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Driving Assistance and Accident Monitoring Using Three Axis Accelerometer and GPS System

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Abstract: ***While travelling on highway we are unaware of the road conditions. Mobile phones today are equipped with inbuilt sensors that give safety enhancement to the drivers on road. The three axis accelerometer and a GPS tracking system of smart phone can give assistance to the driver while travelling. In this paper the emphasis is on safety with advanced driver assistance system (ADAS's). The three axis accelerometer of an Android based smart phone is used to record and analyze various and external road conditions that could be hazardous to the health of the driver and the automobile. With analysis and alerts of these factors, we can increase a driver's overall awareness to maximize safety. Google map is used to create road condition using GPS coordinates. Android operating system in smart phone is used for analyzing the road conditions for safety. Once the data is available to the user, he can efficiently and safely drive the vehicle. In addition a device similar to black box is kept in a vehicle that monitors if the accidents occur. This device consists of GPS, collision sensor as a switch, GSM and a microcontroller unit. This device will send a message to the concerned person about the event of the accident.***

Keywords: Three-axis Accelerometer, GPS system, GSM module, road condition, Smart phone

1. Introduction

While travelling we are focused on arriving at our destination as early as possible. But we are not aware of the factors such as bumps, potholes, lane change or any hazardous road conditions that can cause sudden vehicle fall. The easiest method is to do the manual analysis of the road conditions and upload on central serve, but this method requires strong participation of the users and manual image analysis which requires expensive equipment's and can limit the accessibility [5]. Smart phone that is embedded with sensors like three axis accelerometer, GPS tracking system, cameras, microphones etc. [3] with this assistance can be provided to the driver with embedded sensing device without vehicle communication system requirement. A feature selection algorithm is used to get the knowledge of the road features and predict the road conditions [6]. Using the technology used in a smart phone, it can be used to analyze and provide assistance to the driver on sudden and hazardous situations that arise from vehicle fall and environmental factors [1].This paper describes the road irregularity detection and evaluation using positive data rate with real data world using Android OS based smart phone. Evaluation is carried out in Pune city with promising results. The entire road condition detection data is sent to the web server and this data is used by the user while travelling. This will also help the other person who is unaware of the road condition. In addition to providing assistance to the driver a black box device will be developed that tracks the vehicle fall and monitors the accident. [2]The fall detection or the accident alarm will save the life on time by giving medical treatment.

2. System Description

In today's life we are not always aware of all the dangerous conditions that are experienced while operating an automobile. Factors such as sudden vehicle fall and hazardous road conditions such as bumps, potholes etc. which often contribute to accidents of vehicles. So the automated approach for detecting potholes or bumps with fewer errors that is the use of embedded sensing devices or smart phones. Due to tremendous growth in smartphones embedded with numerous sensors such as accelerometers, Global Positioning Systems (GPSs), multiple microphones, and even cameras [3], the scope of sensor networks has expanded into many application domains such as intelligent transportation systems that can provide users with new functionalities previously unheard of. Car manufacturers are focused on passive approach, for example airbags, seat belts, and antilock brakes, lane departure warning system and collision avoidance systems. With more than 10 million car accidents reported on highway car manufacturers have shifted their focus of a passive approach manufactured with sensors. But it is hard to find in lower priced economical vehicles as they are not cheap add-ons. Since external sensors ultimately add onto the cost of a vehicle initially and cannot be afforded or upgraded. So we target a mobile smartphone as an alternative device that can assist the driver and compliment any existing active safety features. Given its accessibility and portability, the smartphone can bring a driver assist to any vehicle without regard for on-vehicle communication system requirement.

With this as our motivation we envision a cheap and convenient mobile device that is able to analyze and advise the driver on sudden and harmful situations that arise from vehicle fall and environmental factors. In addition a system is develop that makes use of accelerometer to implement a fall monitor. Accident in public is a major problem in many countries and quick assistance is not reached to the people who got the accident. Intelligence schemes [2] such as fall or accident detection with tracking system has been devised to notify the accident to the related people. In this work a device similar to wireless black box using GPS system along with GSM module is developed for accident monitoring. This paper presents a method for road flow map using the data received from the GPS.

2.2. System Overview

Step 1- start
Step 2 - initialize all the parameters
initialize x=left /right
y=Acceleration/breaking
z= up/down vibrations
Step 3 - read the values of all the parameters of Accelerometer using default period
Step 4 - check whether all the parameters are read or not
if yes go to step 5
if no go to step 3 again
Step 5 - Get GPS location
if read go to step 6
if No go to step 5
Step 6 - End.

