Accident Detection and Prevention System for Two-Wheeler Vehicle

IOT -2019

Submitted by:

1) Naman Bhatt(MT2018066)
2) Karuna Nidhan Upadhyay (MT2018048)
3) Rajat Aggarwal (MT2017090)

Introduction

Accidents are one of the leading causes of death in India and majority of accidents could be prevented if the reckless, over speeding and sharp turns can be avoided as they are the major factor for accidents.

Every minute, one serious road accident in the country occurs and 16 die on Indian roads every hour. 1214 road crashes occur every day in India and out of which two wheelers account for 25% of total road crash deaths.

Therefore, we tried to develop an accident prevention and detection model which will try to solve this problem of two wheelers vehicle as they were accounting for 25% of accident through our model to some extent. We tried to send warning messages to already save number in case of over speeding and sharp turn and in addition to that we also added accident notification system which will try to identify the location even if GPS is not working.

Application scope

This warning and notification system approach will also help to analyze the driving pattern of a driver can help the driver to understand his safety level on the road as well as improve his driving habits for a safe driving environment.

We can also use this project for keeping an eye on your beloved children. Sometimes they cross speed and take sharp turn on busy roads. This system will immediately notify their parents through SMS.

This will help in reducing the number of accident occurring on roads due to rash driving and over speeding and also help to deploy ambulance at exact location based upon the SMS received through cloud.

Government can use the previous data of driver about how safely he/she is driving from the system and can cancel their license automatically if they are crossing their limit frequently.

Literature work referred

Fazeen at ref[1] developed an android application for smartphones for detecting driver’s behavior. They have used the accelerometer sensor of smartphones (which are integrated inside the cars) to collect and detect various driver styles or road conditions. They have analyzed the data from the accelerometer sensor (x axis, y axis) to measure the driver's direct control of the vehicle as they steer, accelerateor braking.

In Chigurupati at ref[2] the accelerometer sensor and the GPS sensor for data recording. Also uses the camera of the smartphone for video recording. Then data analyzed to detect rash driving events. The recommended range of accelerating or braking is −3 g to +3 g
Johnson at ref[3] developed a system that can detect only aggressive events. Safe changes (for example non aggressive lane change) are not being detected because they do not exert enough force or rotation to the device. If the system detect that a driver's style becomes aggressive provides audible feedback.

Dai at ref[4] The system can detect and alert the drivers about 3 categories of drunk driving behaviors. The first category is related to lane position maintenance problems like weaving, driving, swerving and turning abruptly. The second category is related to speed control problems like suddenly accelerating or decelerating, braking erratically and stopping inappropriately. The last category is related to judgment and vigilance problems like driving with tires on center or lane marker, driving without headlights at night and slow response to traffic signals.

Eren at ref[5] ,used endpoint detection algorithm which helped to estimate the temporal range of the signal (detecting events like maneuvers). If they detect an event. They use the Warping algorithm (DTW algorithm) to identify the type of the event overcoming different temporal durations of the same event across different drivers. In the end they apply Bayes Classification to identify if the event was a safe event or a risky event. In the experiment analyzed driving patterns of 15 different drivers.

Nidhi kalra at ref[6] suggested the recommended range of normal braking (in negative direction, y-axis) and sudden braking (in negative direction, y-axis) as −1 g to −3 g and < −3 g respectively. The recommended range of sudden forward acceleration (in positive direction, y-axis) is >3 g. The recommended range of left turn (in negative direction, x-axis) and right turn (in positive direction, x-axis) is <−1 g and >1 g respectively. Also the recommended range of pothole (change in value from positive to negative, z-axis), bump (change in value from positive to negative, z-axis) and rough road (change in value from positive to negative, z-axis) is ±1.5 g.

Jin Hyuk Hong at ref[7] proposed an in-vehicle sensing platform that uses android smartphone's sensors and 2 other externals sensors, a Bluetooth –based on board diagnostic reader (OBD2) and an internal measurement Unit (IMU) to predictaggressive driving style.

Johannes Paefgen at ref[8] implemented iOS application of the iPhone collects data from accelerometer, gyroscope and GPS sensors and then data transported to calibration component, determining the 3-dimensional orientation of the device in the vehicle. The calibration functional component contributes to the reliability and the accuracy of measurements. Then data sensors and calibrated parameters transported to trip recording component. During the trip recording sensor data is processed in a data-sampling component to detect critical driving event in real time.

These are the major factors for accident

a) Speed of the vehicle
b) Hard acceleration and sudden brakes
c) Turning angle during lane change and left/right turn
d) Weather conditions
e) Distracted driver (sleepiness, reckless)
f) Bad driving behavior of nearby drivers

Following Factors were used by us in Analysis

a) Speed and speed limit of the vehicle
b) Acceleration
c) Sharp turns and lane changes harshly.

