Identifying and Reporting of Potholes and Humps using IoT

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Abstract - *One of the most vital problems in developing countries is conservation of roads. Well maintained roads contribute a significant portion to the country's economy. Spotting of pavement distress like potholes and humps helps drivers to avoid accidents or vehicle damages, conjointly helps authorities to take care of roads. Many on-going projects in the field of transport networks are operating in the direction of providing driver with relevant data concerning roads and traffic movements. Ultrasonic sensor is used to measure depth and height of potholes and humps respectively. Information about depth of pothole, height of hump as well as location, which is sensed by the sensor is stored in the database. This proposed system note the geographical location coordinates of potholes and humps using GPS receivers and store that information as complaint to the government sector. This serves as a valuable source of information to the concerned authorities and to vehicle drivers. To avoid accidents a web application is used to aware drivers so that safety measures can be taken.*

*Key Words***: Pothole, Web application, GSM SIM808, GPS, Arduino uno, Ultrasonic sensors.*

1. INTRODUCTION

Most Indian roads are not suitable for vehicles because of the uneven surface. Especially in the rainy season poor maintenance of the roads frustrates the problem. So formation of potholes is a very common problem For Indian roads and streets. Potholes are the major concern for public as it impacts the daily transportation.

A pothole is a kind of asphalt failure caused by a combination of water and traffic pressure. Due to water in the underlying soil and traffic passing over the affected area structural failure is created in a road surface. Many recognize that quality of local roads may be deteriorating with time, potholes being one of the main causes. Therefore it has become a need to carry out timely inspection and maintenance of potholes to avoid inconvenience to road users.

However, most of the roads in India are narrow and congested with surface quality being poor and road maintenance needs are not satisfactorily met. Over the last three decades, there has been a tremendous increase in the vehicle population. This proliferation of vehicles has led to many problems such as traffic congestion and increase in the number of road accidents. Pathetic condition of roads is a one of the factor for traffic congestion and accidents.

Fig. 1. Condition of roads with potholes

Potholes shaped because of substantial downpours and development of overwhelming vehicles likewise turn into a noteworthy purpose behind horrendous mishaps and loss of people. As indicated by the study report "Street Accidents in India, 2011", by the service of street transport and parkways, a sum of 1,42,484 individuals had lost their lives because of deadly street mishaps. Of these, almost 1.5 percent or about 2200 fatalities were because of poor state of streets. Figure 1: Portrays the state of streets with substantial potholes. To address the previously mentioned issues, a practical arrangement is required that can gather the data about the seriousness of potholes and bumps and furthermore causes drivers to drive securely. With these proposed framework an endeavor has been made to embrace drivers to avert the mishaps caused because of potholes and raised protuberances. The remaining sections of the paper are as follows: section 2 highlights on the related work that has been done and is going on in the field of detection of potholes and humps. Section 3 will discuss the various components used in the proposed system. Section 4 describes the architecture and also implementation of the proposed system. Experimental obtained results of the proposed work are presented in Section 5. Section 6 is Conclusion and future scope.

2. RELATED WORK

The execution of pothole location framework on texas Instruments C6678 Digital Signal Processor (DSP) is portrayed by Chee Kin Chan[1]. The framework works on several maps as info followed by surface fitting and Connected component Labeling (CCL) for pothole location. Memory management has also been connected for prime goals input pictures likewise as compiler enhancement for proficient code pipelining. The calculation authorized for the

TMS320C6678 SoC Digital Signal Processor (DSP) is implemented by Aliaksei Mikhailiuk[2]. Potholes might be distinguished by looking at the disparity estimations of the section to it of the imbalance of the cleared surface whenever recognized. A setup made to detects potholes based on a vision method by Sachin Bharadwaj Sundra[3] with an explicit camera is mounted over the vehicle and the pictures will be procured. At that point, a project arrangement is planned utilizing MATLAB. Utilizing this methodology, potholes can be identified just if there should be an occurrence of uniform lighting conditions. These solutions do not provide any aid to the driver to avoid accidents. Byeong-ho Kang[4] build up a pothole location framework and strategy utilizing 2D LiDAR and Camera. The blend of heterogeneous sensor framework is utilized to enhance the pothole identification exactness. The pothole location calculation incorporates clamor decrease pre-preparing, bunching, line section extraction, and slope of pothole information work. Vigneshwar K[5] is executed picture pre-preparing dependent on contrast of Gaussian-Filtering and grouping based picture division techniques for better outcomes. From the outcomes the K-implies grouping based division was favored for its quickest figuring time and edge location based division is favored for its particular ID. The IoT based Pothole Detection System, utilizes 2 ultrasonic Sensors for identifying those potholes by Pathan Amir khan Ayyub khan[6] all the more precisely then previously and GPS is utilized for plotting the area of potholes on World Maps, it will give a caution to the driver about potholes utilizing signal and gazing (or handle) vibrator. Ultrasonic sensors are utilized by Rajeshwari Madli[7] here to recognize potholes and protuberances and furthermore to gauge their profundity and stature separately. The framework catches the geological area directions of potholes and mounds utilizing GPS collector. The detected information incorporates pothole profundity, tallness of protuberance and furthermore geographic area, this data is put away in the database (cloud). This fills in as an entirely profitable wellspring of data to the Government experts and to vehicle drivers. An android application is utilized to caution drivers.