2.3 Block Diagram Description

The application is to collect the information of road condition and send the information back to the user through web server. The block diagram of the system is as shown in the Fig 1.The system involves different features collected by three axis accelerometer, GPS location detected by smart phone that is given to the web service. According to [3] the system is used in cars to identify the fatigued surface on the road. Similarly hospital, food mall, car service center can also be detected by GPS and XML which will be helpful to the user while travelling on road. It will give the latitude – longitude coordinates and also the exact location while travelling. The user will give the exact source and destination to the web server, in return the server will send the proper road anomalies giving proper assistance and guidance for safety. The main idea of [1] [4] is to find the road anomalies and mapping of the road conditions. Once the reorientation [1] [7] of the axis of the phone is done the accelerometer reading is estimated to detect the road conditions. The table 1 gives the analysis of the axis. As shown in Fig2.The Y- axis shows that the vehicle is in motion. The X-axis shows left or right change of the vehicle that is the lane change. The Z – axis shows the vibration that means it detects the bumps or the pot holes. When a vehicle experiences a bump, it ascends onto the bump, resulting in a quick rise or spike in the value of the z-axis. This also results in a subsequent increase in X-axis, depending on bump formation. At high speeds, the spike in the value of the z-axis is very prominent. However, for low speeds, this rise is not as obvious but still leaves an apparent impact.

Table 1: Significance of Three Axis Accelerometer

Axis	Direction	Driving condition
X – axis	Left/right	Change in lane
Y – axis	Front/Back	Acceleration
Z – axis	Up/Down	Vibration

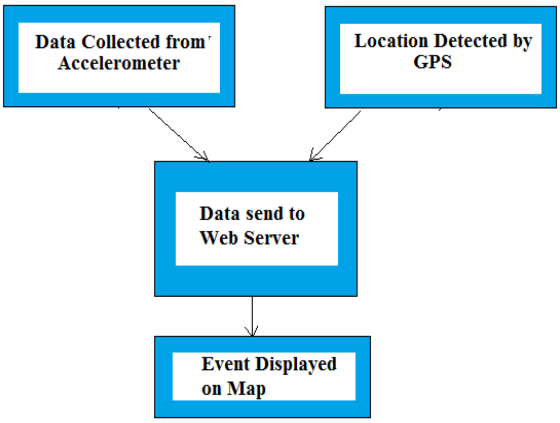

Figure 1: Block Diagram of System Overview

2.4 Technical Specifications

There are some technical requirements that are to be considered as suggested by the author [5]

1) Event should be detected by the system in real time.
2) Android OS based Smartphone should be use with accelerometer sensors.
3) The smart phone used should be able to perform communication task at quality level.
4) Detection of road condition should be done by five to six vehicles.

2.5 Feature Selection Algorithm

The Feature Selection Algorithm [6] is a machine learning algorithm. According to this algorithm a training data set will be taken. A data set will be taken and the initial value will be X with n features. Each set will have different features and the final predicted data set will be the union of all the features. The overview of the algorithm is as shown in Fig.3.

- Step 1 - Let X be the training data set and Ω be the initial set of n features
- Step 2 - Relabel data in X with freeway samples as "1" and all Others as "0." Denote this training data set as X1.Select the best features from Ω that can classify all the freeway data against all other data in X1.
- Denote this feature set as $\Omega1$.
- Step 3- Relabel data in X with freeway ramp samples as "1 and all others as "0." Denote this training data set as X2. Select the best features from Ω that are not in $\Omega1$and that can classify all the freeway ramp data against all other data in X2. Denote this feature set as $\Omega2$.
- Step 4- Relabel data in X with arterial data samples as "1" and all others as "0." Denote this training data set as X3. Select the features that are not in $\Omega1 \cup \Omega2$ and that can best classify all the arterial data against all other data in X3. Denote this feature set as $\Omega3$.
- Step 5- Relabel data in X with local roadway data samples as "1" and all others as "0." Denote this training data set as X4. Select the features that are not in $\Omega1 \cup \Omega2 \cup \Omega3$ and that can best classify all the local roadway data against all others in X4. Denote this feature set as $\Omega4$.
- Step 6 - Output feature set $\Omega new = \Omega 1 \cup \Omega2 \cup \Omega3 \cup \Omega4$

