RoadSense: An Android Application for Guessing Conditions of Road by making use of Gyroscope and Accelerometer

Richa Saxena, Anshul Yadav

Moradabad Institute of Technology, Moradabad

Abstract- Examining the condition of the road has established a basic notable move at the end of the year. So there is the specific reason behind every expansion of research in this area so before starting the journey, it will make sure that the safety and assuagement for various customers on road and aircraft the avenue which results in causing the minimal vandalism to vehicle as well as personal. Basic motivation behind this is to innovate an immutable applications of Android which will result in the anticipated constitution of the ambivalent that makes use of the instinctual properties of gyrator and accelerometer. The road sense application is dependent on the giant for showing road area that will follow basically on topographical counsel using GPS; leaving everyone to write the exercise route. The algorithm used for classification of Decision tree is based on C4.5 which is confederated in constructing information used for establishment of models for getting the characteristic of different road parts. Our test of this application results in giving trustworthy accurateness with 98.6 in percent. Using this mechanism, it is anticipated to photograph the condition of a road for area which is selected. As a result, it could yield positive reprehension to coachman as well as abutting specialist. Additionally, the road master and also government authorities can gain benefit from this application as they can examine the overall condition of road system which indirectly help them to conduct legitimate examination of road development enterprises.

Index Terms-Gyrator, Accelerometer, Machine Learning, Road Sense, Pit, C4.5, Android, WEKA, Real Time Analysis.

I. INTRODUCTION

According to measurements specified by the World Health Association (WHO), road accidents have become one of the main accelerating causes for depriving the death on our earth. Talking specifically, road accidents claim to take about 1.48 million of breathings in every 365 days . Focusing on this difficulty ^[1] it has been observed in particular that many of the road accidents are resultant of the underprivileged positions of roads across the world. These terrible roads are the dominant controversy issue for majority of automobiles and motorists, it is based on the foregrounds that the absolute pathetic conditions of roads drives for increment in terms of costly maintenance, and that to not only for the deteriorating road by themselves but in annexation to that of automobiles ^[1].

Appropriately, this model is looking at the condition of the road that takes into account some of the important answers which will surely enhances and improves wholesome safety in traffic and reduces overall accidents rate which in turn ensure automobiles from atrocious damage caused by damaged roads ^{[2][14]}. Both the administrative authorities responsible for maintenance of road and operators of vehicles are immensely waiting with bated breath to keep abundant data in accordance to the standard of the road construction ^{[3][12]}. Combined methods for observing the condition of the street that will include the reception of prohibitive and advanced equipment supplies, for example, immediate and ultrasonic or information which is clearly defined by accelerometers and gyrator with intense and specific information obtaining model. This paper predicts a structure that will check the condition of road which is based on the predictions done by sensors that makes use of accelerometer, GPS and spinning techniques) and analyze the data based on application that will work in cellular phones which predicts the characteristics of that particular street using determined AI processes that identifies the condition of road.

The obligation regarding the facilities provided in application discussed in this paper are composite which can be highlighted as pursues:

The very first allegiance in terms of this application is, we plot and plan an Artificial Intelligence based calculation (based on C4.5 decision tree) to determine potholes in road which gives resemblance to past projects that makes use of basic circumference, support vector machine in addition to fuzzy logic. The trial of this model shows that this innovation can identifies as well as group determine golden opportunities to identify the street pits and conditions of road with measurable exactness of 98.6 in percent.

The remainder of this paper is sorted out as pursues. Second point after introduction gives an overall basics on three major calculations of artificial Intelligence which are used on major bases in this paper. Third section shows down the soul work done in order to make this application lively that how to determine the conditions of road and various sub facilities available in the application.

II. EXISTING TECHNOLOGIES

A. WEKA and it's Advantages

Weka has the GUI i.e. graphical user interface for easy accessing of these utilities provided by it, as well as a pool of visual tools and helping algorithms for study of data and predictive analytics of various correspondents of gathered data. The vaccine to it was considered primarily as was the system for running computer tools and machine learning experiments in C.

This original version of WEKA tool was mainly developed as a important ingredient for studying data and is currently used wholly in many divergent application areas such as educational purposes and research and development.

Dominance of WEKA consist of:

- Free authentication and authorization under the concept of GNU.
- Transportation capacity, as WEKA is completely executed in the Java programming language and therefore moves on practically for any state-of-the-art registration phase.
- Immense working ability of creating graphs for regression and classification of information because of its graphical UI.

