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# Pothole recognition and alert using ultra sonic, GPS and GSM

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*Abstract—: Maintenance of roads is one tiresome re-constructional task that has to be carried out regularly. The inability to do the same has numerous consequences like fatal condition of highways which result in early need of servicing of domestic vehicles. If proper maintenance is not done, this further results in environmental pollution as well as life threats. Our proposal involves the identification of such potential threats and letting one know the urgency to take care of these threats. This is achieved with the help of a system that comprises of ultrasonic sensors, GSM and GPS module controlled by a processor. Ultrasonic sensors are used to measure pothole's depth in addition to identifying them. The geographical location i.e. the coordinates of potholes using a global positioning system can be obtained. This information inclusive of all the details regarding potholes i.e. depth, width and its location, is sent to municipal corporation with the help of GSM module. The Municipal Corporation further uses this information for maintaining a record.*

*Index Terms—Alerting, Pothole Parameters, Safety, Tracking.*

## I. INTRODUCTION

Vehicle population has tremendously increased over the last two decades. Nowadays traffic congestion and road accidents are increasing mainly due to the proliferation of vehicles. Roads make up to the majority of means of transportation used as of today in India, regular maintenance of these roads is crucial as they are filled with unexpected hurdles such as potholes and humps. Potholes are basically areas of road surface that have ruptured, worn away, or eventually formed a hole.

Potholes leads to unbalance while driving which can eventually lead to accident. According to the report of Global Road Safety, released by the World Health Organization (WHO), India reports for more than 200,000 deaths because of road accidents. These accidents can be due to over speeding, drunk and driving, jumping traffic signals and also due to humps, speed-breakers and potholes. [1]

The solution to this problem must be designed wherein it ensures the systematic and safe flow of traffic on Indian roadways. This can be achieved by maintaining the equality of roads. The regular monitoring of these roads will help the government to be aware of the possible threats of fatal accidents on road.

To achieve this, we wish to have a government vehicle which runs through the entire paths and collects the information about potholes at different locations. Depending upon the depth and the soil structure below the pothole the emergency to fill the hole can be derived.

The motive behind this project is to notify the Municipal Cooperation regarding potholes which will avoid accidents and make roads a better place to ride. This is achieved by establishing a detection system which employs an ultrasonic sensor to measure the area and depth of a pothole. This related information is then processed by the controller and the equivalent coordinates of the location obtained from a global positioning system, are sent via global system for module.

After getting damage due to potholes vehicles require or seek for maintenance which in turn increases vehicle maintenance cost. Roads too require maintenance once affected by potholes.

## II. COMPONENTS

### A. 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. an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code per second. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer

and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors. [5]

**B. ULTRASONIC SENSOR**

Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the audio range. The HC-SR04 module includes ultrasonic transmitter, receiver and control circuit. It measures distance between two objects and this distance is calculated depending upon the time taken by the ultrasonic pulse to travel a particular distance. The module sends a 40 kHz square wave and detect the received pulse signal automatically. The distance is calculated based on the time taken by the transmitted signal to return. [4]

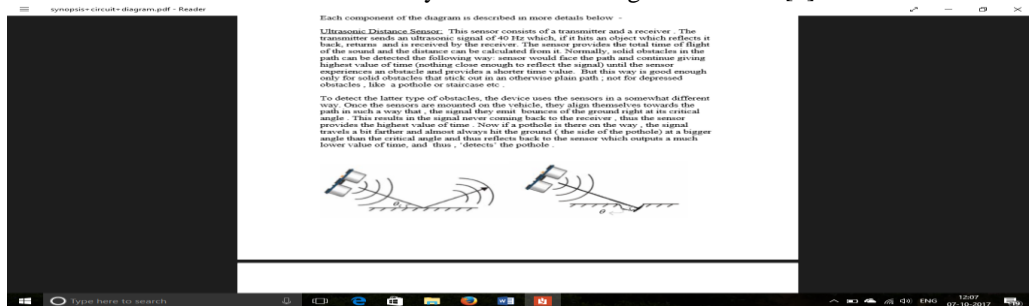


Fig. 1 working of ultra-sonic sensor [4]

**C. GLOBAL POSITIONING SYSTEM**

It is based on the communication with 24 satellites revolving around the earth. It works as follows. These 24 satellites are orbiting around earth in 6 different paths. Theoretically at any point you need a point to point connection with at least 4 satellites to get your position. It determines 4 parameters x, y, z, t using 4 measurements. And then represents in the form understood by the user like latitude/longitude. In real setting, it might even require less satellites if one of the parameters is known. For example, ships sailing in sea know their altitude to be zero. Also, more the satellites you connect more accurate location you will get. GPS locations can get as accurate as up to 15meters.

**D. GLOBAL SYSTEM FOR MOBILE**

The global system for mobile is Quad-band GSM/GPRS modem, it mainly used for communication purpose. It is suitable for SMS, voice as well as data transfer application in M2M interface the modem has RS232 interface, which allows connecting microcontroller with modem. In our system, GSM used for delivering the message about the road condition to the government authorities. The government authority's number is registered in GSM module. When any decision from the controller is received, the GSM sends the message to the government; this message includes the location of the potholes for reconstruction purpose.

