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Automatic Potholes Detection and Alert System with Speed reduction feature to aid Drivers

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Abstract - *With an increase in vehicular traffic, safety on roads becomes a critical issue. A survey shows that around 3000 deaths occur each year in India due to potholes on roads. This loss of life needs to be avoided. Also well- maintained roads will strengthen our economy. In the proposed scheme there will be automatic detection of potholes using ultrasonic sensors, reduction in the speed of the vehicle using motor driver to avoid accidents or damage to the vehicle. The GPS receiver will be used to capture the location coordinates of the potholes and the same will be conveyed to registered mobile SIM via GSM modem. The android device acting as a server will be inserted with this mobile SIM card. The sent messages will include information about the depth and height of the pothole and hump respectively and also its location coordinates.*

Key Words: **Arduino, GSM SIM 900, GPS module, Ultrasonic sensors, Bluetooth module**

1. INTRODUCTION

Fig.1 pothole

Over the past few years there had been an enormous increase in population which leads to an increased load on the infrastructure. Vehicular traffic on roads has increased tremendously. Managing such heavy traffic has become very difficult. Another major problem faced is that our roads are in a poor condition. Potholes are formed due to heavy rains and the movement of heavy vehicles. These potholes are the biggest reason for traumatic accidents and loss of human lives. Also since the roads are in a very poor condition fuel consumption of the vehicles is increasing which causes wastage of precious fuel. Because of these reasons, it is very crucial to get the information of such bad road conditions, collect this information and distribute it to other vehicles, which in turn can warn the driver. But there are various challenges involved in this. First of all, there are numerous methods to get information about the condition of roads. Secondly there must be a proper collection and distribution of this information to all the vehicles that might need this information. Lastly, the information collected must be conveyed in a manner that is easy to understand and use by the driver. The main aim of this model is to try and design a system in which the access point will collect the information about the potholes and then distribute it to other vehicles using a wireless broadcast.

2. LITERATURE REVIEW

The casualties on roads have increased immensely. Major reason for which is the potholes on roads, thus there is an increasing need and demand in developing a safety system for vehicles. These systems have evolved over time. These systems make use of electronic circuitry and ultrasonic sensors to detect potholes. Once the detection is finished, these systems offer a warning to the drivers either through buzzers or through text messages. Sudish Surandharan et al has proposed a pothole and pitfalls spotter. In 2017 Stepheena Joseph et al. present that destructive road conditions may be the outcome of natural events like flooding and tropical rains that make driving risky. Dangerous conditions of roads can also arise from the destitute condition of a road and its surroundings. It can cause road accidents. Also, when one drives at night, headlights are not sufficient enough to help detect potholes or other obstacles. Unforeseen impediments out and about may cause more mishaps. Additionally, due to terrible road conditions there will be an expanded fuel utilization of the vehicle which will cause wastage of valuable fuel.

In this technique the sensor which is utilized to record the vertical and horizontal increasing speeds experienced by the vehicle on its course while a GPS gadget independently logs its relating GPS and organizes the information being gathered. This data can be then handled to get the area of potholes and protuberances. Amurtha S Raibagi has proposed an Ultrasonic anti crashing system for vehicles. This model focuses on building a gadget that represents considerable authority in recognizing interruptions alongside little proximity disincentive identification. Inorder to aid vehicle security a system can be developed that can envision an accident before it happens and consequently give extra time to convey wellbeing advances. Admonitions

can be given by methods of a signal if the driver is moving toward a pothole or any impediment, the driver can be cautioned ahead of time with respect to what the road ahead involves. Varsha Goud has proposed a vehicle mishap and remote caution gadget. Sudarshan S Rode has proposed a Detection of Pothole and Warning System utilizing Wireless Sensor Networks. This position paper targets at proposing an innovative Pothole Detection System that will help the driver in maintaining a strategic distance from potholes on the streets by giving timely guidance. The building configuration further proposes a low maintenance low reaction time and sending cost answer for this issue Our proposed model won't just give a pothole alarming framework through message alert however will likewise help control the speed of the vehicle.

3. COMPONENTS USED IN THE PROPOSED SYSTEM

In the proposed model there is an expense-effective solution in the current interpretation to identify potholes and bumps on roads and to notify drivers of their appearance.

The following are the components used in the proposed work:

3.1 ARDUINO

The Arduino UNO is an exclusive microcontroller floor contingent upon Arduino.cc's set up Microchip ATmega328P microcontroller.

This board contains sets of advanced and basic information and yield (I / O) pins that can be attached to the various boards and circuits. The arduino board has 6 analog pins and 14 digital pins and tends to be customized with the Arduino IDE using a type B USB connection. In Italian, "Uno'' means one and was chosen to stamp Arduino Software (IDE) 1.0's arrival. Arduino's reference forms were Arduino Software's Uno board and 1.0 version, which are currently being developed for new releases. The first in a USB Arduino board progression was the UNO board, and it is the Arduino stage reference model. At the Arduino Uno, the ATmega328 comes pre-modified along with a bootloader that allows transferring new code to it without the use of any software program engineering from outside network. It makes use of the original communication protocol STK500.