*B. C*4.5

C4.5 is defined as a calculative representation which has been developed and created by Ross Quinlan who has made this innovative algorithm to give judgment about information gathered in form of decision trees (DT) which can further be used for issuing orders . C4.5 algorithm is used to design and spreads various computations which is used to tackle the prescribed and scattered information and lost characteristics and create decision trees after improving the analyzed information^{[6][7]} If talking about its descendent in business , C5.0, is greatly speeded then that of C4.5, which is much more power packed and is constructed which can be in turn used for designing the decision trees.

The computation shatters the analyzed information into pieces and after that prepare the sets according to the usage and finally prepares a collection of similar types of data in the form of an array that should effectively groups together the test model as well as preparation of frameworks and test models.

C. Algorithms of Machine Learning

While doing the investigation about machine learning we have used 3 unique devices that can learn reckoning. The direct substitute to that order is the tree which is classified as C4.5. This algorithm will generates twin tree structures to represent combined operations performed by overall model. Whenever there is contrive formation of the tree, they are stick to each and every tuple in the dataset within the presenting model in order to drive the section of data which has been selected for that specific row. Whenever a tree is constructed, the characteristics of C4.5 has been disregard by decision tree algorithms used for reference. them. Support Vector machines (SVM) are instructed to learn. The machine which is used to calculate regression and classification challenges is Support Vector Machine (SVM) classifier . This machine is directed to make various comprehend strategies to make characterization as well as relapse^{[5][7][4][6]}. In the analyzing process, it calculates whether another occurrence comes in which classification. Innocent Bayes computations have which has been used for constructing this single handling enabler which classifies the fact and figures which keens out variety of choices and likelihoods by matching replication and mixing of its features in abundant amount of data gathering and grouping. Counting the Bayes practices, the assumption and acknowledges that all idiosyncrasy are self-sufficient within themselves, assuming the square variable..

III.SYSTEM DESIGN

The system design contains the two phases.

A. Ride

(i) Gathering data from mobile phone's sensor

processes are defined as the most Data gathering important part of the system: as it is having the responsibility of collecting the data related to condition of road. To cope up with such kind of condition an application is created which is based constituently on Android supportable cell phones for collecting three dimensional information from accelerometer and Gyrator^{[11][8][10]}. To monitor the condition of the upper layer of the Road, many sensors are used in order to measure the information about quality of street from cell phones for utilization of its information and to collect and analyze this information for detecting the pits on road. The reason behind making use of these accelerometer and gyroscope sensors which has been positioned on automobile on their dashboards so as to monitor the vehicle when it is on its way of a chosen street. The overall speed of fetching the data and speeding up complete process is considered to be as that of 50 Hz. It has also been observed that sometimes this speed of fetching the data has been varied in terms of frequency so the application will run in a different manner. When the vehicle is on the road for very first time, the information about that particular street is completely unknown but after that when the repetition increases, the accuracy rate also increases in direct relation.

When the application is down in terms of less connectivity and the motorist stops fetching the important information regarding the potholes on road, this Android application preserves the Index of Learning Data in an E-R Diagram or .arff document so as to predict the previous stored information about the road and guarantee the upside of the application even when it is not using Internet . Many a times, the general observation is that it is very difficult to consider the major dissimilarity in different classifications of road conditions such as little bit damaged , medium damage or detailed road condition. Therefore , the consideration in terms of the test which has been considered will have to predict the road characterization, and to identify the dissimilarity between flat road and potholes.

(ii). Manipulating Data

Accelerometer data consideration and various form of readings most of the times contain irreverent information which is said as stir and contains superfluous information. The model which has been considered for this framework generally makes use of some handling of stages in predefined conditions is being joined to it in order reduce the noise while gathering the parameters of all the three axis and to improve the overall standards of the road. Due to definite causes, for example, veering, turning, braking and sensor introduction, as vague alters in vibration; a huge amount of the noise is added to the signals^{[8][13]}. Filters used in it are basically Low pass which are basically used to filter out the irrelevant information in terms of noise by removing all the high frequencies which are intern creating noise and produce a hindrance in speeding up the process of collecting

information . When level of the noise is lessened and has been finished in terms of reduction, the test of accelerometer with variables considerations as (X, Y, Z) when SIFT is considered along with a different test with the help of gyroscope with its variables as opposite to that of (X', Y', Z') will be computed once again and all the vectors which are considered as smooth are joined together into a one dimensional array in a soldiery extant^[14] and the calculations of fetching and computing the data is stored in a variable named $m = (x^2 + y^2 + z^2) 1/2$. 2]² for information collected from accelerometer along with the information which is gathered from gyroscope is stored in variable just the bar of $m' = (x'^2 + y'^2 + z'^2) 1/2$. Let M is calculated by applying the triangular accelerometer coordinates (X, Y, Z) along with M', can also be considered as the highest calculated variable which gets its value.

