A REVIEW PAPER ON "SMART PHONE APPLICATION FOR SMOOTH PATH DETECTION"

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Abstract - Smart Phone Application for Smooth Path Detection proposes to utilize the GPS and various sensors like tri-axial accelerometer, magnetometer, etc. of android phone, for analyzing the road irregularity, sharp turns and can upload this information of that road on centralized server so every application user can use this information during traveling. The system designed is a route suggesting real-time Android Application based on Road Quality that automatically generate the quality and complexity of driving on the road, based on sensors data and save the records based on the GPS location. System is considering standard deviation of accelerometer for y and z axis respectively to determine the bump and magnetometer deviation to identify the number of turns in route. Using this information several alternatives can be suggested to the user where he/she can choose for one of the favorable route from source to destination based on road complexity and time constraints. Using this system, analysis of the road smoothness regarding the potholes and bumps and complexity regarding number of turns for the traversed region can be done. Hence, system can provide update of the road to drivers and government bodies. Besides, Road Man-aging Authorities can get advantages from this system to evaluate the state of their road network , and improve road quality and reduce the complexity wherever needed.

Keywords - Smart-Phones, Tri-axial accelerometer, GPS, Road Quality, IoT, Sensors.

I. INTRODUCTION

Smart-phone's are used for collection of the data is a promising alternative because of its low cost and easy to use feature in addition to its potentially wide population coverage as probe devices. In the previous system explored Smart-phone's were used, attached to vehicles with predetermined orientation, to estimate road roughness where promising results have been observed.

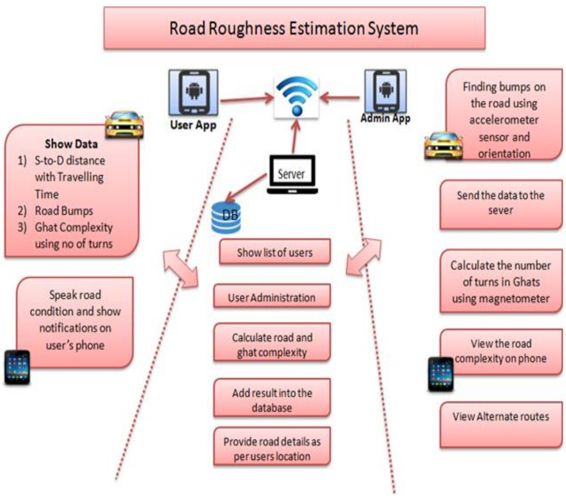
This study will take a next step by attempting to estimate road roughness from smart-phones under more realistic settings, which is beyond particular orientation and/or fastening the devices themselves tightly with vehicles while collecting data. i.e. the smart phone will be loosely fixed inside the monitoring vehicle. Maintaining the good road condition is a very difficult and challenging task. One of the reasons is that the task requires the collection of substantial amount of road network condition data, which is very important for maintenance planning and monitoring, over time, in addition to the considerable efforts that have to be directed to actual maintenance of the road network.

In developing countries, the data collection is usually ignored mainly due to the lack of technology. Therefore, the road infrastructure condition data is generally left un-updated, making it difficult for proper planning of the maintenance. Road condition/Road Roughness is one of the most important measures in the developing countries. The data collected of the road roughness allows/helps the concerned persons to assess the condition and accordingly take the appropriate actions. Road roughness condition, measured by the International Roughness Index (IRI), has been used widely for road infrastructure maintenance and monitoring for many decades.

To measure IRI, there are many approaches, however majority of them, on one hand, requires sophisticated tools, which are expensive to acquire and operate as well as often require skillful operators [4]. Besides this approach, visual inspection is a widely used technique in some countries. This is much cheaper technique, but requires much time for the inspection. The Location Based Distance Calculation algorithm used can be helpful to user at the time if there are multiple routes and for destination and he can choose one of the shortest routes.

II. RELATED WORK

The study conducted by Amita Dhiman and Reinhard Klette [1] Techniques for identifying potholes on road surfaces aim at developing strategies for real-time or offline identification of potholes, to support real-time control of a vehicle (for driver assistance or autonomous driving) or offline data collection for road maintenance. Some of them are gear shifts and overall road conditions which consist of bumps, rough road, uneven road, and smooth road.



