Pothole Detection and Notification System

Vijaya Shetty S[1], Niveditha H.N[2], J.Janani[2], T. Hrishikesh Reddy[2], Praveen Datt[2]

[1]*Associate Professor, Computer Science and Engineering, Nitte Meenakshi Institute of Technology, Karnataka, India*

[2] *Student, Computer Science and Engineering, Nitte Meenakshi Institute of Technology, Karnataka, India*

ABSTRACT

The importance of the road infrastructure for the society could be compared with importance of blood vessels for humans. India is the vast country in the world which does not have proper maintenance of the road, over 95% of the people uses road transportation. Due to this peak usage of road transports, there are many possibilities of potholes on roads which lead to accidents. Other major reasons for accidents are due to the head on head collusions. This project aims to produce a ***Pothole Detection and Notification System****. The main components of the project are the Accelerometer, Ultrasonic Sensor, Wi-Fi Module, GSM, GPA with Arduino Uno, and the Android smart phone. This project would be given to government road contractors to rectify the potholes and avoid accidents and help in traffic analysis. Also, our aim is to make safety systems affordable to every vehicle in the country.*

Keyword: *Pothole detection, Real time tracking, reporting safety, Ultrasonic, potholes, GPS and GSM.*

---

1. INTRODUCTION

Roads are the dominant means of transportation in India today. Over the last two decades, there has been a tremendous increase in the vehicle population. This proliferation of vehicles has led to several problems. Potholes are formed due to heavy rains and movement of vehicles. To address the above-mentioned problems, a cost effective solution is needed that collects the information about the severity of potholes and also helps the drivers to drive safely. With the proposed system an attempt has been made to endorse drivers to ward off the accidents caused due to potholes. Accidents are pretty common on the roads as the cars move very close to each other, which can be prevented by assisting the driver by informing him that another vehicle is very close to him. In case of Emergency help and accident cases, sending the real time location to registered numbers can save the lives.

Proposed work is discussed in Section (2). System requirements and assumptions are listed in Section (3). The description and evaluation of our approach includes a set of test drives, experimental data and results have been analyzed in Section(4). The final section (5) presents our conclusion that our approach yields high true positive rate.

2. PROPOSED WORK

Objectives of our project:

- To ensure safety of the commuters.
- To provide safety on highway while changing lanes.
- To inform the emergency contact in case of an emergency to the driver.
- To detect the presence of potholes with the value produced by the accelerometer.
- To show the position of the potholes in android app for the knowledge of the commuters.
- To show the location of the potholes in the Google maps of android app.

3. SYSTEM REQUIREMENTS

The following System requirements were chosen as a basisfor pothole detection system

Hardware requirements:

1. NODE MCU Arduino board
2. HC-SR04 Ultrasonic Sensor
3. NEO 6M GPS module
4. SIM808 GSM module
5. Accelerometer ADXL345

Software requirements:

1. Arduino IDE 1.8.5
   a. Board Node MCU 1.0(ESP_12E Module)
   b. Board Arduino/Genuino Uno.
2. Android Studio version 2.3.3

4. Our Approach

As explained earlier the System is classified into three subsystems which are Sensing, Communication, and Localization. The three subsystems work independent of each other, but have one common centre point they revolve around that is data. Basically Sensing system generates the data, Communication collects, co-ordinates and distributes the data, Localization uses the data and generates information for the driver.

4.1 Sensing Subsystem

This subsystem is responsible for sensing the data. The data in this case would be the Latitude and longitude of the location of the pothole. This method uses 'Accelerometer' to sense potholes. This is a device that measures total specific external force on the sensor. We can characterize the pothole on the basis of change in deflecting angle of accelerometer.
We use the Ultrasonic Sensor to prevent collisions and avoid accidents. An **Ultrasonic sensor** is a device that is used to measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

4.2 Communication Subsystem

The communication subsystem is the backbone of the system. A GPS tracking unit is a device that uses the Global Positioning System to determine the location of a vehicle, person, or other asset to which it is attached. This position will be recorded at regular intervals. The pothole's location data can be transmitted to a data base (Central Location), or internet connected computer. This allows the asset's location to be displayed against a map backdrop in real time or when analyzing the track later, using GPS tracking software.

4.3 Localization Subsystem

Localization System uses the data provided by Access Point to find the pothole's location and eventually warn the driver about it through the android app. Localization is challenging especially when Access Points are not in range. When vehicles receive the data from Access Point, they can easily identify the location of potholes on the Google map through the android app.