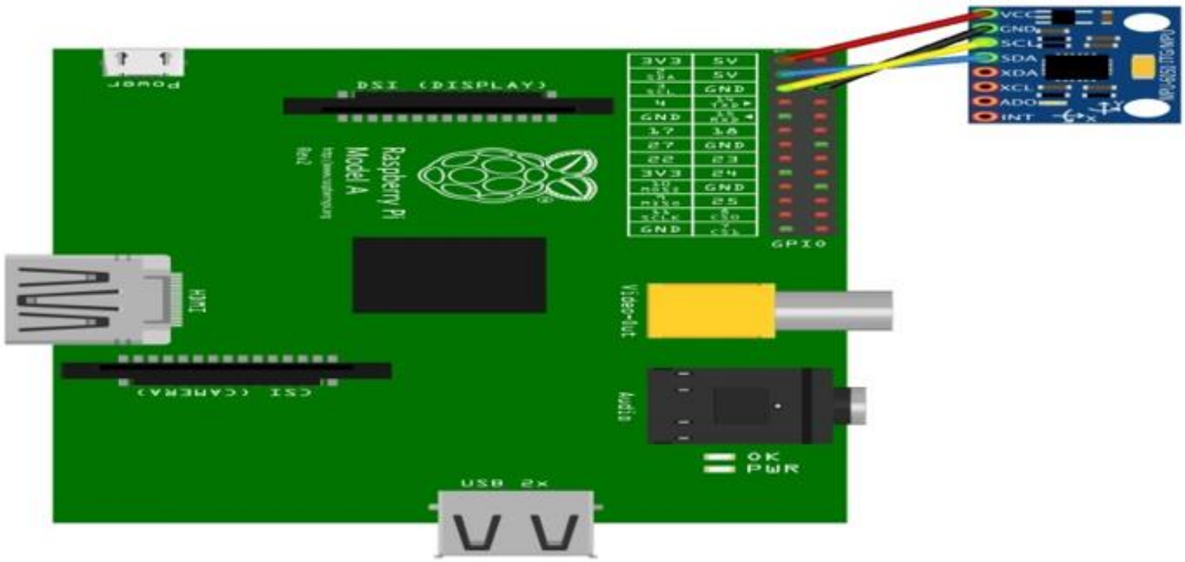
System Model

Hardware used

MPU6050 in which accelerometer and gyroscope were present

Accelerometer: An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. We obtain these values in m/s 2 in x, y, and z direction.

Gyroscope: Gyroscope detects the current orientation of the device, or changes in the orientation of the device. Orientation can be computed from the angular rate that is detected by the gyroscope. It basically works on the principle of angular momentum and it is expressed in rad/s on 3-axis, and denoted by pitch, yaw and roll.



Data preprocessing

The accelerometer had biasness at each axis. This biasness was corrected by placing accelerometer’s each axis perpendicular to a leveled surface and the readings were taken. Averaging of those readings were done and the error was corrected with respect to the actual gravitational acceleration which we got at that particular surface with the help of accelerometer in our mobiles.

Biasness in each axis was:
accel_data['z']=accel_data['z']-2.65
accel_data['x']=accel_data['x']-0.31
accel_data['y']=accel_data['y']-0.16

Data Collection

• Acceleration/Deceleration – determined using data obtained through accelerometer by observing change in acceleration in x-axis due to bending of bike.

• Location in form of longitude/latitude- determined using WIFI-geolocation with help of Google’s API.

•Speed - Calculated with the help of difference between two coordinates recorded at an interval of one minute. Although the long interval might not be able to detect irregularities, combining it with accelerometer reading will provide some stability helping us detect sudden acceleration and deceleration.

Data analysis

• Data from the sensor fusion to determine the accelerating behavior of a driver helps in determining whether the driver reduces his speed or accelerated too harshly or applies brakes too often.

• Data from the sensor fusion to determine the turn and lane changes helps in determining whether drive made a sharp turn/lane change without lowering the speed in turns as well as the angle in which they made such lane change and turn.

• Speed of the vehicle is used to determine if the vehicle is under or over the speed limit. The speed and limit of the road is essential to categorize whether the driver is driving safely or over-speeding.

• Longitude and latitude that we got from Google API based on WIFI positioning system has an accuracy of around 20 meters.

Sensor Fusion

Based upon readings that we got form our testing, we found out that if acceleration value of z axis is greater than -5.6 m/s^2 and any one of following conditions happen

1)If y axis's value is in between -8.5 m/s^2 and -11.6 m/s^2

2)If acceleration in y axis is between 8.5 m/s^2 and 11 m/s^2.

