Road Roughness Estimation and Quality Control System

Shubham Shinde[1], Saurabh Solepatil[2], Suresh Choudhary[3], Umang Gandhi[4], Prof. Shailesh Patil[5]

[1234]Student, Computer Department, Smt. Kashibai Navale College of Engineering, Pune, Maharashtra
[5]Professor, Computer Department, Smt. Kashibai Navale College of Engineering, Pune, Maharashtra

---***---

Abstract - *Threatening road surface conditions are the crucial obstruction for sheltered and pleasant traveling. Both drivers and road maintainers are interested in fixing them as soon as possible. However, these conditions have to be identified first. The Google maps are not proficient to enlighten about any road's condition or its complexity. It is important to know the road condition to any traveler.*

We developed an application to find the road bumps and pothole and ghat complexity on road. In this system, first admin gets the data by using accelerometer sensor of android phone. In that one, txt file is generated. This is sent to the server for analyzing the data. After analysis server gets the detailed condition of the road on the map to the user.

Key Words: **Roughness Estimation, Quality Control System, Bump Detection Logic.**

1. INTRODUCTION

In developing nations, particularly, maintaining a good quality road infrastructure is a big challenge for almost all road authorities. The significance of the road framework is similar to blood vessels for humans.

To obtain road surface condition data, which is crucial for the maintenance and management planning, there are two main approaches listing from visual inspection and the use of sophisticated profilers. This previous approach, relatively precise, but extremely time-consuming since it relies mainly on manual inspection of the inspectors. One approach to road damage detection is to use human reports to central authorities. While it has the highest accuracy, assuming that people are fair, it also has the most human interaction and is not comprehensive. Statistical analysis can be used to estimate damage probabilities of road segments based on their usage intensity.

Road condition should be scrutinized and rehabilitate consistently. It is very difficult to design an optimal system which gathers the road condition data and processes it. Participatory sensing approach can be mostly used for such Data collection.

The advancement in the previous system can be done by attempting to calculate approximately road roughness from smart phones under more realistic settings, which is beyond fixed orientation and/or fastening the devices themselves tightly with vehicles while collecting data. In other words, the smart phone is placed loosely at locations that a driver would be more likely to put their smart phones inside a car while driving. Using smart phones to collect the data is a promising alternative because of its low cost and easy to use.

RELATED WORK

This paper[1] proposes a novel road profile estimator that offers the essential information (road roughness and its frequency) for the adjustment of the vehicle dynamics using conventional sensors, such as accelerometers or displacement/velocity sensors are straightforward to mount, economical, and useful to the estimation of all suspension variables. an adaptive observer estimates the dynamic road signal; afterward, a Fourier analysis is used to compute the road roughness condition online. of passengers' comfort and their safety are accelerometer-based vehicular movement detection module for detecting the periods when the mobile phone user is travelling by vehicle; (b) a map-matching module. Part of the constant concerns for car manufacturers. Semiactive damping control systems have emerged to adapt the suspension features, where the road profile is one of the most important factors determining the automotive vehicle performance.

[2]In this paper the collection of data from smart phone and GPS sensors; frequency domain analysis is also carried out. It has been revealed that the data from smart phone accelerometers has a linear relationship with road roughness condition, whereas the strength of the relationship varies at different frequency ranges. As consequences also give that smart phone sensor have to be used for evaluation of the present status of the road pavement condition. Frequency domain to calculate magnitudes of the signal in different frequency ranges.

[3]This paper describes accelerometer data based pothole detection algorithms for deployment on devices with limited hardware/software resources and their assessment of real-world data obtained using different Android OS based smart-phones. The evaluation tests resulted in optimal setup for each selected algorithm and the performance analysis in the context of different road irregularity classes show true positive rates.