The list of the used sensors includes GPS to detect the current location of potholes and accelerometer to detect potholes. After the sensor data is received, it is processed it is sent to the cloud and stored. Latitude and longitude of pothole location Data are fetched from the cloud to plot the location through android app. We envision the pothole detection system as a background service in the future, used by other applications.

5. Design

When a moving car goes over a pothole, the accelerometer detects it and shows the deflection on X or Y axis. If the deflection satisfies our condition (as mentioned above in the flow diagram (fig -1)) the pothole's latitude and longitude is sent to the cloud. Ultrasonic sensor reads the distance between two vehicles which are approaching closely, If the distance satisfies the condition mentioned above in the flow diagram (fig-2), then the rider will be notified by the buzzer giving alarm to avoid collusion. In case of emergency situation, the rider can press the SOS button which sends his current location with an emergency message to the registered phone number using GPS and GSM. The flow diagram is shown in (fig-3)

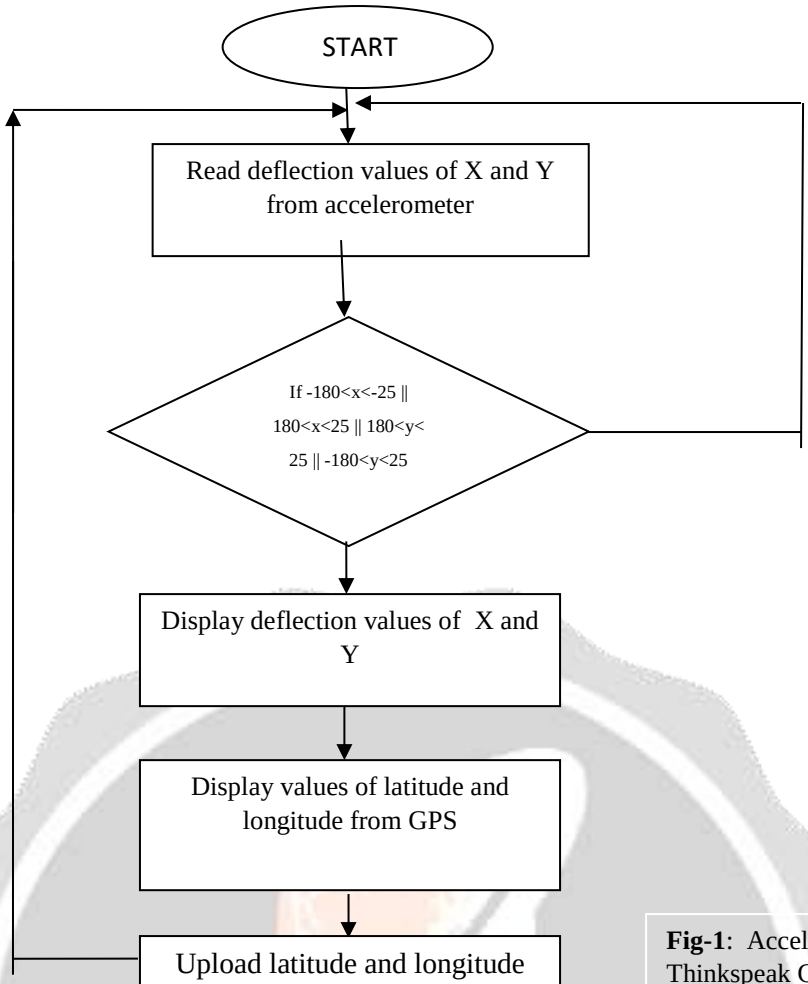