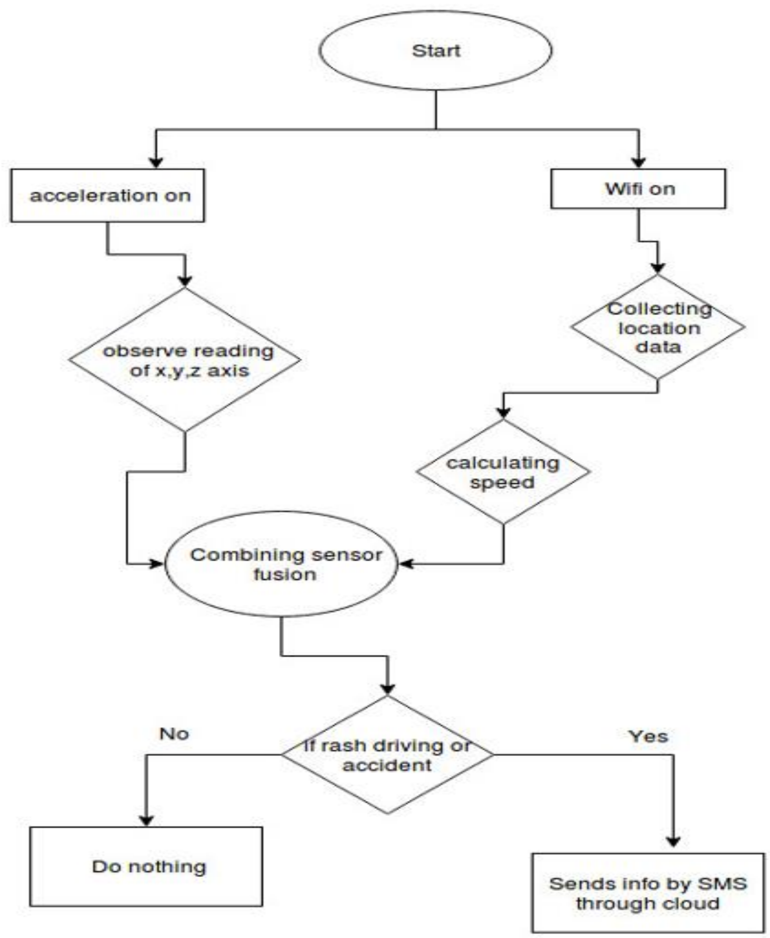
3)If acceleration in x axis is between -11.6 m/s^2 and -8.5 m/s^2.

4)If acceleration in x axis is between 8.5 m/s^2 and 11.6 m/s^2.

In above cases, we can simply conclude that there is an accident and for rash driving the acceleration in x axis should either be greater than 3.1 m/s^2 or less than -3.1m/s^2. The rash driving parameters can further be combined with speed data which will help in giving better results as compared to using x acceleration alone.

We took four speed sp1=30, sp2=20 ,sp3=10 and sp0=40 for our experiment and we can give different results in each case. For example let's suppose speed of vehicle is sp3 which is very low, in this case even if there is an acceleration of greater than 3.1 m/s^2, our model shouldn't describe this as rash driving warning.

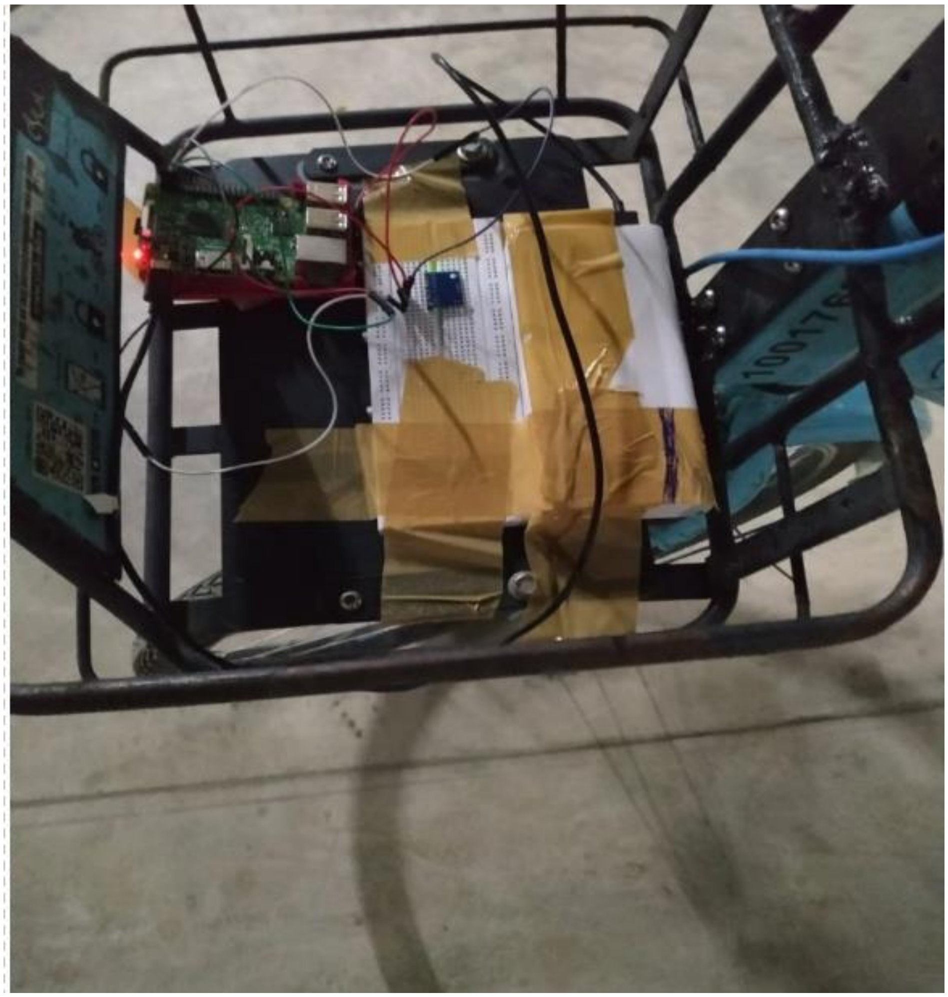
These data were collected from various research papers and were adjusted accordingly with the testing result that we performed.



