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Accident Prevention Alert System for Mobile Devices

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Abstract

Availability and accessibility to high-speed vehicles is very common. In this fast paced world, while teenagers own such vehicles to have fun & excitement, others use it to reach their destination faster. This sometimes results in dangerous driving and causes major accidents. To avoid this, a lot of research and developments made in this field and hence a lot of safety devices are implemented on modern vehicles. Some of these include the electronics stability program (ESP), secure tyre system(STS), anti-lock braking system(ABS), airbags and seat belts etc. But these are very expensive which comes with a cost. This hinders common access/usage to such safety systems. Vehicles manufactured with these sensors are hard to find in lower priced economical vehicles. Also there is lack of portability of such systems, to owner having more than one vehicle need to have such costly system separately installed in each vehicle.

So in this paper, we target mobile devices (not only smartphone)as an alternative device for ADASs that makes use of available sensors and can alert the driver while negligence driving.The proof of concept can done by developing an application in a mobile device that makes use of available following sensors, collect the data and analyze it to conclude on any danger and alert the driver.

Keywords: Mobile devices,Accident,Safe,Prevention,Android, Application

Introduction

With more than 1lakh road accidents reported in India each year, vehicle manufacturers have shifted their focus of a passive approach, e.g., airbags, seat belts, and antilock brakes, to more active by adding features associated with advanced driver-assistance systems (ADASs), e.g., lane departure warning system and collision avoidance systems.

However, vehicles manufactured with these sensors are hard to find in lower priced economical vehicles, as ADAS packages are not cheap add-ons. In addition, older vehicles might only have passive safety features since manufacturers only recently began to introduce an effective driver assist.

Also there is lack of portability of such systems, to owner having more than one vehicle need to have such costly system Separately installed in each vehicle. It multiplies into total cost, which cannot be afforded by common people.

Many factors of vehicle crashes are human factors. Most common causes of vehicle fatal crashes by human factors are as follows: riding a vehicle while under the influence of

alcohol; speeding; sudden braking or turning; failure to use defensive driving techniques; lack of basic riding skills; failure to use special precautions while driving.The most common of single-vehicle fatal crashes is the failure to negotiate with proper turning curves.

Increasing driver awareness about vehicle behavior is beneficial to everyone on the road. The way a vehicle is maneuvered on the road can influence how other drivers react as they habitually follow previous movements to potentially avoid an unforeseen road hazard.

Given its accessibility and portability, the mobile devices can bring a driver assist to any vehicle without regard for on-vehicle communication system requirements.

The proposed work in the Paper tells creating an application in a mobile device(Android) that makes use of available sensors in mobile, collect the data and analyzes it to conclude on any danger and alert the driver.

In recent years, there has been tremendous growth in smartphones embedded with numerous sensors such as accelerometers, Global Positioning Systems (GPSs), magnetometers, multiple microphones, and even cameras. The scope of sensor networks has expanded into many application domains.

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The Android platform is a software stack for mobile devices including an operating system, middleware and key applications.

Android is a mobile operating system based on a modified version of Linux kernel. Android widely used for other devices in present market, such as mini laptop, tablet pc. Android provides GUI SDK tools that allow developer to design the application GUI and write in the Java language.

Most Android-powered devices have built-in sensors that measure motion, orientation, and various environmental conditions. These sensors are capable of providing raw data with high precision and accuracy, and are useful if we want to monitor three-dimensional device movement or positioning, or we want to monitor changes in the ambient environment near a device.

The Android sensor framework lets you access many types of sensors. Some of these sensors are hardware-based and some are software-based. We can access these sensors and acquire raw sensor data by using the Android sensor framework. The sensor framework is part of the "*android.hardware*" package and includes the following classes and interfaces:

- ✓ *SensorManager*
- ✓ *Sensor*
- ✓ *SensorEvent*
- ✓ *SensorEventListener*

Usage of Sensors

Accelerometer: Accelerometer measures the acceleration force in m/s^2 that is applied to a device on all three physical axes (x, y, and z), including the force of gravity.

Accelerometers can be used to measure vibration on cars, machines, buildings, process control systems and safety installations.

Gyroscope: The gyroscope measures the rate or rotation in rad/s around a device's x, y, and z-axis.Gyroscope is used for measuring or maintaining orientation, based on the principles of angular momentum.

Compass: A compass is a navigational instrument that measures directions in a frame of reference that is stationary relative to the surface of the earth.

GPS: The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.

Proximity Sensor: A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

Proposed Work

The proposed work includes creating an application in a mobile device that makes use of available following sensors, collect the data and analyze it to conclude on any danger and alert the driver:

Bumpy Driving and Bad Road Condition – To detect bumpy driving, bad road condition, we utilized the x-axis and y-axis data from the accelerometer to measure the driver's direct control of the vehicle as they steer, accelerate, and apply the brakes. With the phone located on the center console, we recorded driving behaviors of acceleration and deceleration under safe and extreme conditions.