From this we get a single value of both max and max' and by using the values of these variables we can easily modify the data and characterize the roads on basis of their conditions by applying formula given above.



(iii) Selecting and Extracting features

At the distinct when above mentioned machine learning calculations are designed, the row which has been selected or highlights as opposed to crude information is an increasingly compelling information. So as to decrease the information which is considered as input, the overall critical data which has been fetched from various sensors will be categorized in terms of windows removing the fact of noise produced in getting the data in frameworks.

FFT changes a period arrangement of plentifulness after getting the data from the above mentioned phase some common formulas of cosine and sine series are used to fetch the most accurate values of m variable.

Formula used for defining FFT and gathering data is:

1. Fourier cosine series

Since the cos function is considered to be as the even one so we can manipulate the data of m function to create or get the even value of m as :

m = 0

f(t) =
$$1/\pi \sum_{\infty}$$
 Fm cos (m) in terms of time

Here the function F is considered as set that contains all the integer values which are greater than 0. The above mentioned function defines the complete series.

2. Fourier sine series

Since the sine function is considered to be as the odd one so we can manipulate the data of m function to create or get the odd value of m as :

$$\begin{array}{c} m = 0 \\ f(t) = 1/\pi \sum Fm \sin (m) \text{ in terms of time} \end{array}$$

 ∞

Here the function F is considered as set that contains all the integer values which are greater than 0. The above mentioned function defines the complete series.

When the process is removed from calculating the functions a much better matrix of 64 frequency components has been made which is considered as an array of frequency elements ranges from (f0:::f63), MAXacc ,MAXgyro , greaterness , size and name. The information set up is then spared as an .arff record and document position is then point investigate by weka ^[9], an information examination and AI device. Hence, those qualities can be finally utilized by considering the strong point for preparing. In any case, not every one of them are considered as variable for street condition , searching for something and ID .

CFS and WEKA has been used that in general reduces the noise from 66 variable collection to 25 and hence these 25 collections will be sufficient to identify exact type of road conditions ^[13].

(iv) Preparing the classifier model to Identify road conditions

A few highlights or important features in gathered dataset may be possibly consists of iterative or superfluous data which in turn will be able to modify the accuracy of responses received and the order of execution. When such condition occurs, orders given for systems in executing states are mostly recognized in order to perform very minimal amount of calculation and finally it will help to formulate corrective and perceived framework and model. We connected to a association based attribute selection approach^[5], exploiting the way this technology is worked out at WEKA. Finally, we recognize successful 25 collections will be sufficient to identify exact type of road conditions.

B. Map

Within this area, we individually duplicate our investigation for the purpose of executing the wholesome model. For the achievement of this goal we are offering our Android application named Roadsense on variety of cell phones. The mobile phone offered for positioning this application works in a totally unconventional way. The motorist will have the full control over the function of the application in real time driving norms and specifications.

Motorist have to do nothing specific and they generally takes normal routs on a particular road as they always do. For the purpose of identifying and picking up diverse road situation like a flat or plane road and pit-like diverse street conditions, drivers have to take multiple routs on that street.

The major advantage of this application is to identify the quality of a read in continuous fashion and after predicting the condition of road, illustrate it to various motorists which have downloaded the application and taking the same rout and providing them guidelines by giving them several data which can be helpful for them. application.



