Automatic Pothole Detection and Crime Alerting System

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***Abstract*- One of the major problems in developing countries is maintenance of roads. This has resulted in many potholes. Pothole is a depression in the normal surface of the road. Potholes jeopardize road safety and they are often a contributing factor to accidents. Automatic pothole detection and crime alerting system assists the driver in avoiding potholes on the roads, by detecting it and giving prior warnings. Ultrasonic sensors are used to identify potholes and a GPS receiver is used to capture the geographical location coordinates of potholes. This information is also stored in the database. Alerts are given in the form of a message and LCD display. Apart from this, the system also includes crime alerting with respect to a specific location using an android app. Android user can post the crime based on the event happened in that place. Users can also post the photo of the crime activity that happened. This information is stored in the server and it is updated in the app only when more than three people have posted or accepted the same event in order to avoid fake information. Once the event is posted, automatic alert is given to all the general users who cross that area. This helps new users to travel in a safer way**

***Index terms*- Android application, microcontroller, PIC, SQL, ultrasonic sensor.**

I.INTRODUCTION

India is a fast-developing and the second most populous country in the world. It is known to have a gigantic network of roads. Roads are the dominant means of transportation in India even today. They carry almost 90 percent of country's passenger traffic and 65 percent of its freight. But one of the striking underlying facts is the condition of the roads. India is home to several bad roads be it the metropolitans, the cities or the villages. Bad road conditions are nothing new to India and the problem is being addressed since the last 30 years. One of the major reasons for the damage of roads in India is overloading. It is said that about 70 percent of funds meant to be spent for the maintenance of roads goes behind paying laborers. The magnanimity of the expenditure incurred in order to repair road is alarming. And hence, potholes are from ed in the roads. A pothole is a depression in a road surface, usually, asphalt pavement, where traffic has removed broken pieces of the pavement as shown in figure 1. It is usually the result of heavy rains structure and heavy traffic passing over the affected area. Now, It has become a major reason for traumatic accidents and loss of human lives. In 2018, India had 467,044 reported road accidents, an increase of 0.5% from 464,910 in 2017, according to the road ministry's data. India has 1% of the world's vehicles but accounts for 6% of the world's road traffic accidents, according to data from a 2018 World Health Organization . Among them, over 9,300 deaths and 25,000 injured in three Years due to potholes alone.

Fig.1: Roads with potholes.

On the other hand, crime rate in India is increasing at an alarmingly fast pace. Overall, 30,62,579 cases were registered across the country in 2017, up from 29,75,711 in 2016 and 29,49,400 in 2015. The results of some surveys show that most of the people affected due to the crime are new to the Surroundings. There are many areas in India that is identified as crime places by the locals and they be cautious but the people who are new to that place become victims of the crime like robbery, chain snatching, vehicle theft, fire accident etc.

The aim of this paper is to automatically detect potholes and alert the driver in prior so that they can avoid the potential accident and safeguard their vehicle from damage. Alerts can be in the form of a text message (SMS), alarms or series of LED. Along with it the system also gives alerts when a person is about to enter a crime area based on their location taken via GPS using an android app.

II. COMPONENTES USED IN THE SYSTEM

1. PIC 16F877A microcontroller: Peripheral Interface Controller 16F877A is one of the most advanced microcontrollers. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability.

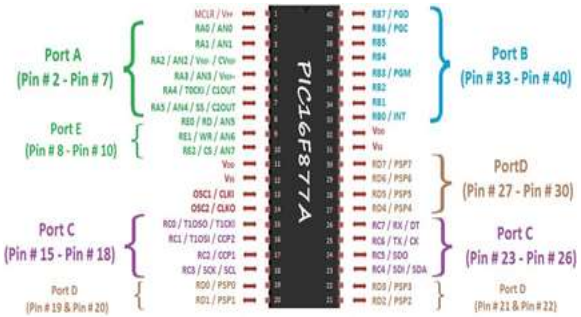


Fig.2: Pin diagram of PIC 16F877A

2. Ultrasonic sensors: This sensor is widely used in many applications in microcontroller platforms where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the ultrasonic transmitter and receiver. The sensor works with the formula Distance = Speed × Time.

