INTELLIGENT ANDROID APPLICATION FOR SENSING ROAD CONDITIONS USING ACCELEROMETER AND GYROSCOPE

Kimaya Salvekar, Rutik Kamble, Girija Dalvi, Suyog Chavan
Department of Computer Engineering
MIT Polytechnic, Pune.

Prof. Mrs. Swarupa Mahesh Deshpande
Department of Computer Engineering
MIT Polytechnic, Pune.

Abstract— **Smartphones are potentially useful to be adopted as a cost-effective and easy to implement tool for the measurement of road surface roughness condition, which is very essential for road monitoring and maintenance planning. In this study, an experiment has been carried out to collect data from accelerometers and gyroscopes on smartphones. The collected data is processed in the frequency domain to calculate magnitudes of the vibration. Road roughness condition that is modelled as a linear function of the vibration magnitudes, taking into account of both data from accelerometer and gyroscope as well as the average speed, achieves better estimation than the model that takes into account the magnitude from the accelerometer and the average speed alone. The finding is potentially significant for the development of a more accurate model and a better smartphone app to estimate road roughness condition from smartphone sensors.**

Keywords—(As per ACM Keywords) ***Road monitoring, Accelerometer, Gyroscope, Android.***

I. INTRODUCTION

As we all know that transportation is that the backbone of any country's economy. Improvement in transportation systems result into the nice lifestyle during which we achieve extraordinary freedom for movement, immense interchange manufactured goods and services, furthermore higher rate of employment levels and social mobility. In fact, the condition of a nation has been closely associated with efficient ways of transportation. Increasing number of vehicles on the road, result into number of problems like congestion, accident rate, pollution and lots of other. All economic activities for various tasks use different methods of transportation. For this reason, increasing transportation is a right away impact on productivity of nation and therefore the economy. Reducing the price of transporting resource at production sites and transport completed goods to markets is one in every of the important key factors in economic competition. To avoid risky transportation this project has been introduced.

In today's world transportation is one if the important factor and every individual has their own vehicle. It's good that our country is developing in transportation and other developing factors but thanks to manmade and natural factors transportation route is affected. Risky roads result in accident prone situations. So to scale back the accidents this application is developed. This application helps to detect and avoid risky roads by notifying us. Road sense Data has developed an affordable system that sits on top of roads, without having to interrupt the asphalt or close the road. By identifying patterns, Road sense Data can predict car crashes and help drivers avoid them. Road sense Data gives drivers enough time to consider all precautions to avoid an accident. In recent years, road condition monitoring has become a well-liked research area. The sense data allows the user to receive condition of the approaching road, the conditions will be classified as worst, average and best. During this way, accidents will be avoided.

II. LITERATURE SURVEY

1. Yukie Ikeda ; Masahiro Inoue "An estimation of road surface conditions using participatory sensing". 2018 International Conference on Electronics, Information, and Communication (ICEIC).

When natural disasters occur, some roads could be blocked and cannot be used. Road surface conditions also deteriorate. Thus, collecting and providing the information on usable roads and road surface conditions can allow people to be evacuated safely. In this study, we proposed an estimation system of the road surface conditions by collecting accelerometer data from pedestrians' smartphones. The method estimates whether the road surface condition is a flat pavement road, a rough road, a slope or a stair by using supervised machine learning method. From the results of experiment, we found that the system can estimate six types of road surface conditions with a high accuracy when training the model with the data from the users.

2. **Juan C. Tudón-Martínez; Soheib Fergani; Olivier Sename; John Jairo Martinez; Ruben Morales-Menendez; Luc Dugard, "Adaptive Road Profile Estimation in Semiactive Car Suspensions" IEEE Transactions on Control Systems Technology. Year: 2015, Volume: 23, Issue: 6.**

The enhancement of passengers' comfort and their safety are 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. Because direct measurements of the road profile represent expensive solutions and are susceptible to contamination (e.g. using laser and other visual sensors), this paper 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 easy to mount, cheap, and useful to estimate all suspension variables. Based on the Q-parametrization approach, an adaptive observer estimates the dynamic road signal; afterward, a Fourier analysis is used to compute the road roughness condition online and to perform an International Organization for Standardization (ISO) 8608 classification. Experimental results on the rear-left corner of a

1:5 scale vehicle, equipped with electro-rheological (ER) dampers, have been used to validate the proposed road profile estimation method. Different ISO road classes evaluate the performance of the proposed algorithm, whose results show that any road can be identified successfully at least 70% of the time with a false alarm rate lower than 5%; the general accuracy of the road classifier is 95%. A second test with variable vehicle velocity shows the importance of the online frequency estimation to adapt the road estimation algorithm to any driving velocity; in this test, the road is correctly estimated in 868 of 1042 m (an error of 16.7%). Finally, the adaptability of the parametric road estimator to the semiactiveness property of the ER damper is tested at different damping coefficients.

