ROAD ANALYSIS USING ANDROID APPLICATION

Ms.Shruti Dethe, Ms.Ashwini Agawane, Mr.Vishal Ghuge, Ms.Sheetal Kadam, Mr.Manish Nair.

Dr. D.Y. Patil Vidya Pratishthan Society's

Dr. D. Y. Patil Institute of Technology, Pimpri, Pune 411018.

ABSTRACT

Road is the biggest mode of transport within a country. The monitoring of road surface anomalies, such as potholes, speed bumps etc., are most significant in order to assure safety and comfort for all road users, especially for drivers. The constant road analysis helps for efficient infrastructure's maintenance and management activity. Our paper discusses the method of detecting bumps and potholes and provides timely alerts to drivers to avoid accidents or vehicle damages.

The methodology utilizes Smartphone's that employs the mobile devices having sensors such as a GPS receiver and a accelerometer. It gathers data on the acceleration due to vehicles motion on road aberration. The information gathered during the trip is transmitted in real time (1Hz frequency) to a central server where data are processed in order to make the transportation system more secure and convenient.

Keywords: *Gyro meter, GPS, potholes, speed breakers, road condition,*

1.INTRODUCTION

Improving the state of road has become the necessity now a day. The traffic conditions in developing countries, like India, are more complicated due to diverse road conditions, heterogeneous mix of vehicles and uncontrolled traffic. Since India is a developing country there is a constant need for good quality transportation, infrastructure and services. This problem has not been totally addressed in India as it is a huge nation with a vast population .This problem can be solved by using smart phones. Most recent smart phones consists of helpful sensor which have built in G-sensors, electronic compass, gyrator, receiver, accelerometer, Gyro meter, GPS (Global Positioning System) and cameras are prepared in smart phone. A few operations utilize these sensors in smart phones and mix mobile sensing approach to figure out issues relevant to communal system, human use, surrounding observation, and change in data.

The paper outlines structure for road anomalies like road speed breaker and pothole detection using Android OS. This framework uses Accelerometer and Gyro meter Sensor's of Android Smartphone for detecting of potholes and GPS for plotting the area of pothole on Google Maps. This data can be useful to client at Smartphone based method excludes the use to utilize specific sensors in the vehicle. This approach has the advantage of high scalability as the number of mobile users is growing speedily.

1.1 Motivation

We can crowd-source the information about roads and traffic from road users. Almost every one in India uses smart-phone due to their accessibility at low cost. We can use the sensors in Smartphone's to compute the information to collect and send the information about roads. When phone is carried by a vehicle rider, accelerometer sensor present in phone depicts the behavior of the vehicle acceleration.

1.2 Goal

Detect speed breakers and potholes using different sensors present in Smartphone, carried by vehicle rider/driver. Our project is based on notifying road conditions to user based on the stored data. This can be done by proposing new feature set and techniques for event detection.

1.3 Aim and objectives:

1. To notify user about status of road using gyro meter data obtained from Smartphone.
2. Easy to find pothole and bump or speed breaker.
3. User friendly Interface of application.

2.RELATED WORK

[1] A simple and precise way to solve the problem of identification of damaged roads is discussed. It uses typical smart phones with GPS sensors and accelerometers to quantify the abrupt fluctuations sensed by the car when driving over a bad road surface. The study of this paper helped us to understand and develop our proposed model.

[2] The authors investigated discontinuities in a lake in Bangalore, India over three months and found that there was double digit percentage change in several chemical and physical parameters, confirming that frequent monitoring of lakes would be valuable. The app also measures contaminant concentration levels of pH, Hardness, Alkalinity, Copper, and Nitrites by detecting color changes in chemical test strips. All data collected by the app is uploaded to a cloud platform that enables spatiotemporal visualizations of health parameters of multiple lakes. This work has helped us to understand the details with respect to data modeling and cloud storage.

[3] Road accidents are one of the universal problems faced by people all around the world. A major reason is reckless driving on speed breakers and ditches causing high causalities due to no warning signs, lack of street lights, substandard construction etc. There has been some research related to finding a Computer Science oriented solution but no substance in terms of a product. We present an Android application to solve this and have collected data from different parts of Karachi to detect upcoming speed breakers and ditches within a 10-12 meter radius. The application will be able to accurately warn users ahead of time and prevent hazards using a Support Vector Machine which has been trained with data from multiple devices. Speed breaker and ditch locations are loaded on the Cloud and filtered using a defined threshold.

[4] Users can share information with location-based systems. This system will be use to report any crime where and when it happened. The proposed system will be very useful for users when travelling to unfamiliar areas, where they have little knowledge about the foreign environment. This model has helped us to optimize the real time data acquisition model such that only the filtered data with potential valid information will be stored in the cloud.

