks. It may take longer time if the roads are irregular , further damaged roads lead to accidents . Potholes are one of the major irregularities which is the cause for many accidents in developing countries like India. 11389 accidents were caused in the year 2014 due to potholes and humps alone. Having this social concern in mind, we have proposed a system, that contains the sensors that detects a pothole by notifying changes in its co-ordinates. These co-ordinates helps to identify severity of the potholes. As the user approaches the location of the pothole , he is warned about appropriate pothole through a long vibration feedback. Thus the system acts as a safety mechanism which allows the user overcome the road accidents. The aim of this paper is to analyze a pothole detection system for the riders. The system uses the sensors in real time to detect the potholes hence giving warning to the riders in the form of feedback i.e.

buzzer. As soon as the pothole is detected the buzzer starts beeping by alerting the rider.

Fig-1: Potholes on roads

2. RELATED WORK

Wang, H. W. et.al [2] , proposed that, Fast economic growth and rapid technology advance in recent years, have led to major impact on the quality of traditional transport system. The aims to improve the transport system by Intelligent transportation system (ITS) has become more and more famous. Moreover, improving the safety of traffic is an major issue of ITS, and the pothole on the road causes a major harm to drivers' safety.

Chaudhuri, Diptanil, and Shivangi Dwivedi. [3], proposed The road networks have been constructed with the aim to ease communication over long distances but this can be not justified if the road is damaged. Although the detection and maintenance of these is done manually. As it takes a lot of time to find the solutions , many automobile manufacturing companies have upgraded their vehicles with techniques which can overcome these issues. But due to this there is increase in cost of vehicle; so to overcome this problem detection and maintenance of damaged roads is a important. This can be done by using an accelerometer as a vibrational detector and a GPS transmitter which can be clamped on the wheels of vehicle sending continuous data (vibrations along with location) to the main server.

Youngtae jo et.al [4] ,proposed Aging roads and poor road-maintenance systems result a large number of potholes, whose numbers increase over time. Potholes jeopardize road safety and transportation efficiency. Absolutely , they are often a major factor to car accidents. To solve the problems associated with potholes, the locations and size of potholes must be determined quickly. A proper road-maintenance strategies can be developed using a pothole database, which requires a specific pothole-detection system that can collect pothole information at low cost and over a wide area. Since the pothole repair has long relied on manual detection efforts. Recent automatic detection systems, such as those based on vibrations or laser scanning, are not sufficient to detect potholes correctly and inexpensively owing to the unstable detection of vibration-based methods and high costs of laser scanning-based methods.

MohdRosli Hainin et.al [5],proposed in particular bitumen pavements are necessary and is a major transportation and communication ways in modern civilizations. Apart from these due to weather impacts and also loads from vehicles, surface of these roads often faces serious deterioration or distress from time to time. Rehabilitation and road maintenance work requires more time and it also creates a traffic disturbances and is also very costly. Problems such as lacking of data reading consistency and time-consuming have made the current visual inspection method to be less competent.

Mednis, Artis, et.al [6],proposed The necessity of the road infrastructure for the society could be compared with necessity of blood vessels for humans. To make sure that the road surface quality it should be monitored continuously and repaired when an as required. The minimal distribution of resources for road repairs is possible providing the availability of comprehensive and objective real time data about the state of the roads. Participatory sensing is a promising approach for such data collection. It can be done by using a mobile sensing system for road irregularity detection using Android OS based smart-phones. Selected data processing algorithms are discussed and their evaluation presented with true positive rate as high as 90% using real world data. The minimal parameters for the algorithms are determined as well as recommendations for their application.

3.SYSTEM ANALYSIS

3.1. Arduino Nano

Arduino is an open-source platform which is based on easy-to-use hardware and software. Arduino boards have ability to read inputs -light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. The Arduino Nano is small in size as compared to arduino uno , it is complete, and breadboard-friendly board based on the ATmega328P (Arduino Nano 3.x). The Arduino IDE software is used to program the arduino. The pin 13 of arduino nano is the led. Obviously the same program is used for Ardunio Nano as that for arduino uno.

3.1.1.Technical Specifications :
1.Based on Microcontroller:Atmel ATmega168 or ATmega328
2. It operates at a voltage of 5V.
3. 7-12 V input voltage is recommended.
4. Input Voltage(limits): 6-20 V
5. It consist of 14 digital I/O pins out of which 6 provide PWM output.
6.It consists of 8 Analog Input Pins.