3. Amr S. El-Wakeel; Jin Li; Aboelmagd Noureldin; Hossam S. Hassanein; Nizar Zorba "Towards a Practical Crowdsensing System for Road Surface Conditions Monitoring", IEEE Internet of Things Journal, Year: 2018.

The Internet of Things (IoT) infrastructure, systems, and applications demonstrate potential in serving smart city development. Crowdsensing approaches for road surface conditions monitoring can benefit smart city road information services. Deteriorated roads induce vehicle damage, traffic congestion, and driver discomfort which influence traffic management. In this paper, we propose a framework for monitoring road surface anomalies. We analyze the common road surface types and irregularities as well as their impact on vehicle motion. In addition to the traditional use of sensors available in smart devices, we utilize the vehicle motion sensors (accelerometers and gyroscopes) presently available in most land vehicles. Various land vehicles were used in this paper, spanning different sizes, and year model for extensive road experiments. These trajectories were used to collect and build multiple labeled data sets that were used in the system structure. In order to enhance the performance of the sensor measurements, wavelet packet de-noising is used in this paper to enable efficient classification of road surface anomalies. We adopt statistical, time domain, and frequency domain features to distinguish different road anomalies. The descriptive data sets collected in this paper are used to build, train, and test a system classifier through machine learning techniques to detect and categorize multiple road anomalies with different severity levels. Furthermore, we analyze and assess the capabilities of the smart devices and the other vehicle motion sensors to accurately geo-reference the road surface anomalies. Several road test experiments examine the benefits and assess the performance of the proposed architecture.

4. Amr S. El-Wakeel; Abdalla Osman; Aboelmagd Noureldin; Hossam S. Hassanein "Road Test Experiments and Statistical Analysis for Real-Time Monitoring of Road Surface Conditions", GLOBECOM 2017 - 2017 IEEE Global Communications Conference.

Road information services (RIS) is a major component of the information and communication technologies with the main purpose of RIS-based systems is to monitor road health conditions, weather information and traffic congestion. Considering the road conditions, there are various kinds of road surface types and anomalies with lack of efficient analysis of their behavior on the vehicle sensor measurements. Consequently, there are difficulties in detecting and categorizing the different road types and anomalies. This paper demonstrates road test results for the measurements of inertial sensors mounted in land vehicles while monitoring various road surface types and anomalies. In addition, a wavelet-based feature extraction together with statistical approach for the road types and anomalies are explored in this study. Two road test experiments on two different vehicles performed in Kingston, ON, Canada together with in-depth analysis are discussed in this paper.

5. Kenta Ito; Go Hirakawa; Koji Hashimoto; Yoshikazu Arai; Yoshitaka Shibata "Road Surface Condition Understanding and Sharing System Using Various Sensing Technologies", 2017 31st International Conference on Advanced Information Networking and Applications Workshops (WAINA).

In this paper, we introduce a road surface condition understanding and sharing system. Traffic accidents and obstructions due to bad weather conditions and poor road conditions are serious social problems. It is necessary for drivers to understand weather and road conditions in advance to avoid traffic accidents and obstructions and it is necessary to alert drivers to weather and road conditions in order to reduce driving and judgement errors. In addition, gathering information from others and communicating information to others are necessary. Based on above, we construct a road surface condition understanding and sharing system using various sensing technologies. In particular, to realise gathering information from others and communicating information to others, we work on implementation, experimentation and improvement on wireless communication (Vehicle-to-Infrastructure communication and Vehicle-to-Vehicle communication). We conduct communication experimentation in real environments.

III. System Architecture

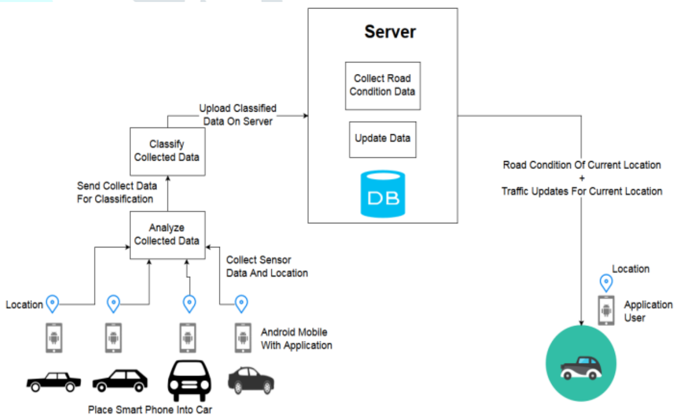

Fig.1 System Architecture

The system architecture shows the overview of application. The proposed system analyses the road condition and paved surface. It identifies bad road patches and offers notification to navigation system. For that builtin accelerometer sensor and gyroscope sensor are used. To enhance the system result we use decision tree algorithm. Propose system has self-managing database which collects data from vehicle drivers, android smart phones. This data is updated in real time periodically. Application utilizes this data to tell other application users about road condition.

