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# Automatic Rash Driving Detection and Reporting Using Smartphones

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**ABSTRACT:** Real-time abnormal driving behavior monitoring has been a corner stone for improving the safety of driving. Previous works on driving behavior monitoring using smart phones just gives a coarse grained result i.e. only differentiating abnormal behavior from the normal ones. For making driving safe and reduce the risk of potential road accidents we need to take a fine -grained monitoring approach which not only detects the abnormal driving behavior but also identifies the definite abnormal driving behavior pattern i.e. Weaving, Swerving, Sliding, sudden Braking, Fast U-Turns and sudden Acceleration etc. After reviewing and studying the records of the driving traces collected from real driving environments, we find that all of the above driving behavior has their unique patterns on acceleration and orientation. Recognizing these observations, we further propose a fine-grained system to detect real-time highly accurate abnormal driving behavior pattern using the smart phone sensors. We extract effective features to capture the patterns of abnormal driving behaviors. After that, two machine learning methods, Rash driving, or officially driving under the Influence (DUI), is a major cause of traffic accidents throughout the world. We propose a system which uses only the accelerometer and the gyroscope sensor of the smart phone to detect the driving patterns and help in preventing road accidents. A program installed on the mobile phone computes accelerations based on sensor readings, and compares them with typical rash driving patterns extracted from real driving tests. Once any evidence of rash driving is present, the mobile phone will automatically alert the driver.

**KEYWORDS:** Real-time abnormal driving behavior, Coarse-Grain, Fine-Grain, Accelerometer, Gyroscope, Global Positioning System (GPS).

### I. INTRODUCTION

Traffic and rash driving accidents is ranked 8<sup>th</sup> at the 'Top 10 leading causes of death' all over the world, published by the World Health Organization. Road injuries took 1.4 million lives in 2016 alone. About three-quarters (74%) of whom were men and boys[1]. Studies show that most traffic accidents are caused due to rash and lethargic driving. Therefore, it is necessary to detect such rash driving behaviors to alert the driver or report them to the nearby traffic security bureau to take necessary actions. Although there has been works on abnormal driving behaviors detection, the focus is on detecting drivers status based on pre-deployed infrastructure, such as some sensors like infrared sensor and cameras, which incur high installation cost, such as EEG[3].

The focus is on detecting such 'patterns' using pre-built infrastructure installed inside the smart-phones, such is accelerometer and gyroscope. This will prevent any extra-cost for buying separate devices for this process. This proposed system will be even more easily accessible, since smart phones have become increasing popular over the recent years and plays very important role in our daily lives. More and more Intelligent Transportation System using smart-phones are being developed.

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Driving behavior analysis is also a popular direction of smart phone-based vehicular applications. However, existing works on driving behaviors detection using smart phones can only provide a coarse-grained result using thresholds, i.e. distinguishing abnormal driving behaviors from normal ones.

Since threshold values vary from car types and sensors sensitivity, there is question mark on the accuracy of detecting and differentiating between various driving behavioral patterns. Therefore, such solutions fail to provide satisfying and accurate fine-grained identification, i.e. identifying specific types of driving behaviors. Moving along this direction, we need to consider a fine-grained abnormal driving behaviors monitoring approach, which can be easily satisfied by our approach of using smart-phone devices like accelerometer and gyroscope. The fine-grained abnormal driving behaviors monitoring is able to improve drivers awareness of their driving habits as most of the drivers are over-confident and not aware of their reckless driving habits.

As most of the drivers are not aware of their rash driving habits, the fine-grained rash driving (also called as abnormal driving) detection and monitoring system can help drivers aware of their driving habits. This can help the drivers from preventing to drive carelessly. Some rash driving behaviors are obscure and the drivers could easily miss them. If we can identify driver's rash driving patterns automatically, the drivers can be made aware of their bad driving habits, so that they can correct them, helping to prevent potential car accidents. Besides, if we can pass these results from the monitoring back to a central server the police and other similar law enforcement divisions so they can detect the rash driving on a place and can react to it quickly or Vehicle Insurance Company to analyze the policyholders driving habits or verify their claims.

The work in this paper is divided in two stages. 1) Rash Driving Detection 2) Reporting Rash Driving. Rash driving Detection is done by with the help of embedded-smartphone sensors: accelerometer and gyroscope. Then with the help of GPS, the application will find the nearest police station and hospital using K-nearest neighbour algorithm, in case of an accident.

Paper is organized as follows. In section III, we have mentioned the research and literature survey for our project. Section IV describes rash driving detection implementing smartphone-sensors, connected component analysis and set of selection or rejection criteria. The flow diagram represents the step of the algorithm. After detection of text, how the incident is reported using K-Nearest algorithm and Haversine Formula, is given in Section IV. Section V presents experimental results showing the functioning application. Finally, Section V presents conclusion.