3. COMPONENTS USED IN THE PROPOSED SYSTEM

The proposed system for spotting potholes and humps on roads suggests a cost effective solution and also warning drivers about pothole's existence. Components used in the proposed work are mentioned as follows:-

A. Arduino UNO:-

The Arduino UNO is a wide used open-source microcontroller board supported the silicon chip ATmega328P microcontroller and developed by Arduino.cc. The board is provided with sets of digital and analog input/output (I/O) pins. These pins will be interfaced to various enlargement shields and different circuits. It has fourteen digital input/output pins, out of that six are used as PWM outputs, six analog inputs, a 16 MHz ceramic resonator,

a USB association, an influence jack, ICSP header, and a push button. It's programmable with the Arduino IDE (Integrated Development Environment) via a kind B USB cable. The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that permits uploading new code to that while not the employment of an external hardware applied scientist.

B. HC-SR04 ultrasonic (US) sensor:-

The HC-SR04 ultrasonic (US) device is a four pin component, having pin names are Vcc, Trigger, Echo and Ground respectively. This device is also a very talked-about device utilized in many applications where measure distance or sensing objects are required. The module has 2 devices comes in the front that forms the ultrasonic transmitter and Receiver. Power the sensing element employing a regulated +5V through the Vcc and Ground pins of the sensing element. This consumed by the sensing element is a smaller amount than 15mA and hence may be directly battery-powered by the on board 5V pins (If available). The Trigger and Echo pins are each I/O pins and therefore they are connected to I/O pins of the microcontroller. The trigger pin should be created high for 10uS to begin the mensuration, so turned off. This action can trigger an ultrasonic wave at frequency of 40Hz from the transmitter and also the receiver can look ahead to the wave to come back.

C. GSM/GPRS module:-

To determine communication between a computer and a GSM-GPRS system GSM/GPRS module is employed. International System for Mobile communication (GSM) is a design used for mobile communication in most of the countries. International Packet Radio Service (GPRS) is an extension of GSM that allows higher knowledge transmission rate. GSM/GPRS module consists of a GSM/GPRS electronic equipment assembled at the side of power offer circuit and communication interfaces for computer. SIM808 module is a GSM and GPS two-in-one operate module. It is supported the most recent GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation. It features ultra-low power consumption in sleep mode and integrated with charging circuit for Li-Ion batteries, that make it get a super long standby time and convenient for projects that use rechargeable Li-Ion battery. It has high GPS receive sensitivity with 22 tracking and 66 acquisition receiver channels. Besides, it also supports A-GPS that available for indoor localization. The module is controlled by AT command via UART and supports 3.3V and 5V logical level.

4. DESIGN METHODOLOGY

The design of the projected system is shown in figure. 2. It consists of three parts; microcontroller module, server module and also the internet application module. Microcontroller module is employed to assemble information

regarding potholes and humps and their geographical locations and this information is distributed to the server. Server module receives data from the microcontroller module, processes and stores the information. Internet application module uses the data hold on within the server information and provides timely alerts to the driver.

The architecture of the proposed system is shown below in figure 2. The system consists of 3 modules ie. Microcontroller module, server module and the application module. Microcontroller module here Arduino is used, gathers the information about potholes and their geographical locations by GPS and this information is sent to the server. Server module receives information from the microcontroller module and then processes and stores in the database. Web application module uses this information stored in the server database and provides timely alerts to the driver.
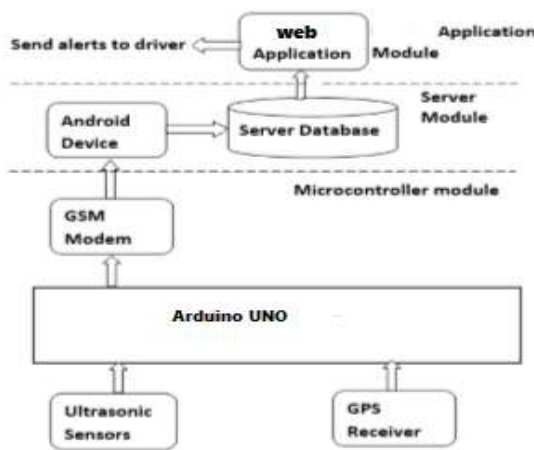
Fig. 2. Architecture of system

Microcontroller module: This module consists of four elements, namely, Arduino UNO, ultrasonic sensors, GPS receiver and GSM modem. Ultrasonic sensors are accustomed measure the gap between the automotive body and also the paved surface and this information is received by the controller. The gap between automotive body and also the ground, on a swish paved surface, is that the threshold distance. Threshold value depends on the ground clearance of vehicles and may be designed consequently. If the gap measured by ultrasonic device is larger than the edge, it's a pothole, if it's smaller, it's a hump otherwise it's a swish road. The GPS receiver captures the situation coordinates of the detected pothole or the hump and sends messages to the registered mobile SIM victimization GSM electronic equipment. This registered mobile SIM is available on the android device that acts as a server. The messages sent embrace data regarding depth of the pothole or height of the hump and its location coordinates.