A [4] alternative solution by exploiting the sensing ability of mobile phones. However, it is challenging to detect road congestions in a daily-living environment using undedicated mobile phones while guaranteeing energy efficiency. The proposed system only depends on the accelerometer and cellular signal, which have compared with other built-in sensors (e.g., GPS). It detects road congestions in a daily-living environment using undedicated mobile phones while guaranteeing energy efficiency. The proposed system only depends on the accelerometer and cellular signal, which have been proven to be energy efficient as efficient as compared with other built-in sensors (e.g., GPS). It consists of three interactive modules: (a) an accelerometer-based vehicular movement detection module for detecting the periods when the mobile phone user is travelling by vehicle; (b) a map-matching module relying on the cellular signal for determining the travelled road segments; and (c) a road congestion estimation module for inferring the congestion degree of the travelled road segments.

Paper[5] analyse data obtained by smart phone accelerometers in the frequency domain to extract features that are corresponding to road bumps. They developed a pattern recognition system for detecting road condition from accelerometer and GPS readings.

Road condition adversely affects the ride quality of vehicles. Road roughness is an internationally accepted indicator to which it is usually used to measure the condition of road pavement. The coarseness of road is a vital feature because it influences not only quality but vehicle delay costs, fuel consumption and maintenance costs also. The International Roughness Index (IRI) is a measurement indicator that has been used internationally for road pavement condition [6].

2. INFORMATION DESIGN AND WORKING

The application running on the Smart phone collects data from the accelerometer, magnetometer, and GPS and then processes this to detect breaking and bump events. It then put together with time and Location tag to this event data and sends it transversely to the web server for further processing. Sensor gathered road condition details i.e. the location of a bump from admin phone and stored on the server side for other users. the data which we get from accelerometer and magnetometer, in that we consider y-axis for Ghats detection, here we calculate the angle of 'Y' axis with the north direction by which we can get how much car is turned at right or left side. For this, we also consider the previous angle of 'Y' axis with north direction. This helps to count the number of turns in specific alarm, and also we can conclude how much they are tough Smartphones along with the time and location tags. Using this information.

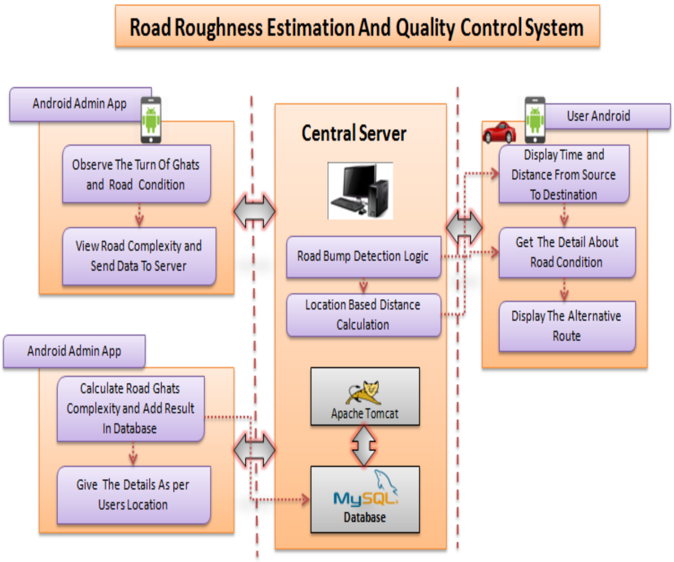

Fig-1 : Architecture diagram for Proposed System

Web service infers a higher level of evaluation such as road is smooth or it is with too much speed bump, Ghats are too complex or they are easy to drive, etc. The Smart phone sends over its location, and the web service responds with events of interests in the Smart phone sends over its location, and the web service responds with events of interests in the vicinity of this location. These events are displayed on a map on the phone so that the user of the application can choose to take alternate routes based on this. Standalone HTTP Server fetches text file from the admin android app and Perform Analysis on text file according to the road bump logic. Add results into database user to notify on which location has bumps and find the complexity of the ghat. Provide road details to users as per the user's location. Figure2 shows the flow of the system.