**III. METHODOLOGY**

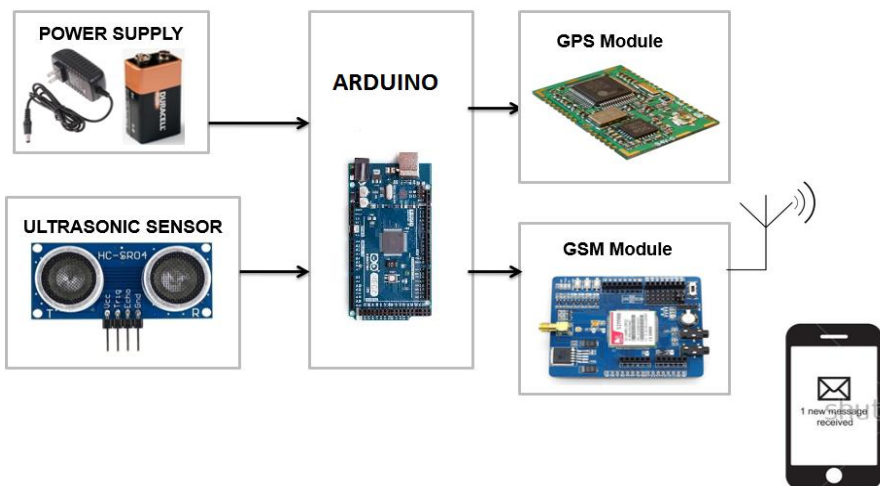


Fig.2 Block diagram of Pothole detector circuit.

The working of proposed system can be divided into 3 sections-

- Sensing
- Controlling
- Output

The combined operation of the project can be understood by knowing what functions each of its sections performs. Coming to sensing section, its only function is to sense the presence of a pothole on the pathway. With the help of an ultrasonic sensor we are able to detect the presence of a pothole as well as its other parameters such as length, width and height. The sensor generates an 8 cycle burst of ultra sound at 40 KHz when triggered with a short 10 uSec pulse.[2] The working can be understood with the help of timing diagram shown in fig.3.



Fig. 3 Timing Diagram of HC-SR 04 [4]

Initially an echo is generated immediately after the generation of burst, and at the beginning it provides the actual distance between the sensor and the ground. The subsequent values obtained from sensor are compared with the actual distance and if it is within a tolerance range no action is taken. Otherwise it can be inferred that a pothole is detected. This information is processed by an Arduino processor operating at 16MHz. The main function of this section is to get the location of the pothole with the help of gps module and process this information to produce a compatible data that can be accessed on other operating systems. This function also has an additional feature of alerting the driver about the proximity of vehicle with any threatening pothole. The ultimate purpose of this system is proposed by the last section i.e the output section which comprises of gsm and a buzzer. [3] It provides the service of transmitting the processed information which includes the coordinates of pothole and its dimensions obtained from previous sections. At present, the work done on this concept has reached only up to the reception of information which contains dimensions of pothole in a text format which can be seen in fig. 4 & fig. 5.

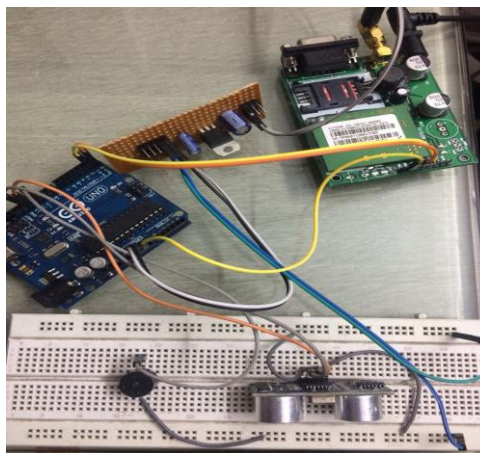


Fig. 4 Interfacing GSM and ultra-sonic with Arduino processor



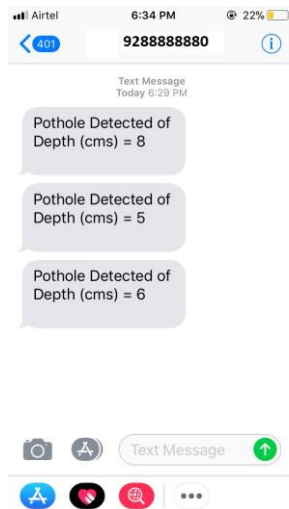
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#### IV. RESULT AND DISCUSSION



**Fig. 5 Text message received containing dimensions of potholes encountered.**

Thus, it is observed that three potholes are detected and their dimensions are measured. This information is obtained in the form of a text message at a registered number.

#### V. CONCLUSION

The main advantage of this device is, it is low cost equipment and can help maintenance authorities in order to reduce man power in reporting quality of roads. Many enhancements can be made on this device like hump detection; adaptive speed control, obstacle avoidance and preventing drink and drive cases. The only limitation of this device is, sometimes it takes discrete changes in level of road surface as potholes.

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