Server module: This module consists of two parts; the android device and also the information. It acts as an intermediate layer between the microcontroller module and

also the web application. The server module is enforced as an android application that runs on a device and is liable for reading messages sent by the registered mobile SIM present within the microcontroller module. It processes the contents of this message and stores it within the information (cloud). Integration device networks with cloud and internet of Things, it's attainable to permit broader access to device information.

Web application module: This module is enforced as an android application that's installed on the vehicle driver's mobile phone to provide timely alerts concerning the presence of potholes and humps. Figure 3 shows the advancement of this application. The appliance incessantly runs in the phone background. It initial captures this geographic location of the vehicle and so accesses the locations of potholes and humps keep within the server information. The hole between the vehicle area and furthermore the pothole area keep in data is figured. On the off chance that the hole between the two is inside a hundred meters, an alarm message pops educated the portable screen. This message is went with a sound blare so the driver will separate it from elective glimmer messages.
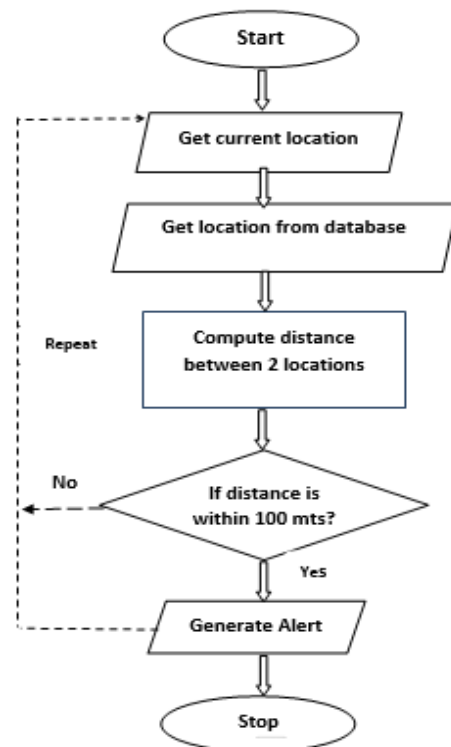

Fig. 3. Flowchart

5. EXPERIMENTAL RESULTS

The working model of the proposed system is shown in figure 4 below. It was tested in a simulated environment with potholes and humps. Tests were carried out in two phases. In the first phase, information about potholes and humps was recorded and stored in the server database (cloud). In second

phase, alerts were generated based on pothole and hump information stored in database (cloud). While testing in the simulated environment, the microcontroller module was fixed on a toy-car and the threshold value was configured to 10 cm. During the various tests it was found that the microcontroller module worked as expected to identify potholes and humps. Table I shows the information of set of potholes and humps identified by the system in the simulated environment. Information about potholes and humps was successfully sent to the server. The server processed the messages received and stored in the database (cloud).
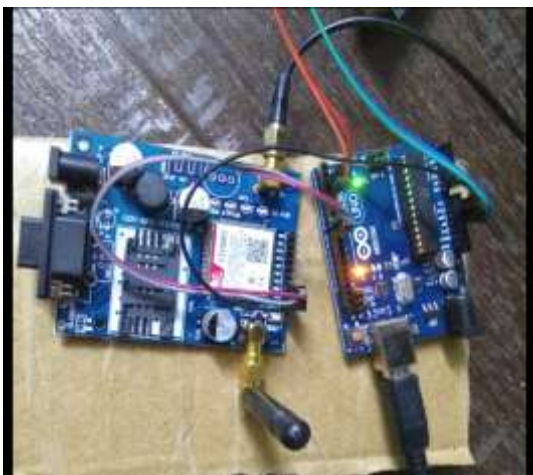
Fig. 4. Working model of the proposed system.

Table - I: Information about potholes and humps collected in simulated test environment

Above table shows all the details about pothole including its location. In the above table, obstacle type 'P' indicates a pothole. This complaints are going to registered with their dates and location and also can view the location.

Fig. 5. Geographical location of potholes

6. CONCLUSIONS

The model proposed in this paper serves two important purposes; automatic detection of potholes and humps and also alerting vehicle drivers to evade potential accidents. The proposed approach is an economic solution for detection of deadly potholes and uneven humps, as it uses low cost ultrasonic sensors. The web application used in this system is an additional advantage as it provides timely alerts about potholes and humps. This application also registers pothole complaints with the date and location and also it registers one complaint only once. The solution also works in rainy season when potholes are filled with muddy water as alerts are generated using the information stored in the database (cloud). We feel that the solution provided in this paper can save many lives and ailing patients who suffer from accidents.

The proposed system considers the presence of potholes and humps on roads. However, it does not consider the fact that potholes or humps get repaired or fixed by concerned authorities periodically. This system can be further improved to consider the above fact and update server database (cloud) accordingly.

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