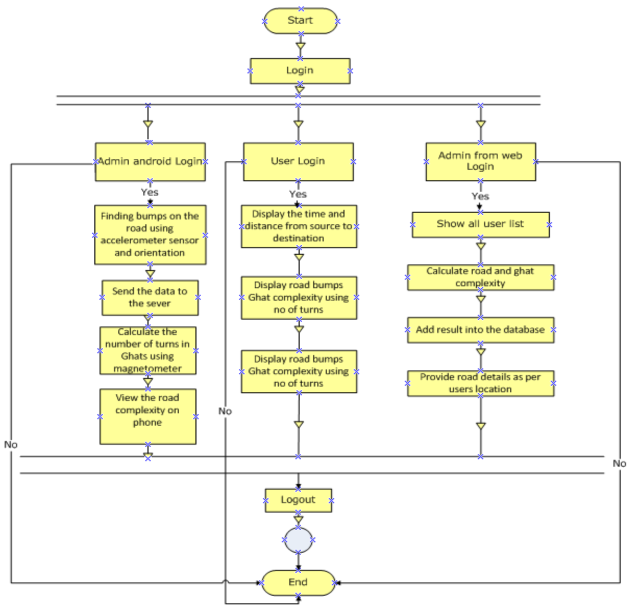

Fig-2: Work Flow of the System

3. ALGORITHM USED

3.1 Bump Detection Logic

The system take the data as x , y, z co-ordinates and the axes can be viewed as along with vehicle axes .

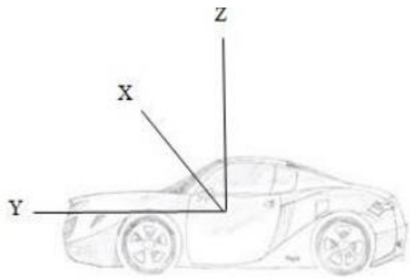

Fig –3: Axis Direction

The data is collected in the form of x, y, z, coordinates as a text file. For bump detection, the standard deviation of y and z coordinate are calculated. As, if the bump occurs they and z coordinates are affected so, need to consider both values. Bump is detected if the deviation is large. Information is stored on the server to help other users.

Both of the Y-axis or running direction and Z-axis or vertical direction, 50[ms] Standard deviation is large. And it is given by the equation below.

Standard deviation:

$$\sigma = \sqrt{\frac{\sum(x-\overline{x})^2}{N}}$$

where

σ = the standard deviation

x = each value in the population

$\overline{x}$ = the mean of the values

N = the number of values (the population)

In ghat complexity estimation, we consider Y axis for ghat detection. Here we calculate the angle of 'Y' axis with the north direction by which we can get how much car is turned at right or left side. For this, we also consider the previous angle of 'Y' axis with north direction. This helps to count the number of turns in specific ghat, and also we can conclude how much they are tough.

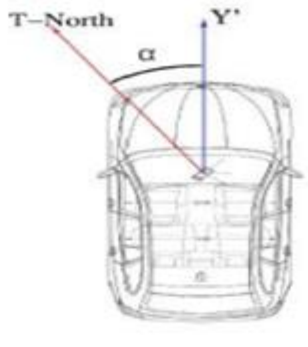

Fig - 4: Axis Direction When Vehicle Is moving

4. EXPERIMENTAL RESULT

The bump detection for the proposed system is given in the figure below. The data is collected from a phone in the form of x, y, z coordinates and is given to the system for calculation of bumps on road. The graph shows time on X-axis and standard deviation value on Y - axis. Road condition is determined so that user can choose an alternate route and reach the destination on time as shown in below figure.