## II. LITERATURE SURVEY

- Our project is the live implementation of the research conducted in the paper [9], which further elaborates the semantics of the project and the technicalities
- The World Health Organisation's statistical research [1] gives us more insight and seriousness of the subject topic we chose to handle.
- The paper [7] gives more insight and particulars in detecting varying speed and acceleration patterns of the drivers at certain situation.
- We also went through other technologies referred in papers [3], [4], [8] and [13] and looked for ways to improve the flaws from those existing technologies.

## III. RASH DRIVING DETECTION

Rash Driving usually occurs when vehicle moves recklessly. This could either be a huge speed difference in a short amount of time, or uneven, zigzag path. Acceleration and angular velocity are the 2 parameters used to detect Rash driving.

In our application, we use accelerometer sensor for getting the acceleration ( $\Delta$  the speed difference between 2 consecutive time-instance), and gyroscopic sensor for getting the angular velocity. The application also has 2 modes:

- A normal mode, which will simply provide the use with readings, but won't inform them of a rash driving.
- The 'car mode' to activate the functions of the applications.

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We have calibrated the threshold values separately for highways and for the cities in this app. This is because the driving behaviours are observed to be vastly different on these cases. For highways, the driving is abnormal if the speed-difference within 5 seconds is more than 60km/hr, and angular velocity of 25°/sec. In case of cities, it is 30km/hr and 60°/sec as there will be lots of unavoidable turns and speed variations.

The application detects a rash driving with the help of these following steps:

1. The application will take readings from the sensors periodically.
2. The app will detect an accident, if either the accelerometer or gyroscope threshold values are crossed.
3. If the accident is detected, the app will alert the user, for a particular amount of time.

Note: The application is currently designed with parameters high speed national highways in consideration.

### IV. ACCIDENT REPORTING

After an accident or a Rash driving is detected, a popup message appears, asking the driver whether to report an accident or not. If the driver, either doesn't respond to the message within 10 seconds or if the driver presses 'Yes' button at the message, the accident will be reported to the web-portal of the nearest registered hospital or a law-enforcement office. To find the nearest neighbour we are implementing K-nearest neighbour.

1. To calculate the distance between the driver and a hospital, we use Haversine formula:

$$d = 2r \arcsin \left( \sqrt{\sin^2 \left( \frac{\varphi_2 - \varphi_1}{2} \right) + \cos \varphi_1 \cos \varphi_2 \sin^2 \left( \frac{\gamma_2 - \gamma_1}{2} \right)} \right)$$

2. Here  $\varphi_2$  and  $\varphi_1$  are latitude of point 1 and point 2 respectively.  $\gamma_1$  and  $\gamma_2$  are longitudes of point 1 and point 2 respectively.
3. Using the distance between 2 points from the Haversine formula, we can then compare the distances of the hospital/police stations in the K-nearest neighbour algorithm.
4. After receiving the nearest location, the registered hospital will receive the location of the report generated, along with the details of the driver and any medical data like blood-group. The police web-portal will also receive the data from the requested driver.

### V. EXPERIMENTAL RESULTS

Figures show the results of rash driving detection from a smartphone and reporting the accident by using K-nearest algorithm.

In Figure 1, the app is in 'Car mode' where it starts to detect the rash driving. Here is where we keep a check on the accelerometer and gyroscope sensors in case of any abnormal readings.

Figure 2 and 3 shows us the cases when a rash driving or accident is detected. As we are using the parameters for highways rash driving will be detected when the changes in speed at consecutive instances is about 45km.

The accident will be detected if the speed reduced from a very high speed to zero. The user has an option to not report the accident.

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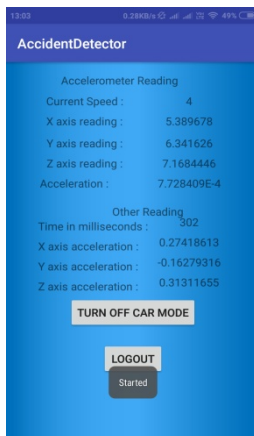


Figure 1: The App Started

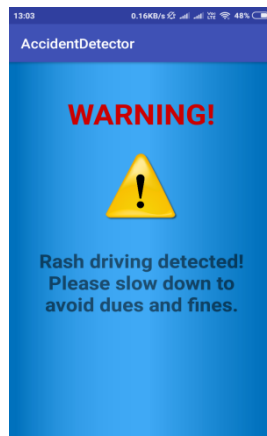


Figure 2: Detects and reports rash driving

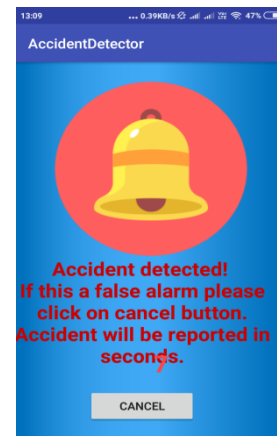


Figure 3: Detects and reports an accident

## VI. CONCLUSION

We have implemented an abnormal driving detection using the inbuilt Smartphone devices. The Software successfully detects the rash driving from the readings of the gyroscope and accelerometer. We have applied KNN-Algorithm and Haversine Formula to report the accidents to the nearby registered hospitals and police stations

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