Advantages of propose system

Propose system don't need any extra hardware. Propose system utilize inbuilt mobile sensor. Propose system inform traffic updates to nearest users.

IV. PROBLEM STATEMENT

Title: A Smart Road Sense Data.

The main objectives of the system are:

• To detect and classify irregularities of the road while you're driving.

• Roads are needed to be monitored continuously for anomalies to avoid inconvenience to the road users.

• To enhance the road type detection algorithm through detecting other road anomalies.

• To let users know about road conditions by notifying them

PROPOSED WORK AND MODULES

Project Modules:

- Admin
- User
- System

Admin- Admin module will be one web module. Admin will verify user information and allow or reject to user. If admin allows user then verification pin will be sent to user registered mail id or mobile number.

Admin can view the all road conditions on web.

Admin can also add road condition on particular location.

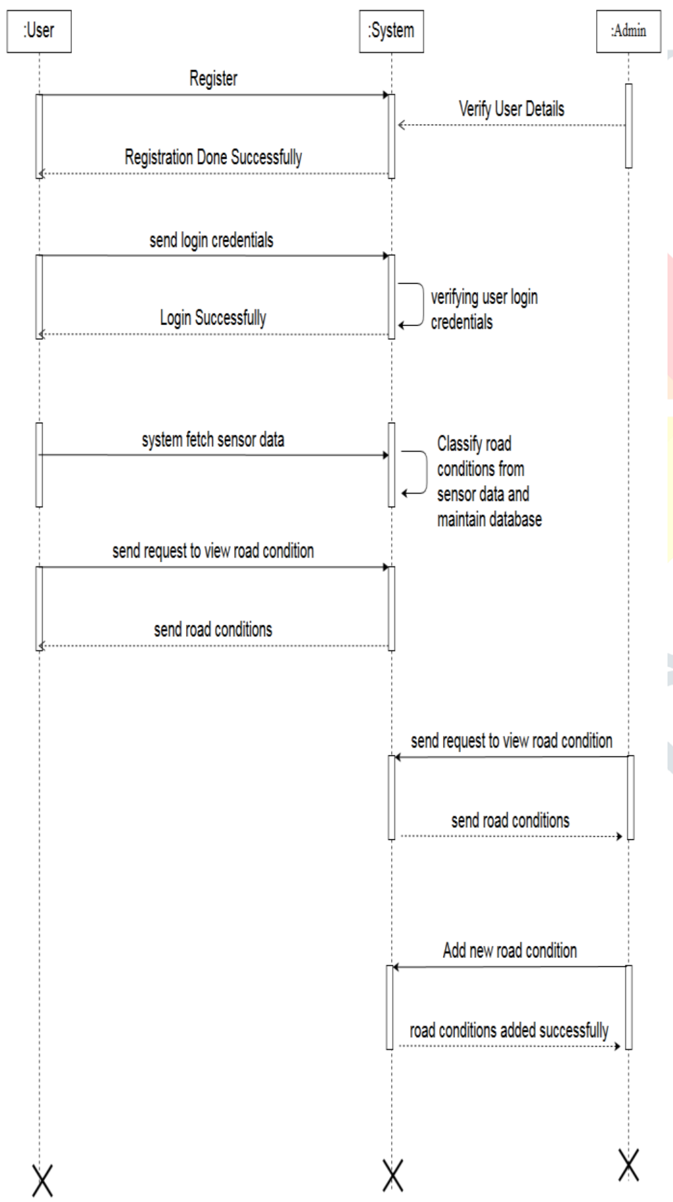

Fig. 2 Sequence Diagram

User- User register into system with personal information. Automatically user verification request is sent to admin. After verification user can login into system. After login user start road condition detection service.

If road conditions are present into database then those road conditions are displayed to user.