3.DESIGN AND METHODOLOGY

3.1 System architecture:

The system framework can be represented in figure 1.The user will be deploying the application on his/her android device. The simple interface needs minimum user interaction. A simple start and stop button mechanism creates to connect to the service where the application will begin to collect the necessary data and check for upcoming speed breakers. When an oncoming speed breaker or pothole is detected the user will be notified by a voice alert or vibration. When the user has finished the drive, the collected data is processed and that data which is helpful for adding new locations is sent to a cloud server where all locations are stored of all users.

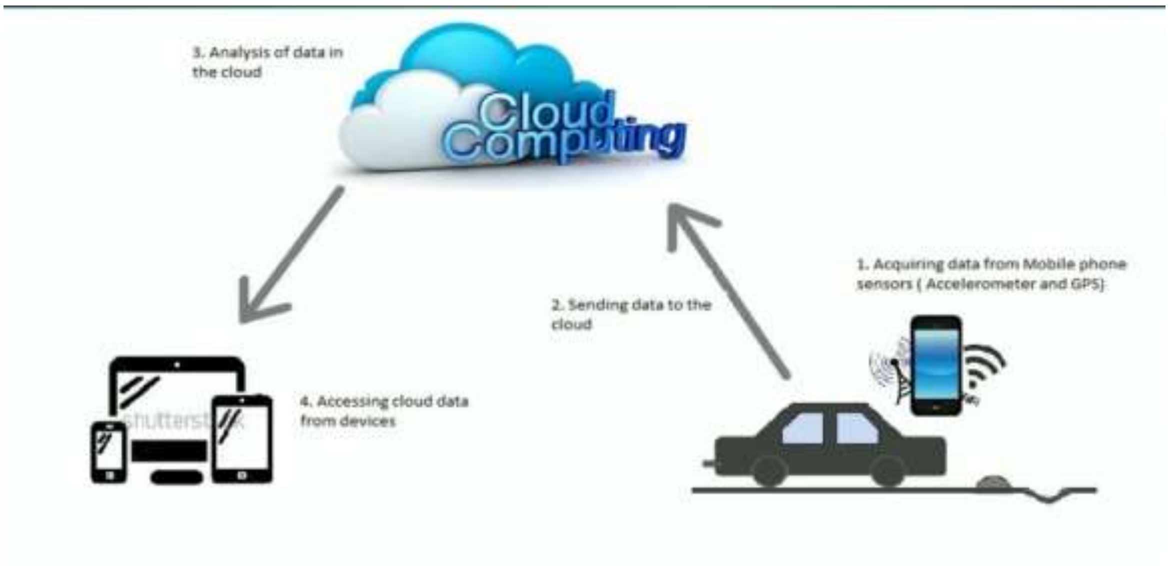

Figure 1.System Architecture

These locations are then updated and new locations are sent as an update to users so the next time they approach a stored location they can be alerted before head of time. Our design does not distinguish between different shapes of speed breakers as the data detection methodology is the same for all types. We decided to adopt the detection methodology for our product which utilized two sensors in Android smart phones, the Gyro meter and GPS sensor. The gyro meter is capable of detecting movement across three axes as shown in figure 2. Using the overall amplitude is preferred when wanting to keep the mobility of the smart phone. This is calculated by $a=\_(x^2 + y^2 + z^2)$ where x, y and z are the respective axes of the device. Other methods would require the phone to be in a fixed position in the vehicle and be in a certain orientation. The amplitude calculated will represent the overall acceleration of the vehicle.

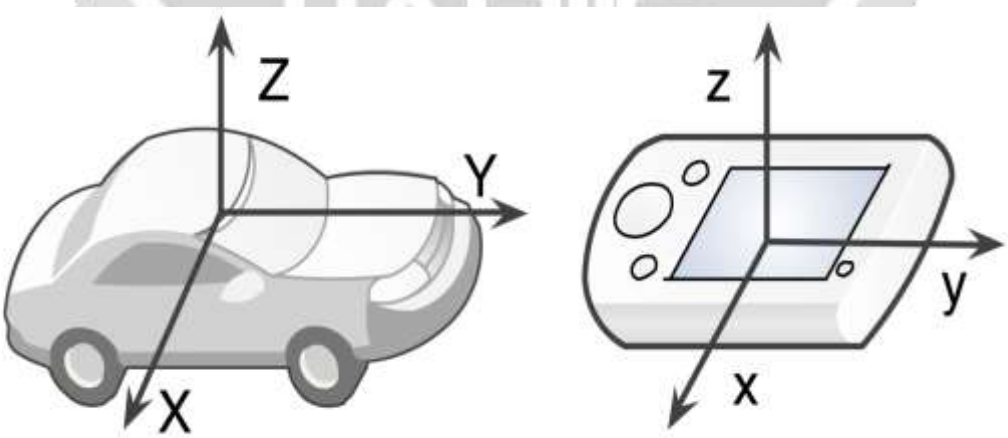

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Figure 2. Axes of Smartphone and Vehicle.