The study conducted by Chellaswamy C [2] an internet of things based road monitoring system (IoT-RMS) is proposed to identify the potholes and humps in the road. The IoT-RMS automatically updates the status of the road with location information in the cloud. Each road vehicles can access the information from the server and estimate the speed according to the potholes and humps present on the road.

Pit-free: Pot-holes detection on Indian Roads using Mobile Sensors [3] by Gaurav Singal proposes a system which makes use

Smart-phone sensors (such as Accelerometer and gyroscope) to identify the pot-holes on road and GPS for the location of the pit. In this system SVM (Support Vector Machine) had been used to classify the raw data.

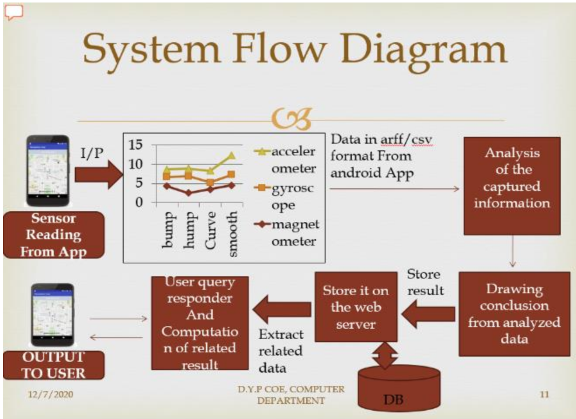
The study conducted by Azza Allouch [4] is to create a real-time Android Application Road Sense that automatically predicts the quality of the road based on tri-axial accelerometer and gyroscope, show the road location trace on a geographic map using GPS and save all recorded workout entries. A Decision tree classifier is applied on training data to classify road segments and to build our model.

M. Ghadge et al. [6] used an accelerometer and GPS to analyze the conditions of roads to detect locations of potholes and bumps using a machine learning approach, defined by K-means clustering on training data and a random-forest classifier for testing data. The data is divided first into two clusters of “pothole” or “non-pothole”, and then a random forest classifier is used to validate the proposed result provided by the clustering algorithm. It is reported that clustering does not perform well when clusters of different size and severity are involved; size and severity of a pothole are the major properties considered in the system.

III. ARCHITECTURAL DESIGN

Using Smart-phone’s to collect the data is a promising alternative because of its low cost and easy to use feature in addition to its potentially wide population coverage as probe devices. In our previous study we explored the used of Smart-phone’s, fixed to vehicles with predetermined orientation, to estimate road roughness where promising results have been observed.

This study will take a further step by attempting to estimate 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 are placed loosely at locations that a driver would be more likely to put their Smart-phone’s inside a car while driving.

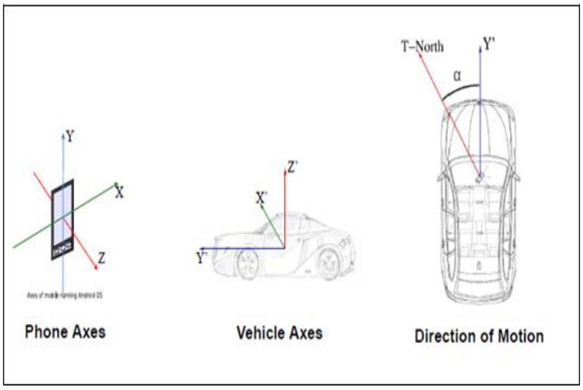


Bump Detection: The lowest layer of the system is on the application running on the Smart-phone. The application collects data from the accelerometer, magnetometer and GPS and then processes this to detect braking and bump events.

It then attaches a time and Location tag to this event data, and sends it across to the web server for further processing. Bump is detected using sensor data gathered from admin phone, details of location of bump is stored on the server side for other users.

Finding turns on the Road: As we have seen the data which we get from accelerometer and magnetometer, in that we consider y axis for turn 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.



Evaluation of Road at Server Side: The REST web service on the server receives the event traces of several Smartphone's along with the time and location tags.

Using this information, the web service infers 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.

Make data available to other users: The web service needs to send over the inferred events to the Smartphone running the application.

The Smartphone 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.