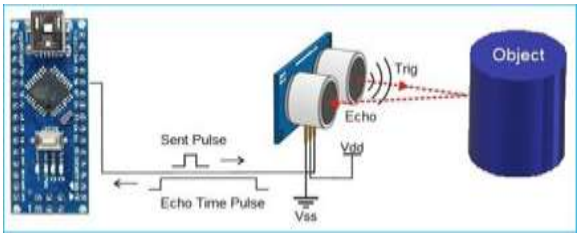


Fig.3: Working of Ultrasonic sensor

3. RS232 cable: RS232 is a standard protocol used for serial communication, it is used for connecting computer and its peripheral devices to allow serial data exchange between them.

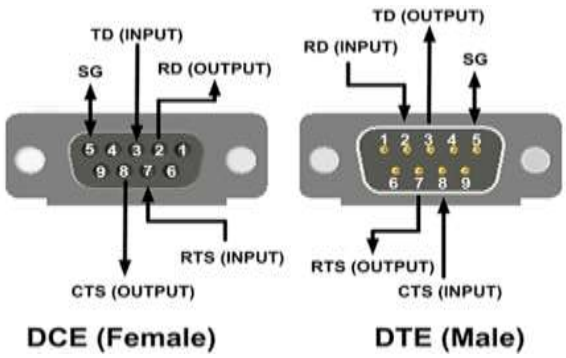


Fig.4: RS232 cable

4. GPS Receiver: A GPS Receiver is a L-band radio processor capable of solving the navigation equations in order to determine the user position, velocity and precise time (PVT), by processing the signal broadcasted by GPS satellites. Global Positioning System (GPS) is a satellite navigation system and is used to capture geographic location and time, irrespective of the weather conditions. A GPS receiver's job is to locate four or more of these satellites, figure out the distance to each, and use this information to deduce its own location. This operation is based on a simple mathematical principle called trilateration.

5. GSM SIM 900A: The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mmx24mmx3mm, SIM900A can fit in almost all the space requirements in user applications, especially for slim and compact demand of design. It uses any network provider's SIM to communicate over the telecommunication network. This modem also provides integrated support for GPRS and TCP/IP stack.

6. MPLAB IDE and PICkit2 programmer: MPLAB IDE is a free, integrated toolset for the development of embedded applications on PIC microcontrollers. It is called an Integrated Development Environment, or IDE, because it provides a single integrated environment to develop code for embedded microcontrollers.

PICKIT2 Programmer is a low cost MPLAB compatible PIC programmer. It can program PIC controllers operating at 3V3 and 5V, both online & offline. This PIC Programmer uses a USB port for power and connection to the computer. They are

used to program and debug microcontrollers, as well as program EEPROM.

7. MySQL and JSON: MySQL is a relational database management system based on SQL- Structured Query Language. The application is used for a wide range of purposes, including data warehousing, e-commerce, and logging applications. The most common use for MySQL is for the purpose of a web database.

JSON or JavaScript Object Notation is a minimal, readable format for structuring data. It is used primarily to transmit data between a server and web application, as an alternative to XML. In a nutshell, it gives us a human-readable collection of data that we can access in a logical manner.

III. PROPOSED SYSTEM

The proposed method consists of two main applications. The first one is the automatic detection of pothole which detects potholes on roads and alerts the drive and the second is the crime alerting system to ensure safe travelling.

POTHOLE DETECTION SYSTEM:

This system has a transmitter and a receiver section. The transmitter section consists of ultrasonic sensors, display device and a location fetching device which are connected to the microcontroller. The ultrasonic sensors are placed under front suspension of the vehicle. An ultrasonic sensor is an electronic device that uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. In this way ultrasonic sensors are used to detect the potholes on the road surface. These sensors will detect the potholes on the road based on the measurement of height and depth from the road surface level. The sensor inputs are given to the microcontroller. Threshold level is set based on the distance between the car body and ground surface, on a smooth road surface. If the measured value of the sensor is greater than the threshold level, it is identified as a pothole. A microcontroller will monitor these levels and process all the data based on the threshold level set within it and gives alert to the driver through a SMS and will also through an LCD display. The GPS captures the location coordinates of the detected pothole and a message is also sent to the maintenance server for repairmen.

The receiver section consists of a server module and mobile application in order to store the received data from the microcontroller in the maintenance center database. This database is also used to retrieve the information of an existing pothole and alert the other drivers crossing the same location. The data in maintenance center database helps them to locate the pothole and repair it. It is also by an official to frequently update the data.