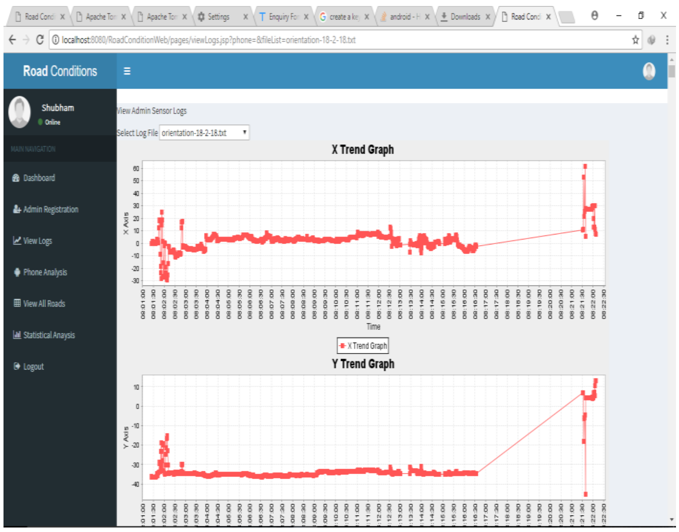

Figure (i)

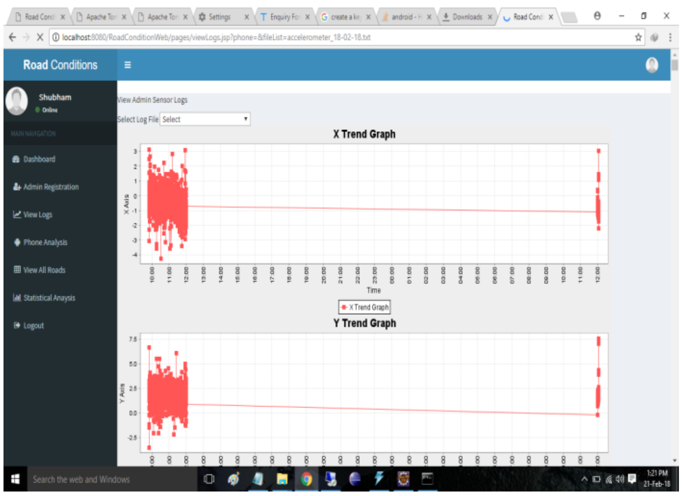

Figure (ii)

Fig. (i) & (ii)Detection Of Road Condition

5. CONCLUSION

By using this application we can collect the road condition related data by smart phone and store it on the server so it will be helpful for the other traveller to know the road roughness and complexity of ghats in advance. It will not only help the people to reach the destination at right time but it can also save many lives by avoiding accidents. The information can help to choose one of the shortest routes for the safe journey.

REFERENCES

[1] Juan C. Tudón-Martínez, Soheib Fergani, Olivier Sename, John Jairo Martinez, Ruben Morales-Menendez, and Luc Dugard "Adaptive Road Profile Estimation in Semiactive Car Suspensions"2015 IEEE TRANSACTIONS ON CONTROL SYSTEMS TECHNOLOGY.//www.ieee.org/publications_standards/publications/rights/index.html.

[2] Viengnam Douangphachanh, Hiroyuki Oneyama "Formulation of a Simple Model to Estimate Road Surface Roughness Condition from Android Smart phone Sensors."2014 IEEE Ninth International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) Symposium on Human-Centric Sensing and Social Networks Singapore, 21–24 April 2014.

[3] Viengnam, DOUANGPHACHANH, Hiroyuki ONEYAMA" Estimation of Road Roughness Condition from Smart phones under Realistic Settings"2013 IEEE,13th International Conference on ITS Telecommunications (ITST).

[4] Mingqi Lv, Ling Chen, Xiaojie Wu, and Gencai Chen" A Road Congestion Detection System Using Undedicated Mobile Phones"IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS. VOL. 16, NO. 6, MAY 2015.

[5] Perttunen, M., Mazhelis, O., Cong, F., Kauppila, M., Leppänen, T., Kantola, J., Collin J., Pirttikangas, S., Haverinen,J., Ristaniemi, T. : Distributed road surface condition monitoring using mobile phones. Ubiquitous Intelligence and Computing, 64–78, 2011.

[6] Douangphachanh, H. Oneyama, "Using Smart phones to Estimate Road Pavement Condition," Paper presented at the 1st International Symposium for Next Generation Infrastructure, Wollongong, NSW, Australia, October 1-4, 2013