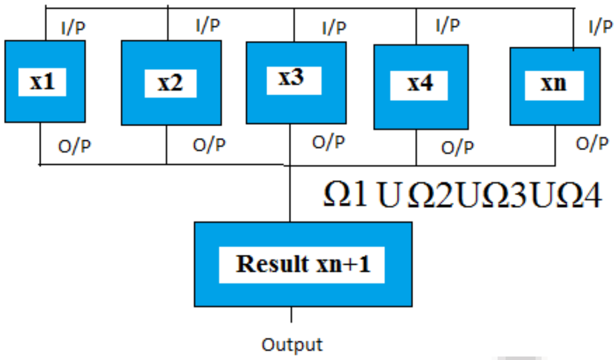

Figure 2: Overview of Feature Selection Algorithm

3. System Description of Monitoring the Accidents

Overview of monitoring the accidents in shown in Fig.3. The device will be classified as linear fall and non-linear fall. The nonlinear fall is free falling without external force and linear fall is due to the external force that is due to the collision of the vehicle. When the external force collides the vehicle, it will send a short message to the relatives indicating that the event has occurred and the person in the vehicle requires medical help. The fig.4 shows the block diagram of monitoring the accident. System is like a black box consisting of switch indicating a collision sensor, a microcontroller unit. The signal from the microcontroller unit will be given to the smart phone. The GPS module of the smart phone will give [8] the exact location of the accident and the GSM network will send a short message to the relatives about the event of accident.

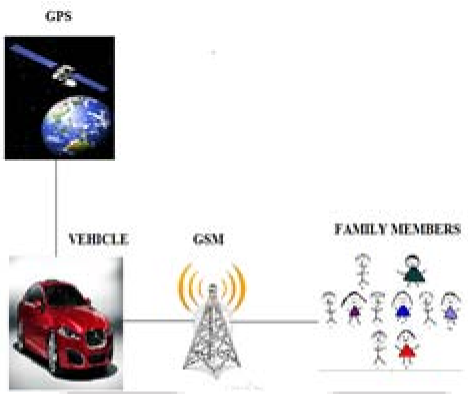

Figure 3: System Overview of Monitoring the Accident

The main purpose of the device [8] is to decrease the death rate and record the information of the vehicle. The smart phone will transmit all the data through SMS to other mobile. Hence a short message from the wireless device using GSM and GPS tracking device that will give the exact geographical location (latitude and longitude) and the area where the accident has occurred.

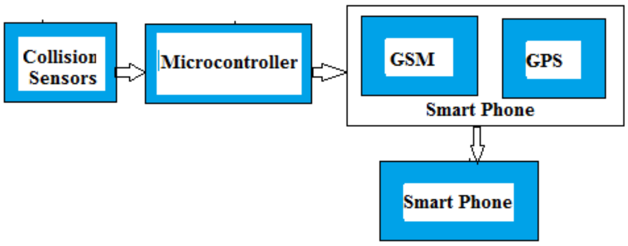

Figure 4: Block Diagram of Monitoring the Accident

4. Experimental Setup

Our device, which is a mobile smartphone, contains GPS, microphones, and an accelerometer offering flexibility in methodology and user implementation. Encouraging results in identifying numerous road anomalies and sudden driving maneuvers allow for our system to evaluate an entire road's condition and help advice drivers on unsafe characteristics, respectively, both of which are distinguishable factors that can determine safety on the road. Using a mobile phone for these purposes creates numerous variables that must be accounted for us. Measurements can be misleading in certain situations so Phone location and orientation inside the car should be configured to achieve accurate measurements. Providing quantitative data can help define a baseline in these instances. All data recognized by the mobile is stored on the phone that the user has full control over. . For the driver to recognize these safety factors, we utilize audio feedback. This feature is easily implemented using Android application programming interfaces, with specification options ranging from audio level, speech rate, and language selection. We factor in all of these ideas during our measurement analysis to provide a secure and accurate technique that is most applicable for a wide range of drivers and vehicles on the road. The app created is sent to the mobile with the server IP address. When the user uses this app, it connected to the user for road information.

4.1 Device used

The device used is an Android-based smartphone: Samsung Grand. Version 4.1.2 This phone made it relatively easy to acquire data to be thoroughly analyzed. Given its mobility and rise in popularity the past few years, a smartphone-based measuring device makes these findings unique and applicable for future implementations. The phone contains a Bosch BMA150 three-axis accelerometer that is capable of detecting multiple motions triggered by a vehicle. It has a sensitivity range of ±2g/4g/8g with a max axial refresh rate of 3300 Hz. Motions captured by the phone can be induced by a number of occurrences. For example, acceleration, braking, uneven road conditions, or any degree of change in direction performed by the automobile such as lane changes can be numerically distinguishable.