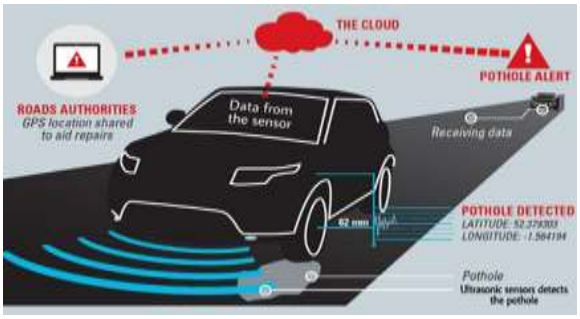


Fig.5: Pothole detection system

CRIME ALERTING SYSTEM:

The proposed system also contains a crime indication system with respect to a specific location. Android users can post the crime based on the event happened in that place in the mobile app. Users can also post the photo of the crime activity that happened. This information is stored in the server and it is updated in the app only when more than three people have posted or accepted the same event in order to avoid fake information. Once the event is posted, an automatic alert is given to all the general users with the app who cross that area. This helps new users to travel in a safer way. New users who are unaware of the crime that may happen when they travel in a particular route can now verify the route by using the android mobile app and then can plan to travel in a safer route. A warning message will be sent once they enter the risk area.

IV. ARCHITECTURE AND WORKFLOW

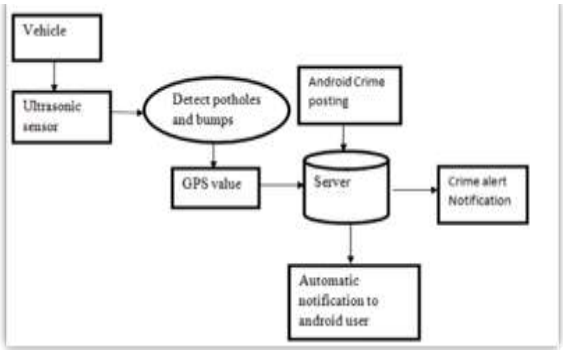


Fig.6: Architecture of the system

The architecture of the proposed system consists of the microcontroller module, server module and the mobile application module. Microcontroller module is used to collects all the information about potholes and crime along with their geographical locations and this information is sent to the server. Server module receives information from the microcontroller module, processes and stores it in the database. Mobile application module uses information stored in the server database and provides timely alerts to the user.

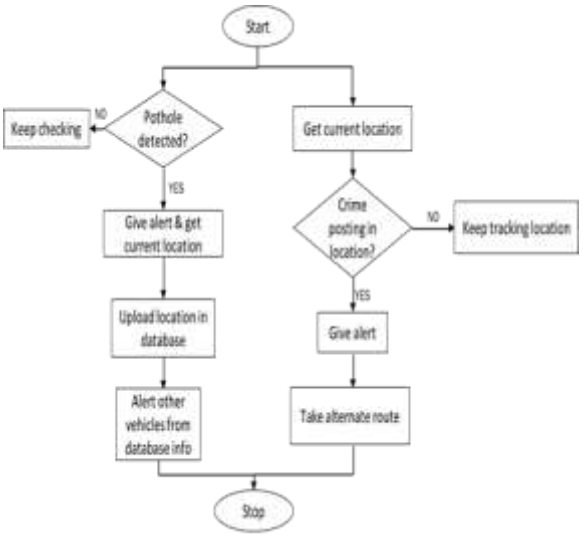


Fig.7: Workflow of the system

V. RESULT AND OUTPUT

The model was tested in an environment with artificial potholes and crime inputs. The entire system was tested in two stages. In the first time, the potholes were detected and stored in the database and in the second time the alert was given based on the information stored in the database.

While testing, the microcontroller module was fixed on a toy-car and the threshold value was set to 5 cm. During the tests it was found that the microcontroller module worked as expected to identify potholes and alerts were given properly.