System-

System detects road condition with the help of mobile sensors. System maintains records of road condition along with location into database. System update record automatically by using mobile sensor information

ALGORITHM

Algorithm 1 Haversine algorithm:
To calculate the distance from target point to origin point:

1. R is the radius of earth in meters. LatO = latitude of origin point, LongO = longitude of origin point, LatT= latitude of target point, LongT= longitude of target point.
2. Di erence in latitude = LatO-LatT Di erence in longitude = LongO - Long =Di erence in latitude in radians=Di erence in longitude in radians O= LatO in radians.T= LatT in radians.
3. A= sin(/2) * sin(/2) + cos(O) *cos(T)*sin(/2)*sin(/2)
4. B= min(1,sqrt(A)) Distance = 2*R*B

Algorithm 2:C4.5 Algorithm:
C4.5 is collection of algorithms for performing classifications in machine learning and data mining. It develops the classification model as a decision tree. The general algorithm for building decision trees is:
1.Check for the above base cases.
2.For each attribute a, find the normalised information gain ratio from splitting on a.
3.Let a best be the attribute with the highest normalised information gain.
4.Create a decision node that splits on a best.
5.Recur on the sublists obtained by splitting on a best, and add those nodes as children of node.

RESULT

It is a service similar to google map service which will get automatically updated information from users mobile and provide results to other users. And improve the users traveling experiences.
According to road condition, phone will detect values of road using accelerometer sensor and gyroscope sensor and will classify it into good, bad or worst condition and will notify the app user accordingly.

- It will accept a source 'From' and a destination 'To' and will also set a route.
- Application will notify user via message notification.
- It will help user to file a report if any condition is not detected.

V. FUTURE SCOPE

- More accurate detection of road conditions.
- More user friendly GUI.

CONCLUSION

Propose system uses an accelerometer sensor and gyroscope sensor for collection information and GPS for plotting the road location trace in map. It implements decision tree algorithm. Our best results is obtained because of grouping two sensors; accelerometer and gyroscope. We are going to inform nearest user about traffic. The smart phone-based method is extremely useful because it removes the necessity for deploying special sensors in vehicle.

REFERENCES

1. Yukie Ikeda ; Masahiro Inoue "An estimation of road surface conditions using participatory sensing". 2018 International Conference on Electronics, Information, and Communication (ICEIC).
2. Kazuyuki Kojima ; Hiroki Taniue ; Jun'ichi Kaneko "Mahalanobis distance-based road condition estimation method using network-connected manual wheelchair". 2016 IEEE International Conference on Consumer Electronics-Taiwan (ICCE-TW).
3. Takumi Satoh; Akihito Hiromori; Hirozumi Yamaguchi; TeruoHigashino "A novel estimation method of road condition for pedestrian navigation". 2015 IEEE International Conference on Pervasive Computing and Communication Workshops (PerCom Workshops).
4. Juan C. Tudón-Martínez; SoheibFergani; Olivier Sename; John Jairo Martinez; Ruben Morales-Menendez; Luc Dugard, "Adaptive Road Profile Estimation in Semiactive Car Suspensions" IEEE Transactions on Control Systems Technology. Year: 2015, Volume: 23, Issue: 6.
5. Viengnam Douang phachanh; Hiroyuki Oneyama "Estimation of road roughness condition from smartphones under realistic settings", 2013 13th International Conference on ITS Telecommunications (ITST).
6. Kongyang Chen; Mingming Lu; Xiaopeng Fan; Mingming Wei; Jinwu Wu "Road condition monitoring using on-board Three-axis Accelerometer and GPS Sensor", 2011 6th International ICST Conference on Communications and Networking in China (CHINACOM).
7. Amr S. El-Wakeel; Jin Li; AboelmagdNoureldin; Hossam S. Hassanein; Nizar Zorba "Towards a Practical Crowdsensing System for Road Surface Conditions Monitoring", IEEE Internet of Things Journal, Year: 2018, (Early Access).
8. Amr S. El-Wakeel; Abdalla Osman; AboelmagdNoureldin; Hossam S. Hassanein "Road Test Experiments and Statistical Analysis for Real-Time Monitoring of Road Surface Conditions", GLOBECOM 2017 - 2017 IEEE Global Communications Conference.
9. Quan Yuan; Xinze Li; Cai Wang; Yibing Li; Yan Gao, "Cluster and factor analysis on data of fatal traffic crashes in China", 2017 4th International Conference on Transportation Information and Safety (ICTIS).
10. Kenta Ito; Go Hirakawa; Koji Hashimoto; Yoshikazu Arai; Yoshitaka Shibata "Road Surface Condition Understanding and Sharing System Using Various Sensing Technologies", 2017 31st International Conference on Advanced Information Networking and Applications Workshops (WAINA).