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A REAL-TIME POTHOLE DETECTION APPROACH FOR A SAFETY TRANSPORTATION SYSTEM

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ABSTRACT: *Roads are the predominant mode of transportation. Due to lack of maintenance majority of accidents takes place which is mainly due to potholes. A pothole is a structural failure in road surface. The pressure to the road surface increases due to the increased traffic which creates potholes. In order to reduce accidents occurred by pothole we propose a pothole detection method where we detect the pothole and update its location in Google maps. The module contains two sections, hardware containing the sensors and the software updating the cloud database and plotting the location of the potholes on Google maps. The potholes on the road surface are detected using an accelerometer sensor. The deviation in accelerometer values, its corresponding latitude and longitude details from GPS are uploaded to firebase. The values between certain ranges from accelerometer sensor which denotes the pothole are only extracted and are plotted on Google maps. In addition to this the luminescence and noise level at that area is determined using LDR and an analog microphone respectively. The usage of server allows us to take the complete database whenever required which cannot be done by thingspeak.*

Keywords: *Sensor, LDR, Accelerometer, Potholes, GPS.*

INTRODUCTION:

Roads are an important mode of transport in India. India has the second larger road network in the world. Road network quality is significant factor in the economy development and well-being of the people in a nation. Nowadays the use of automobile increases rapidly which led to several issues and problems such as increase in pollution, traffic etc. Since the number of automobiles are increasing day by day, the number of road accidents and traffic issues are also growing rapidly.

Nowadays, many researches has been undertaken in the field of automated vehicles and road systems in order to minimize accidents and traffic issues. The main goal of this research is to minimize the accidents and makes driving safer. One of the most important reasons for road accidents are potholes. A pothole is a structural failure in road surface. Since the speed of driving is very fast nowadays, a sudden disturbance on the road surface makes the vehicle to lose balance and leads to accidents. An average of 9300 deaths and 25000 were injured in past three years due to potholes.

In order to reduce such accidents we propose a pothole detection system where we detect pothole using accelerometer and update its location on Google maps using the latitude and longitude from the GPS.

COMPONENTS OF THE PROPOSED SYSTEM:

1. Accelerometer sensor:

An accelerometer is a device that measuresthe acceleration forces. By calculating the speed increasing capacity of the vehicle with respect to gravity, an accelerometer can figure out the angle it is tilted with respect to the earth. By determining the tilting angle the accelerometer determine the speed and direction of the vehicle. Here we use MPU6050 sensor which is a Micro Electro-Mechanical System (MEMS) consist of three-axis accelerometer and three-axis gyroscope. This helps to measure acceleration, velocity, orientation, displacement and many other motion related parameter of the system. It uses I2C protocol for communication.

Figure 1 MPU6050 SENSOR

2. GPS module:

The GPS is an electronic device that allows us to get the longitude and latitude of a particular place along with its time and speed. It uses the standard NMEA protocol to transmit the position data via serial port. For this proposed system we use NEO-6M module. NEO-6M module is a well-performing complete GPS receiver with built-in ceramic antenna, which provides a strong satellite

search capability. It has data backup battery (EEPROM), which helps the device to store the data even when the main power supply is switched off.

Figure 2 NEO-6M MODULE

3. GSM module:

Global System for Mobile communication (GSM) is an electronic device used to provide communication between two mobile devices or a computing machine. It is digital cellular technology used to transmit both voice and data service between two nodes at different frequencies. It uses time division multiple access (TDMA) technique for communication process. It improves the spectrum efficiency and provides high speech quality. It uses encryption for making the phone calls and short message service more secure.

Figure 3 GSM MODULE

4. Wifi Module:

The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers . This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts. There is an almost limitless fountain of information available for the ESP8266, all of which has been provided by amazing community support.

Figure 4 WIFI MODULE

5. Google Maps:

Google Maps is a web mapping software developedby Google. Google maps are available as mobile app in every android phones for the purpose of route navigation. It provides route for each and every corner in the world. It offers a route planner, that helps the user to find the route of a particular destination via public or private transport and also by walking. It is being used by many transportation companies and also provides satellite images of the streets.