Fig-1: Accelerometer-GPS to Thinkspeak Cloud

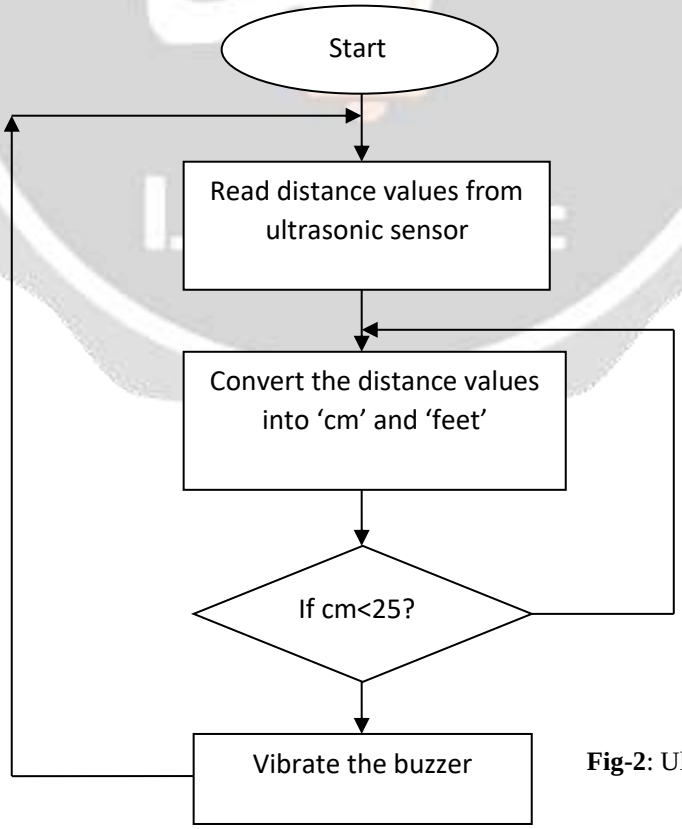

Fig-2: Ultrasonic-Buzzer Module

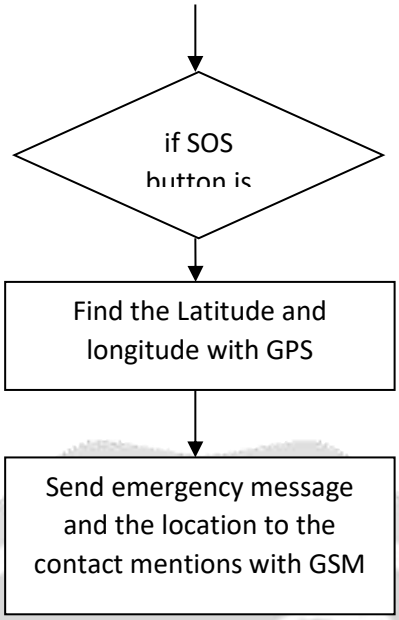

Fig-3: SOS-GSM Module

6. Test cases

Test Case 1: A single pothole on a perfectly good road.

On a perfectly good plain road, when the vehicle encounters a pothole, in this case when the deflection of the angle in the accelerometer went down to -15^{O} and back to 5^{O}, suggests that there is a pothole in that location. When the pothole is detected then the GSM immediately tracks the location of the pothole and send it to the cloud which is reflected on the app on an android phone.

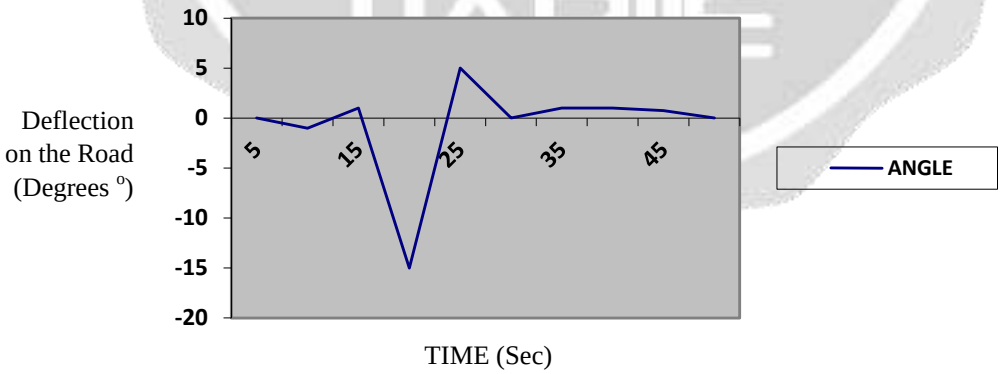

Fig-4: Graph showing a deflection due to single pothole.

Test Case 2: Multiple potholes on road**.**

On a road, when the vehicle encounters a multiple potholes, in this case with a deflection of the angle in the accelerometer deflecting more frequently then it suggests that there are multiple potholes on the road. When the potholes are detected then the GSM tracks all the location of the potholes and sends it to the cloud which is reflected on the app on an android phone.