Conclusion

We tried to analyze the behavior of driver by notifying through warning on already saved contact numbers, if in case he tries to drive the vehicle recklessly and do rash driving/ over speeding. We also added a notification system that if in case some accident happens, a message can be sent (without GPS) to nearest hospital based on location given by WIFI positioning system as GPS uses lot of energy.

We hope this model will help in reducing the number of accidents in India and can also be used by parents for monitoring their children.



Future Work

Lot of things can be added in this model to apply this at greater level. First thing that we were not able to apply because of shortage of time is the detection of holes/pits in advance and notifying the driver about their exact location.

This model gives location based on WIFI positioning system which can only be used for significant changes in position. IN future, we can use something which will help us to determine small changes in location.

Here we are sending the message to already save number. This can be sent dynamically to nearest hospital based on location.

Accident also depends upon the nearest vehicle driver pattern. Suppose if someone is driving. Nearby driver behavior can also be incorporated in warning notification system to avoid the possibility of accident.

Code

https://github.com/rajatnituk/Accident-detection-and-prevention-system-.git

Video links: (Testing)

Accident test

https://drive.google.com/file/d/12r1fG1G1qZ_aVz7j5eyVoAEeIMDZ1076/view?usp=sharing

Sharp turn test

https://drive.google.com/file/d/1iRLTk7Rf7uQ-XZRiK8Wd06_0H6NUtk1l/view?usp=sharing

Speed test

https://drive.google.com/file/d/1FcePajlIDzVIprrmpm13eEGTZowPnacc/view?usp=sharing

References

1) Fazeen, M., Gozick, B., Dantu, R., Bhukhiya, M., Gonzalez, M.C.: Safe Driving Using Mobile Phones. In: IEEE Transactions on Intelligent Transportation Systems (2012)

2) Chigurupa, S., Polavarap, S., Kancherla,Y., Nikhath, K.A.: Integrated Computing System for measuring Driver Safety Index. In: International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 2 (2012)

3)Johnson, D.A., Trivedi, M.M.: Driving Style Recognition using a smartphone as a sensor platform. In: IEEE 14th International Conference on Intelligent Transportation system,October (2011)

4)Dai, J., Tang, J., Bai, X., Shen, Z., Xuan, D.: Mobile phone based drunk driving detection. Proc. 4th Int. Conf. Pervasive Health NO PERMISSIONS, pp. 18 (2010)

5) H. Eren, S. Makinist, E. Akin, A. Yilmaz: Estimating Driving Behavior by a smartphone. In:Intelligent Vehicles Symposium, Alcala de Henares, Span, June (2012)

6) Nidhi Kalra, Gunjan Chugh, Divya Bansal: Analyzing Driving and Road Events via Smartphone. In: International Journal Of Computer Applications No. 12, July 2014

7) Jin-Hyuk Hong, Ben Margines, Anind K. Dey: A smartphone-based sensing platform to Model Aggressive Driving Behaviors. In: CHI, Toronto, Canada (2014)

8) Johannes Paefgen, Flavius Kehr, Yudan Zhai, Florian Michahelles: Driving Behavior Analysis with Smartphones: Insights from a controlled Field Study. In: MUM’12, ULM, Germany (2012)