TECHNICAL SPECIFICATIONS:

Operating Voltage: 5 Volt

Input Voltage: 7 to 20 Volts

Digital I/O Pins: 14 (6 PWM output)

Analog Input Pins: 6

Direct Current per Input-Output Pin: 20 mA

Direct Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB

SRAM: 2 KB

Clock Speed: 16MHz

The Arduino Uno device can be driven using an alternative energy source or a USB connection. The arduino device dynamically chooses the power source. External power (non-USB) can come from either an Alternating Current to Direct Current converter or a battery. The adapter is normally linked by connecting into the power socket of the platform a 2.1 mm center-positive jack. Battery leads are often inserted into the facility connector's Vin and GND pin headers. 6 to 20 voltage external supply is needed for the functioning of the arduino board. If the supply is less than 7V, however, the 5V pin will supply less than 5 volts and the device might become volatile. Using just 12V, the transformer will overheat and damage the board. The suggested range is between 7 and 12 Volts.

3.2 ULTRASONIC SENSOR

Ultrasonic sensors are used to feel proximity and to detect highly reliable rates. It is a tool that ascertain the distance to an object using ultrasonic sound waves. Transducer is used to send and experience ultrasonic pulses that relay back facts about an object's proximity. To produce clear-cut echo recurring design High-frequency sound waves are reflected from boundaries.

HOW ULTRASONIC SENSOR WORK

Ultrasonic pulsation is the spectrum of human hearing frequencies above. Transducers that are microphones are used to receive and send the ultrasonic signal. Ultrasonic sensors use a single transducer to transmit a signal, and to receive the echo. The space to a target by measuring time negligence between the sending and receiving of the ultrasonic pulse is dictated by the sensor. It sends an ultrasonic pulse out at 40kHz which proceeds through the air and it will bounce rear to the sensor if there is a stumbling block or object.

By computing the travel time and the speed of sound, the distance can be calculated.

Test distance = (high velocity = 340 M / S)/2

3.3 GSM MODULE

GSM, initially the Groupe Special Mobile, is a standard established by the European Institute of Telecommunications Standards. It was established to define the protocols used by cell phones for second-generation (2 G) digital cellular networks and is now the established global standard for mobile telephony – with a market penetration

of over 90 per cent operating in over 219 countries across the world.

GSM system was invented as a distributed system for communication purposes using the multiple access time division (TDMA) technique. A GSM uploads and decreases data automatically, and sends it out over a channel with two different channels of client data in its own specific time period. Each has their own particular time slot.

GSM Module features are high-quality voice, high spectrum performance, support for services, SIM phone book maintenance, fixed dialling number, cryptography to make phone calls secure, short message service, Integrated services digital network compatibility.

3.4 GPS MODULE

The GPS formerly NAVSTAR GPS, seems to be a spacecraft-based radio radar system developed by all the government of the United States and controlled by the Aerospace Force. This is one of the global navigation satellite systems (GNSS) that delivers geo location and authentication tokens to such a GPS receiver somewhere on or around the Earth where there is an unbroken field of vision for four or more GPS satellites. The comparatively weak GPS transmissions are blocked by objects such as hills and dwellings. The GPS doesn't quite offer the ability to transfer any data, and it maintains control of a telecommunications or broadband transmission, although these techniques may increase the usefulness of the GPS positioning data. The GPS feature is based on the ' trilateration ' Statistical principle. The location of the same satellites shall be determined from the estimates of distance.

4. WORKING PRINCIPLE

This contains two modules, Arduino platform module and the mobile application module. The potholes and bumps data are collected from the Arduino module and its geographic areas and this information will be sent to the mobile phone. Mobile phones receive Arduino module data and give the driver timely warnings.

The proposed system block diagram is shown below.