4.2 Lane change Detection

To detect lateral movements or lane changes performed by the driver, we look at the axis of the accelerometer. Using three axis accelerometer inside the phone it is possible to recognize lateral movements created by an automobile and

differentiate a left-lane change from a right-lane change and road anomalies. The following are the results.
1) If sX > 0 indicates left turn ahead
2) If sX < 0 indicates right turn ahead

4.3 Bump Detection

The embedded accelerometer is capable of detecting subtle or extreme vibrations experienced inside the vehicle. For example, vibrations experienced as jerks can be caused by potholes or damaged road or rough road. Speed bumps and potholes are two nuisances that plague drivers on the road every day. Using a smartphone, we look for these road characteristics using a combination of the x-axis and z-axis of the accelerometer. When a vehicle experiences a bump, it ascends onto the bump, resulting in a quick rise or spike in the value of the z-axis. This also results in a subsequent increase in the x-axis, depending on the bump formation. At high speeds, the spike in the value of the z-axis is very prominent. However, for low speeds, this rise is not as obvious but still leaves an apparent impact. To detect bumps at low speeds, we compensate with the x-axis and a dynamic threshold based on speed. If the difference between two consecutive acceleration values of the z-axis exceeds the threshold, as well as an x-axis threshold, a bump can be assumed Differentiating a pothole from a bump can be a difficult task using only a z-axis threshold.

1) If sY >0 indicates speed breaker ahead
2) If sY<0 indicates clear road ahead
3) If sZ > o indicates ahead
4) If sZ< 0 indicates pothole ahead

Maximum experimental data of the lane change bump along with the speed has been collected and sent to the server. When the driver travels on the road and clicks on the application it gets connected to the server and gets the required and sufficient data from the server and can drive safely. The snapshots have been attached.

4.4 Accident Monitoring

By expanding on work with accident monitoring along road anomaly detection. A device similar to black box is placed in the vehicle that can detect the accident. Since collision sensor is used in that device, the Bluetooth module of the device and the Bluetooth of mobile are paired. When the vehicle collides it send the signal to the microcontroller; ATmeg16. Since the Bluetooth is paired, it will send the signal from the driver's mobile to the immediate relatives. For accidental monitoring the threshold of three axis accelerometer is set to be x >10, y > 10, z > 10. If this condition occurs it indicates that the accident event has occurred. Poor road conditions can lead to accident.

4.5 Road Mapping

In addition to the accelerometer readings, we recorded GPS coordinates at the time when the road anomalies occurred. We take the accelerometer value for single GPS value and denote the accelerometer value as a segment of a particular area. We have used the threshold value for x , y , z as 1. Google map give destination track along with GPS coordinates and XML script. The XML script gives the exact locality and sub locality.

5. Results

Table 2: Result table

Lat	Long	speed	x	Y	Z
18.503	73.846	0.263	0.506	0.08	10.562
18.503	73.846	0.562	2.478	0.734	3.820
18.503	73.846	0.725	3.334	0.923	2.234
18.503	73.846	3.7345	3.719	1.456	8.213
18.503	73.846	5.8180	-5.766	8.309	1.239
18.503	73.846	9.9156	2.320	9.123	1.458

The evaluation and experiment is successfully performed in Pune city. As shown in the table the latitude and longitude and speed values are shown. The positive value in x indicates that the x value is greater than 0and it is a left turn and the negative values in x indicates that it is less than 0 and it is a right turn, y values shows that the vehicle is in motion and the increase in z shows that there is a bump on that event. The first snapshot result shows two options one is start road assistance. When that application is clicked the server gets the information that the user wants the road data anomalies. In reply the as shown in the second snapshot server sends the information to the user that the road assist is available and is ready to assist. Edit Emergency Contact Details, in this option the emergency contact details have been loaded, in case of collision occurs the message will be sent to the concerned person

6. Conclusions and Future Scope

Using a smart phone, some innovative applications that are integrated inside an automobile can evaluate the overall road conditions including bumps, potholes, rough road, uneven road, and hospital and food mall. Along with these findings, an analysis of driver behavior for safe driving such as vehicle accelerations and lane changes is identified, which can advise drivers who are unaware of the risks they are potentially creating for themselves and neighboring vehicles. Along with this a GPS tracking system can be developed for vehicle accidental monitoring. The system detects accident when the vehicle collides. After accident is detected, short alarm message data that is alarm message and position of accident will be sent via GSM network. Thus our overall work will give safety for the driver inside the vehicle. The accident occurred can be captured if a camera is placed in the black box. So that the relatives can understand the reason of collision and inform to the police