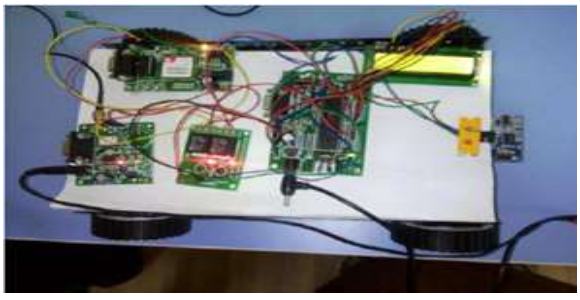


Fig.8: Working model of the pothole system

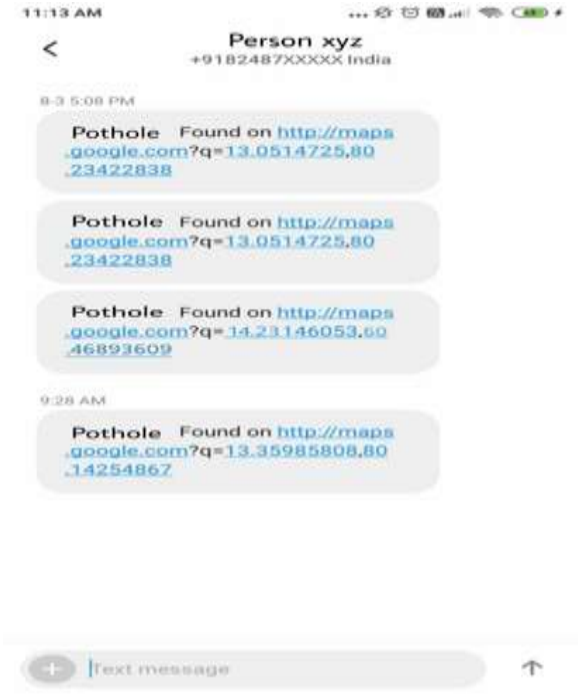
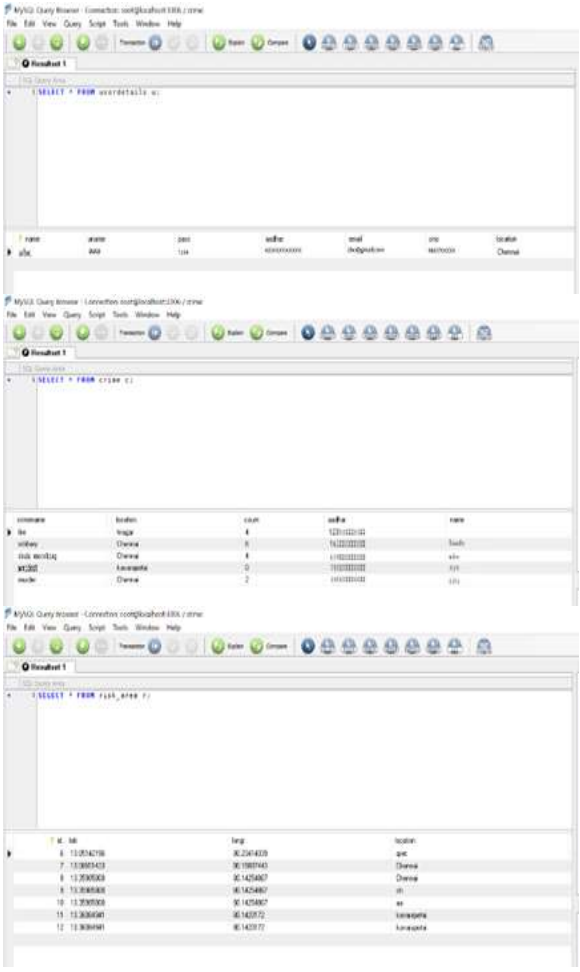


Fig.9: Alerts generated for pothole detection



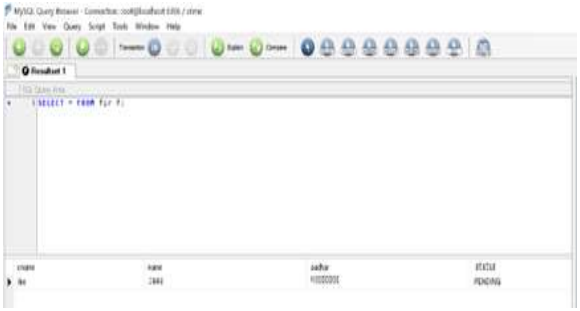


Fig.10: Outputs from MySQL server

Fig.11: Alert generated for crime detection

VI. CONCLUSION AND FUTURE WORK

This system serves not one but two applications. The Ultrasonic sensors detect the potholes and alert the user to avoid accidents. Crime detection and alert is communicated to the new user to alert them from crime events happening around the place. And this facility helps them navigate through a safer alternate route. The proposed system makes use of low-cost components and thereby provides economic solutions to major problems faced by the people. 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. We feel that the solution provided in this paper can save many lives and ailing patients who suffer from tragic accidents.

This project can be further enhanced by developing the android app to suggest an alternate and a safe route. Also, Google maps and SATNAV can be integrated in the proposed system to improve user experience. The system can be made to work in a similar way like Google maps by using test vehicles.

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