3.2 Data collection:

Accelerometer data was gathered from different areas of Pimpri. Multiple phones were used along with different vehicles. On some drives, more than one phone was used to record drive data, but the data gathered was still unique due to the different positions of the phones. The total distance spanned was approximately 200km, covering some of the most visited parts of the city. An android application was programmed to collect data which would be used to train a model which would be able to detect speed breakers and potholes. While the application is running, a log is maintained which keeps track of all sensor inputs from the gyro meter from any change detected in any of the three axes and was broken down into two second intervals. A change is detected by using the android sensor managers and corresponding GPS locations were obtained by keeping track of the received GPS coordinates from the android location manager. In the database table each row consists of the timestamp of when the change was detected, the overall acceleration of the phone which is derived from the individual axes, and the corresponding longitude and latitude coordinates at that instance. Each line represents a change detected by the accelerometer.

3.3 Algorithms Used:

Step Detection Algorithm

Based on the experiment results, step detection logic is designed as follow:

Top Up:
We assume that there are no steps initially and introduce possible steps one at a time, testing each candidate to find the one that reduces some criteria.

Bottom up:
Bottom-up algorithms take the " exact opposite" way to top-down, first we consider that there is 1 step in middle of every sample in the digital signal, and then combining steps based on few criteria's tested for every candidate merge.

Sliding Window:
By considering a minimum "window" of the signal, this algorithm look for proof of a step in the window. The window "slides" across the time series, one time step at a time. The proof for a step is tried & tested by statistical procedures.

3.4 Location Based Distance calculation

It uses the Haversine formula to calculate the circle distance between two points-that is, the shortest distance over the earth's surface –giving an 'as-the-crow-files' distance between the points.
Haversine formula:
$a = \sin^2(\Delta\varphi/2) + \cos(\varphi 1).\cos(\varphi 2).\sin^2(\Delta\lambda/2)$
Haversine formula a=asin² (Δ/2)+cos(∅). cos(∅□).□□□ □(Δ□/2)
c=2.atan2(√□,□(1 − □))
d=R.c
where ∅ is latitude , □ is longitude, R I earth's radius
Note that angels need to be in radians to pass to trig functions.

4.CHALLENGES

4.1 GPS Inaccuracy During a drive:

The application logs both accelerometer and GPS sensor data. The inaccuracy of GPS coordinates of smart phones varies between 5-8 meters depending on factors such as number of available satellites and the surrounding environment. This introduced a challenge as speed breakers and ditches may not be detected with their true position. To tackle this, we used the Haversine formula with a threshold of 5 meters to assume two reported instances of a speed breaker or ditch to be the same.

4.2 Phone to be switched on:

Another issue regarding collecting locations of speed breakers and ditches is that if the user's smartphone should power off during a session, then all potential detected locations will be lost and not sent to the server. To overcome this, the application was designed with simple start and stop buttons so the user can stop the application before her phone shuts down. The application was also designed to have minimal impact on battery performance to reduce the chance of such an event from occurring.

4.3 Speed breakers vs. Potholes:

The main challenge encountered was being able to differentiate between a speed breaker and a pothole as both had similar vibrations and patterns when data was collected. This problem proved difficult for a number of reasons. Though a speed breaker follows a general shape, a potholes does not. Even going over the same pothole multiple times gives different results as the pattern obtained depends heavily on the angle at which the car approaches it, the speed of the vehicle, the suspension system and height of the vehicle. There are many external variables which must be considered when tackling this problem. Though speed breakers and potholes can be distinguished in a controlled experimental setup, those approaches are not suitable for an application which is intended to be used in any position.

4.4 Battery consumption:

The application is intended to be able to run in the background and will be collecting data from sensors and writing to files. The application code was revised and structured to be efficient and consume less power on mobile phones. Design changes such as reducing the number of file writes and the frequency of checking the users location showed to improve results. When checking for upcoming speed breakers or ditches, all the stored locations are read to memory instead of repeatedly accessing storage to improve performance. When the user is warned of an upcoming speed breaker or ditch then the application will not check for a few seconds because no other anomalies can come in between the currently detected upcoming anomaly and the user's current location.

5.CONCLUSION

In this paper, we are proposing Crowd-sourcing based mobile app for detection of potholes and speed breaker using crowd sourcing and step detection algorithm. The app will be installed in the vehicles driver Smartphone. The app will detect the potholes, speed breaker and transfer the information like type of obstacle, GPS location and the time of detection to the cloud. The cloud will process the data based on sliding window and the processed information will be uploaded to the end user app periodically. The similar kind of information will be available to the government agencies like BBMP, PWD etc.

Though the application is accurate in predicting speed breakers and potholes, it is still limited as not being able to distinguish between the two to a high degree of accuracy when mobile position and orientation is left to be in any position in the vehicle. These issues can be worked on in the future and resolved, possibly with the advancement of built in sensors in mobile phones. Another problem which can be solved is the GPS inaccuracy, this can be tackled as GPS coordinates can still inaccurate to a few meters and thus the exact location of speed breakers and ditches cannot always be detected.

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