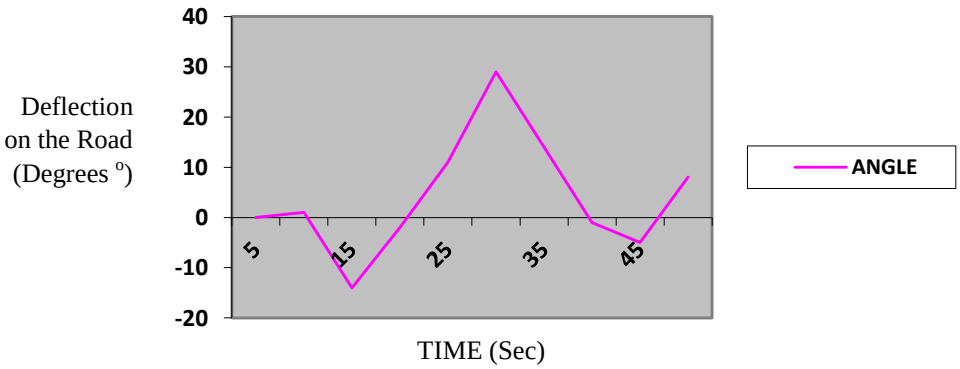

Fig-5: Graph showing deflection for multiple potholes.

6. Conclusion:

This paper describes accelerometer data based pothole detection algorithms for deployment on devices with limited hardware/software resources and their evaluation on real world data acquired using Android OS based smart-phones. The model proposed in this paper overcomes two major problems that concern the people the most and which leads to frequent accidents; the automatic detection of the potholes and the collusion detection using Ultrasonic sensor. It also sends an emergency help message after the accident place when the SOS button is pressed. It is fully automated and it's very time saving and efficient. The proposed work is also economical as it uses low cost devices. Hence, it brings to the notice of the government officials and as a result, they can maintain the roads properly and prevent the accidents. The project provides a user friendly Android interface. Proposed system is precise in calibration which helps to detect events while driving in different four-wheel vehicle types such as passenger cars, minivans and buses.

7. Acknowledgement:

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crowned our effort with success. I express my sincere gratitude to our Principal Dr. H. C. Nagaraj, Nitte Meenakshi Institute of Technology for providing facilities.

We wish to thank our HOD, Dr.Thippeswamy M.N for the excellent environment created to further educational growth in our college. We also thank him for the invaluable guidance provided which has helped in the creation of a better project.

I hereby like to thank our guide Dr. Vijaya Shetty S, Associate Professor, Department of Computer Science & Engineering on her periodic inspection, time to time evaluation of the project and help to bring the project to the present form.

Thanks to our Departmental Project coordinators. We also thank all our friends, teaching and non-teaching staff at NMIT, Bangalore, for all the direct and indirect help provided in the completion of the project.

8. References:

1. Road Condition Detection Using Smartphone Sensors, 2012 IEEE - Ravi Bhoraskar, Nagamanoj Vankadhara, Bhaskaran Raman, Purushottam Kulkarni

2. The Pothole Patrol: Using a Mobile Sensor Network for Road Surface Monitoring, IJETAE 2014 - Jakob Eriksson, Lewis Girod, Bret Hull, Ryan Newton, Samuel Madden, HariBalakrishnan.

3. Pothole Detection System using Machine Learning on Android, IJETAE 2012 - Aniket Kulkarni , Nitish Mhalgi, Sagar Gurnani , Dr. Nupur Giri.

4. Road Conditions Detection Using Arduino Based Sensing Module and Smartphone, IEEE 2010 - Syuan-Yi Chen, Annie Shih and Chun-Yi Hsiao.

5. Real Time Pothole Detection using Android Smart phones with Accelerometers, IEEE 2011 - Artis Mednis , Girts Strazdins , Reinholds Zviedris , Georgijs Kanonirs , Leo Selavo

6. R Gass, J Scott, C Diot, "Measurements of In-Motion 802.11 Networking", IEEE Workshop on Mobile Computing System and Applications, 2006 .

7. Study of a bus-based disruption tolerant network: mobility modeling and impact on routing, X Zhang, JK Kurose, BN Levine, D Towsley, H Zhang, 13th annual ACM international conference, 2007

8. "http://www.its.dot.gov/vii", RITA | ITS | Vehicle Infrastructure Integration, JAN 2007

9. "http://dev.emcelettronica.com/datasheet/st/LIS3L06AL", Datasheet of ST LIS3L06AL accelerometer, JAN 2008

10. Pothole detection System using Wi-Fi, Mtech project Report submitted by Shonil Vijay, JUL 2007