6. LDR and Microphone:

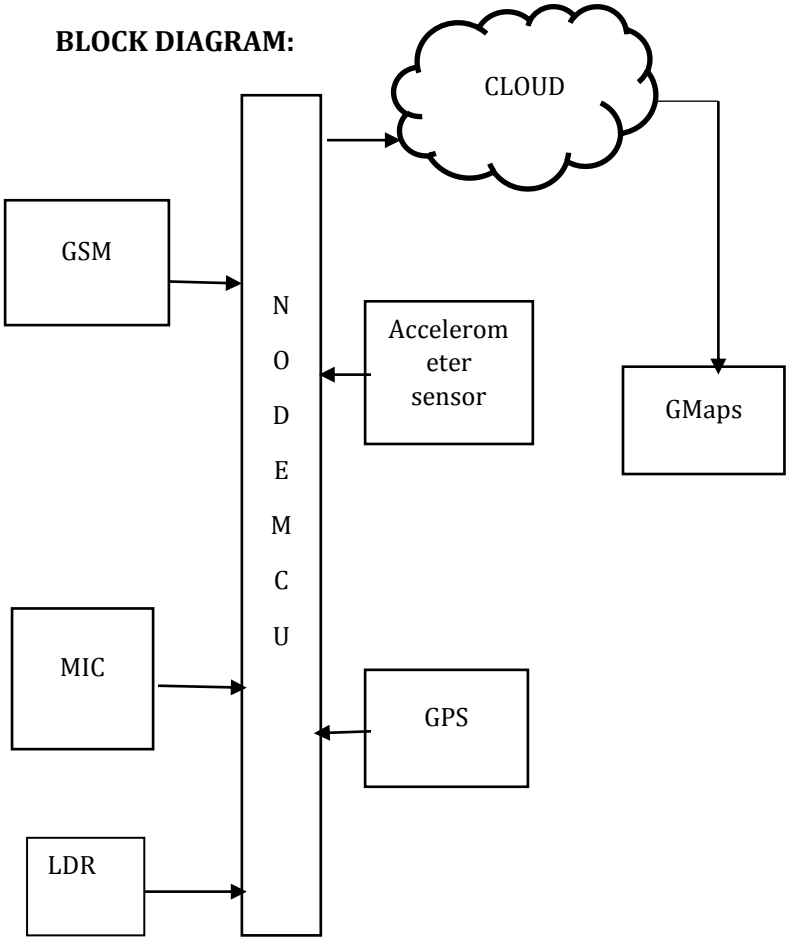
Light Dependent Resistor (photoresistor) is a component whose changes in resistance depends on the luminescence capacity of the component.

Figure 5 LDR

A microphone, colloquially named mic or mike, is a device – a transducer – that converts sound into an electrical signal. Microphones are used in many applications such as telephones, hearing aids, public address systems for concert halls and public events, motion picture production, live and recorded audio engineering, sound recording, two-way radios, megaphones, radio and television broadcasting, and in computers for recording voice, speech recognition, VoIP, and for non-acoustic purposes such as ultrasonic sensors or knock sensors. A microphone is used to detect the noise level at a particular area.

Figure 6 MICROPHONE

BLOCK DIAGRAM:



An accelerometer sensor is used to detect the deviation (potholes) in the road surface. The gyroscope present in MPU6050 can detect rotation about the three axes X, Y and Z. The values of the three different axes are updated continuously in the cloud. A threshold value is set. The values from the gyroscope axes are compared with the threshold value, any deviation in the values are considered to be potholes. The values are analyzed. The GPS interfaced with the accelerometer sensor collect the deviated values and gives its location with its latitude and longitude along with time and date. These locations are located on the Google maps by accessing its API.

OUTPUT:

The proposed system shows the location of pothole the in Google maps and the values of LDR and microphone along

with latitude and longitude from the server using the URL as shown below.

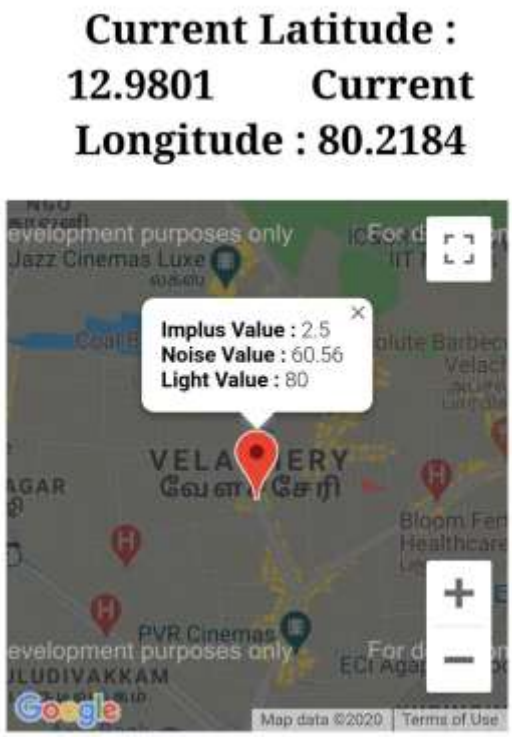


Figure 7 SAMPLE OUTPUT IN GMAPS

```
Array
(
    [id] => 11
    [glat] => 12.9801
    [glong] => 80.2184
    [impluse] => 2.5
    [noise] => 60.56
    [light] => 700
    [created] => 2020-03-10 15:58:12
    [actual_link] => http://www.secure2pay.in
)
```

Figure 8 VALUES UPDATED IN THE CREATED URL

CONCLUSION:

Considering the current road system and traffic, it is important to a safety system that alert the vehicle driver about the upcoming pothole in their way. In this proposed system, we have discussed the pothole detection and the updating its location in the Google Maps. The propose system uses accelerometer sensor for the detection of pothole and GSM module for communication between the interfaced devices. This module helps to reduce the number of accidents due to potholes. It makes driving fast and efficient. This method an overcome the following dependencies

i) Accelerometer must be calibrated by attempting several test for detecting the pothole.
ii) Wi-Fi is not mandatory for the working of the prototype when it use GSM.

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