Fig-2: Arduino Nano

3.2. Ultrasonic Sensors

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor as it is used in many applications where measuring distance or sensing objects are required. The module has two eyes like projecties

in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple formula that is :
Distance = Speed × Time
The ultrasonic wave are transmitted by the ultrasonic sensors. This wave travels in air and when it gets collide /objected by any material it gets reflected back toward the sensor this

reflected wave is measured by the Ultrasonic receiver module. HC-SR04 distance sensor is mostly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc.

4. PROPOSED SYSTEM

The pothole detection system is developed to alert the riders about the potholes on the roads. The system uses a Arduino Nano board, ultrasonic sensors, buzzer and a connecting wires. Once the sensors are mounted on the vehicle, they align themselves towards the path in such a way that ,the signal they emit bounces of the ground right at its critical angle .This results in the signal never coming back to the receiver ,thus the sensor provides the highest value of time .Now if a pothole is there on the way ,the signal travels a bit farther and almost always hit the ground (the side of the pothole) at a bigger angle than the critical angle and thus reflects back to the sensor which outputs a much lower value of time, and thus , 'detects' the pothole .

4.1. System Architecture

The Arduino Nano microcontroller acts as the brain of the system, taking readings from the ultrasonic sensors to compute the distance values. The HCSR04 ultrasonic sensors are tasked with identifying the recurring obstacles coming in the riders route by sending and receiving ultrasonic waves. The sensor is located at the bottom side of the vehicle. It also provides audio feedback to the rider using buzzer.
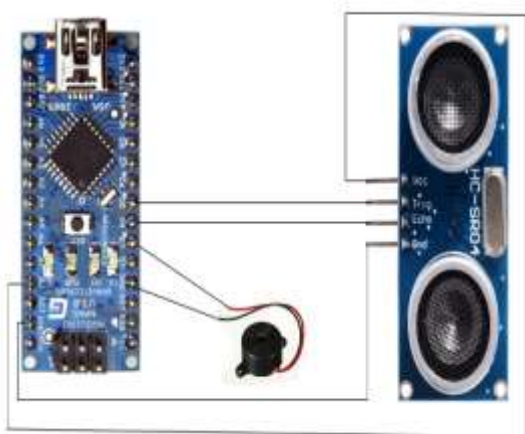

Fig-3: System Connections

4.2. Functioning of the system

The ultrasonic sensors generate high frequency sound waves and evaluate the echoes received back by the sensors.

For the task of obstacle detection, the ultrasonic sensor mounted at the bottom of the vehicle sends ultrasonic waves towards the below ground and starts the timer. The timer is stopped when the waves reflected from the ground are received(As the pothole is detected).

Fig-4: Ultrasonic Sensor working on a) plain ground and b)pothole

Using the time required by the waves to return back to the sensor, the distance value between the vehicle and the pothole is calculated in the Arduino board using the following formula:
Approx. speed of sound $c = 331.5 + [0 \cdot 6 \times$ (air temperature in degree Celsius)]at
20 degree $c = 331 \cdot 5 + (0 \cdot 6 \times 20) = 343 \cdot 5$ m s c= 0 · 03435 cm μS
The time interval between ultrasonic waves sent by the sensor is in μS.
distance = (c*time taken)/2

Therefore, time taken=(2*distance)/c
i.e. duration distance=2/29.1
If the current distance value is found to be less than the calibrated value then detection of a pothole is inferred and the feedback is given in the form of buzzer providing caution to the riders.
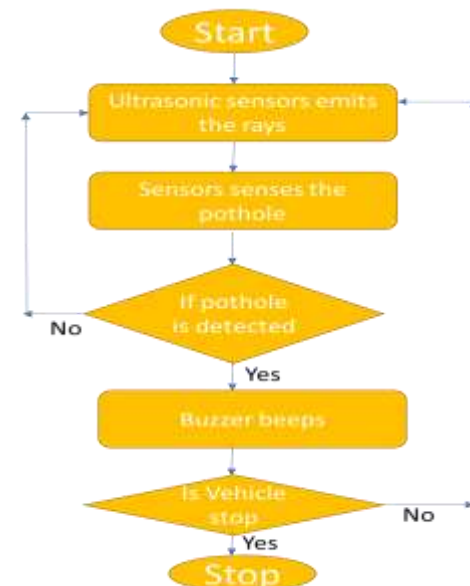
Fig-5: Flow of the system

5. CONCLUSION

Hence we have analyze a pothole detection system for the riders. The system uses the sensors in real time to detect the potholes hence giving warning to the riders in the form of feedback i.e. buzzer. As we lose more than 1 lakh lives on Indian roads due to accidents and the proportion of these accidents due to pot holes on the road is quite significant .So by developing this types of systems can reduce the no of accidents taking place on roads due to potholes. We can also use more number of sensors to increase the functionality of the system. As it is a cost effective and detachable system many number of people can use it irrespective of their financial condition.

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