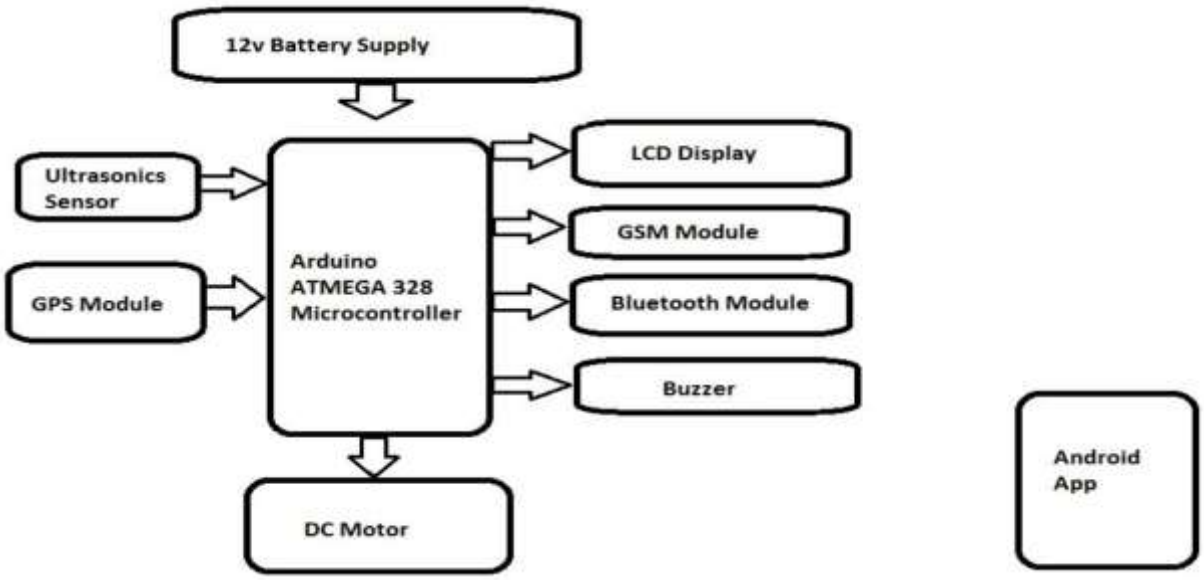

Fig.2 Block Diagram

The Arduino module consists of five components, Arduino, ultrasonic sensors, GPS receiver and a GSM modem. Ultrasonic sensors are used by sending and receiving light rays to prevent accidents and detect obstacles such as cars.

By the use of ultrasonic sensors, the length between the vehicle frame and the road surface is calculated and this data would then be sent for additional study to the Arduino. The distance among vehicle frame and the floor, on a smooth road, is the edge distance or the threshold distance. Threshold value depends on the floor clearance of vehicles and can be configured accordingly. If it's a pothole, then the gap measured through ultrasonic sensor is more than the threshold value and if it's smaller then it is a smooth surface. The precise location of the potholes is collected by GPS which will send these details to the enrolled mobile users through text messages. Registered SIM present on the device will act as a server. The notifications sent also provide a record of that same pothole's estimated depth and the coordinates for its location.

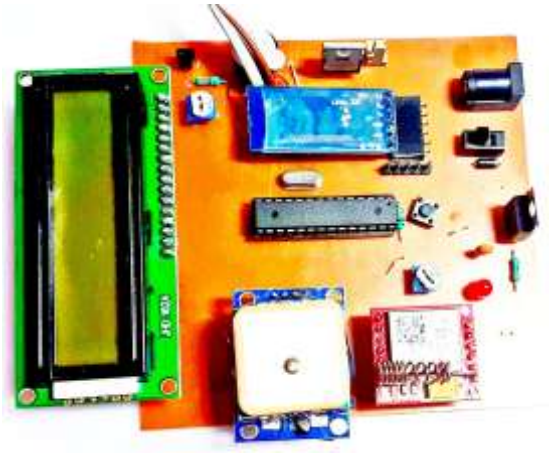

Fig.3 Circuit Implementation

The vehicle driver will have to install an android app on his smartphone in the Mobile application section to get timely warnings about the existence of potholes. This application will be constantly running in the background of his smartphone. The geographic location of the car will be collected and then the location of potholes in the vicinity will be accessed. If the distance between the two is not the safe distance then alert message will be sent on the registered SIM. Additionally, using a motor driver there will be a reduction in the speed of the vehicle. This will help avoid accidents or harm to the car.

5. FUTURE SCOPE

In our project we are using single node. In future it may require one database server. If we are using a number of nodes, we have to make a cloud. It can be integrated in the proposed system to improve user experience. Also, the suggested system contemplates the existence of potholes and humps. However, it does not contemplate the reality that worried authorities periodically renovate potholes and humps. This system can be improved by considering the above facts and updating server databases accordingly. Also, in future this project can be implemented in each and every vehicle. To acquire better outcomes and accuracy phased array ultrasonic sensors can be used. It can improve the form of ultrasonic testing. The information in the central server can be exploited by the concerned authorities for remedial actions on the potholes. The validation and remedial action can also be taken by identifying the presence of potholes in the certain site. It can also be incorporated with Google maps via a feedback mechanism that can recommend an alternative route with less potholes.

6. CONCLUSIONS

One of the significant tasks in determining the entire plan of action for pavement conservation and rehabilitation is precisely the detection of potholes. Manual observation and assessment methods are exorbitant and time-consuming. Thus, many efforts are being made for advancing a technology that can automatically detect and acknowledge potholes and can also contribute towards the improvement of examine efficiency and pavement quality through prior investigation and immediate action. The model suggests automatic identification of potholes and humps, alert vehicle drivers and automatic reduction in vehicle speed to prevent potential injury.

The mobile application made use in this technique is at a greater distance of benefits because it supplies timely warnings regarding potholes and humps. This serves as a valuable source of information to the government authorities and to vehicle drivers. The suggested approach is an economic solution for detection of dreadful potholes and irregular humps, as it uses cheap cost ultrasonic sensors. The solution too tasks in season when potholes are crammed with sludgy water as alerts are generated using the knowledge stored within the database. We feel that the answer provided during this paper can save many lives and ailing patients that suffer from tragic accidents. The proposed system takes into consideration the presence of potholes and humps. However, it doesn't consider the very fact that potholes or humps get repaired by concerned authorities periodically. This system can be further improved to consider the above facts and update server database accordingly. Well-maintained roads contribute to a significant part of the economy of the country.

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