IV. TECHNICAL REQUIREMENTS

The following technical requirements were chosen as a basis for bumps detection system :

- System should be able to detect bumps in real time. Collection of raw data for off-line post-processing is an additional feature.
- Smart phone must have the accelerometer and GPS sensors.
- The system running on a smart-phone should be able to perform its native communication tasks at an adequate quality level. Utilization of all resources for pothole detection is not acceptable.
- System should detect bumps while driving in different two-wheel vehicle types, buses, cars.

V. EVALUATION

Based on the experiment result, road bump detection logic is designed as follows :

Condition 1: Both of the Y-axis or running direction and Z-axis or vertical direction, 50[ms] Standard deviation is large.

Condition 2: These sections are appeared with wheelbase time. Here, each variable is defined as follows. A recording order number is defined 'i'. An acceleration data are defined X(i), Y(i), Z(i) for each axis. For Y-axis or running direction and Z-axis or vertical direction, 50[ms] standard deviation is defined $SD_y(i)$, $SD_z(i)$. For the condition 1, simultaneity index is defined $SD_{yz}(i)$, and it is calculated by Equation 1,

$fSD_{yz}(i) = SD_y(i) * SD_z(i)$ ... Equation 1

Cycle number of wheelbase time is defined N_w. For the condition 2, Bump Index is defined $B_{yz}(i)$, and it is calculated by Equation 2,

$fB_{yz}(i) = SD_{yz}(i) * SD_{yz}(i + N_w)$ ... Equation 2

N_w is related with vehicle speed. Vehicle speed is defined V [m/s]. Wheelbase is defined L_w [m].Recording cycle is defined H [Hz]. N_w is calculated by Equation 3,

$fNw = (Lw/V) * H$ ... Equation 3

VI. EXPERIMENT RESULT

This logic is applied to data. The 50[ms] standard deviation of Z-axis acceleration or vertical direction $SD_z(i)$ is drawn in Fig. Simultaneity index $SD_{yz}(i)$ is drawn in figure,

Bump index $B_{yz}(i)$ is drawn below:

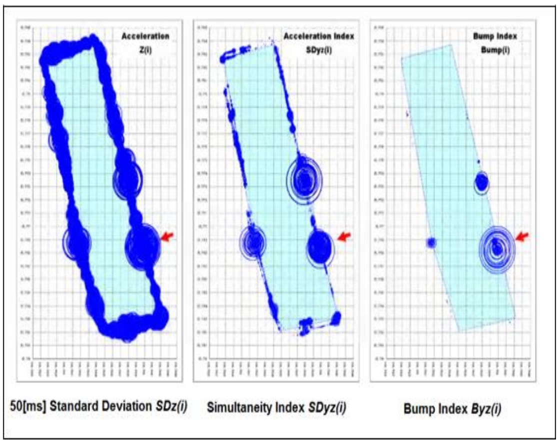


Figure 13: Standard Deviation graph analysis to extract Bumps

VII. CONCLUSION

By means of Smartphone App for Smooth Path Detection system user would evaluate the road and be able to upload this data of that road on central server so every application user can use this information during traveling.

It also provides information that can be helpful to user at the time if there are multiple routes and for destination and he can choose one of the easy and smooth less accident prone route.

VIII. FUTURE SCOPE

In future we will try to reduce the error rate of the existing system for correct road estimation.

The system can be upgraded to perform collaborative analysis of road complexity by extracting data from various diverse sources.

REFERENCES

[1] Pothole Detection Using Computer Vision and Learning: Application to detect pothole using accelerometer IEEE transaction 2019

[2] IoT Based Humps and Pothole Detection on Roads and Information Sharing : Application to detect humps using accelerometer IEEE transaction 2018.

[3] Pitfree: Pot-holes detection on Indian Roads using Mobile Sensors IEEE transaction 2018.

[4] Road Sense: Smartphone Application to Estimate Road Conditions using Accelerometer and Gyroscope IEEE transaction 2017.

[5] Road Disturbance Estimation and Cloud-Aided Comfort-Based Route Planning IEEE transaction 2017.

[6] Machine Learning Approach for Predicting Bumps on Road IEEE conference paper 2015.

[7] Formulation of a Simple Model to Estimate Road Surface Roughness Condition from Android Smart-phone Sensors conference paper 2017.