Figure 2. Map



Figure 3 Axis



Figure 4. Phone orientation inside the car

IV. CONCLUSION

In this paper, we inspect the AI calculation in order to predict the quality of a particular street which has been chosen for consideration. This area makes use of and GPS to plot the flow of street GMap. It also makes use of sensors (usually accelerometer) to relevant information regarding the three axis coordinates when the vehicle is moving. For this purpose three techniques has been considered which are names as Naïve Bayes, Support Vector Machine along with C4.5. Our research demonstrates the determined precision rate of 98.6% manifest the primacy of C4.5 during the term. Our finest results have been found because of collecting data from two different sensor which are named as spinner and Accelerometer. The application which is based on Android that makes use of sensor based technology which is quite useful as it requires exceptional sensor messages in the motor vehicle to evacuate. The Android based application can be considered as an effort for displaying its users with much accurate understanding of results and displays about their transport courses. With additional job in this area, it is

feasible for undertaking into consideration that will give an accurate influence for refining the conditions of road and in in the construction of nation worldwide. For coming future task, we want to enhance the conditions of road in order to locate potholes and flat or plane one by making use of innovative classifiers provided by AI.

V. FUTURE SCOPE

The most important objective of this application is to build a intelligent vehicle system to enhance vehicles and humans safety and also reduce accidental injuries. The roads in our country due to heavy loads and poor quality of material in construction, these damage on roads in our country often cause potholes in roads due to which transportation is affected, mostly accidents will takes place, it also affect some quick transport, also results in traffic jams, along with affecting humans who are travelling via roads. This innovation will help India in doing better road management, quick and safety transport of citizens. Once a user passes through the road, the road condition is being analyzed by the application in real time conditions and will be saved at firebase using our application and if another user goes or gets close to that road then the notification of that pit road is sent to the user smartphone which in turn will guarantee the safety of the travelers and alleviation of different users of road. Also it helps in causing less damage to cars. We need our innovation to genuinely improve conditions of road and finally upgrade individual's travelling time as we can't normally keep this advancement and potential for social great to ourselves. In Future, we will create adaptable arrangements that utilization publicly supported information to help individuals and associations settle on informed choices.

REFERENCES

 W. H. Organization. (2015) Global status report on road safety. [Online]. Available: http://www.who.int/violence injury prevention/road safety status/2015/en.pdf/

- [2] R. Madli, S. Hebbar, P. Pattar, and V. Golla, "Automatic detection and notification of potholes and humps on roads to aid drivers," IEEE Sensors Journal, vol. 15, no. 8, pp. 4313–4318, 2015.
- [3] P. Mohan, V. N. Padmanabhan, and R. Ramjee, "Nericell: rich monitoring of road and traffic conditions using mobile smartphones," in Proc. 6th ACM Conf. Embedded Netw. Sensor Syst, Raleigh, NC, USA, 2011, pp. 323–336.
- [4] K. Kulkarni, K. V. Prashant, S. Nasikkar, T. Ahuja, and N. Mhetre, "Predicting road anomalies using sensors in smartphones," Imperial journal of interdisciplinary research, vol. 2, no. 6, 2016.
- [5] A. Mednis, G. Strazdins, R. Zviedris, G. Kanonirs, and L. Selavo, "Real time pothole detection using android smartphones with accelerometers," in Proc. Int. Conf. Distrib. Comput. Sensor Syst.Workshops, Barcelona, 2011, pp. 1–6.
- [6] M. H. Dunham, Data Mining: Introductory and Advanced Topics. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2002.
- [7] A. K. Sharma and S. Sahni, "A comparative study of classification algorithms for spam email data analysis," International Journal on Computer Science and Engineering, vol. 3, no. 5, pp. 1890–1895, 2011.

- [8] Y. Wang, J. Lin, M. Annavaram, Q. A. Jacobson, J. Hong, B. Krishnamachari, and N. Sadeh, "A framework of energy efficient mobile sensing for automatic user state recognition," in Proc. 7th ACM MobiSys, Krakow, Poland, 2009, pp. 179–192.
- [9] A. T. Campbell. (2013) Smartphone programming. [Online]. Available: http://www.cs.dartmouth.edu/campbell/cs65/myruns/ myrunsmanual.html
- [10] S. A. Hoseini Tabatabaei, A. Gluhak, and R. Tafazolli, "A survey on smartphone-based systems for opportunistic user context recognition," ACM Comput. Surv(CSUR), vol. 45, no. 3, pp. 1–51, jul 2013.
- [11] Data mining software in java. [Online]. Available: http://www.cs. waikato.ac.nz/ml/weka/
- [12] M. A. Hall, Correlation-based feature selection for machine learning, Hamilton, New Zealand, 1999.
- [13] P. Harrington, Machine learning in action. Manning Greenwich, CT, 2012.
- [14] W. H. Organization. (2015) Global status report on road safety. [online].Available:https://www.who.int/violence_injury_prevention/ro ad_safety_status/2018/en/