7. Acknowledgement

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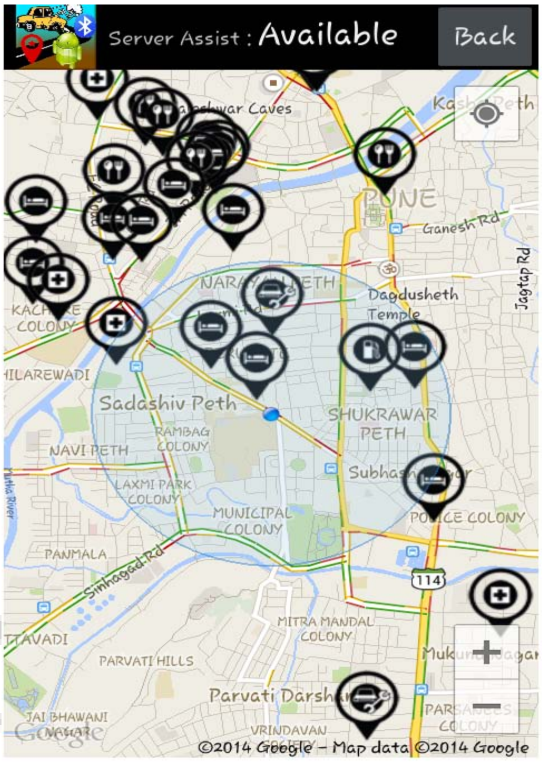
8. Final Images on Mobile phone

1) Final Application GUI image as seen on the mobile phone.

2) Accelerometer and “GPS Tracking for Accidental Monitoring of Vehicles” Proceedings of the location image as assisted by the server



References

[1] Mohamed Fazeen, Brandon Gozick, Ram Dantu, Moiz Bhukhiya, and Marta C.González, “Safe Driving Using Mobile Phones” IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 13, NO. 3, pp.1462-1468, SEPTEMBER 2012.

[2] N. Watthanawisuth, T. Lomas and A.Tuantranont, “Wireless Black Box Using MEMS Accelerometer and “GPS Tracking for Accidental Monitoring of Vehicles” Proceedings of the location image as assisted by the server IEEEE MBS International Conference on Biomedical and Health Informatics, pp.847- 850, Jan 2012.

[3] P. Mohan, V. N. Padmanabhan, and R. Ramjee, “Nericell: Richmonitoring of road and traffic conditions using mobile smartphones,” in Proc. ACM SenSys, Raleigh, NC, Nov. 2008.

[4] Gabriel Agamennoni, Member, IEEE, Juan I. Nieto, Member, IEEE, and Eduardo M. Nebot, Senior Member, IEEE, “Robust Inference of Principal Road Paths for Intelligent Transportation Systems”, IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 12, NO. 1, pp.298-308, MARCH 2011.

[5] Mendis.A; Digital Signal Process. Lab., Inst. of Electron. & Comput. Sci., Riga, Latvia, Strazdins.G, Zviedris.R, Kanonirs.C, “Real time pothole detection using Android smartphones with accelerometers” Distributed Computing in Sensor System and Workshops, IEEE CONFERENCE PUBLICATIONS, pp.1-6, June2011.

[6] Jungme Park, Zhihang Chen, Leonidas Kiliaris, Ming L. Kuang, M. Abdul Masrur, Senior Member, IEEE, Anthony M. Phillips, and Yi Lu Murphey, Senior Member, IEEE, “Intelligent Vehicle Power Control Based on Machine Learning of Optimal Control Parameters and

Prediction of Road Type and Traffic Congestion", IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 58, NO. 9, pp.4741-4765, NOVEMBER 2009.

[7] Bhaskar.R, Vankadhara.V, Raman.B, Kulkarni.P, "Wolverine: Traffic and road condition estimation Using smartphone sensors", IEEE CONFERENCE PUBLICATIONS

[8] Abdallah Kassem, Rabih Jabr, Ghady Salamouni, ZiadKhairallah Maalouf Department of Electrical and Computer Engineering, Notre Dame University, "Vehicle Black Box System", SysCon 2008 - IEEE International Systems Conference Montreal, Canada, pp.1-6, April 2008.

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