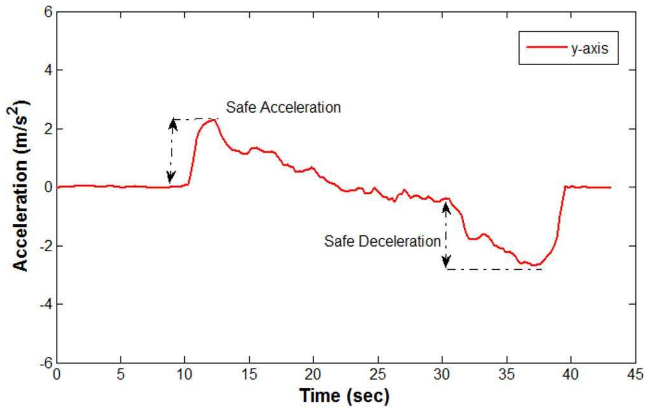


Figure 1: Safe Acceleration\deacceleration

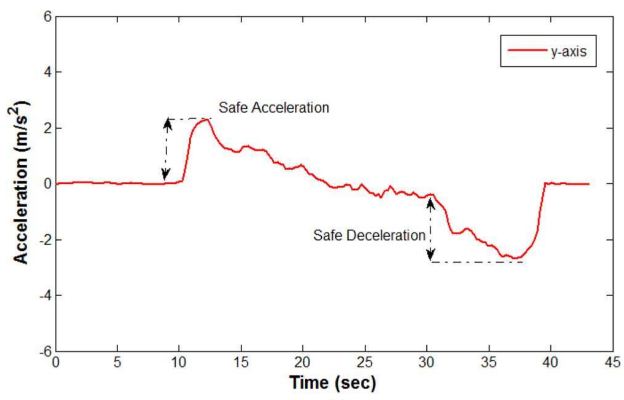
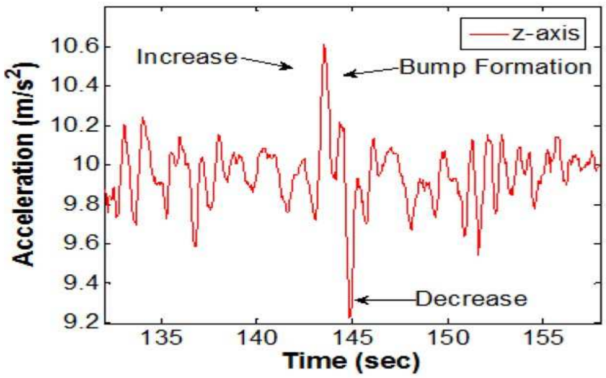


Figure 2: Extreme Acceleration\Deacceleration

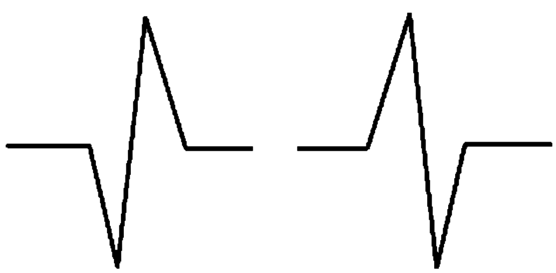


(a)

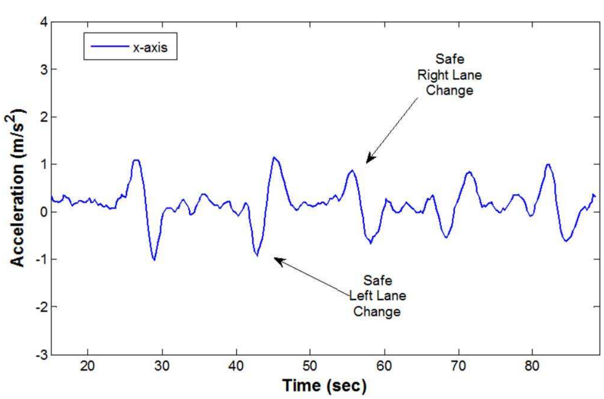
Figure 3: Bumpy Driving

Frequent Lane Change or Zigzag driving – To detect frequent lane change, zigzag driving performed by the driver, we look at the x-axis of the accelerometer. Using the previous phone orientation from the acceleration/deceleration patterns, it is possible to recognize lateral movements created by an automobile and differentiates a left-lane change from a right-lane change. Below Figure shows the formation of each maneuver.

(a) Left Lane Change
(b) Right Lane Change



(a) (b)



(a)

Figure 4: Safe Right\Left Lane Change

Over speeding– For the speed detection, we use GPS sensor to render vehicle position based on latitude and longitude. These values are good to calculate ground speed of the vehicle.Combine the z-axis and speed; we calculate the angle of lean θ using the laws of circular motion:

θ= arctan(s2/g*r), (1)

Where s is the forward speed in meter/second is, r is the radius in meters and g is the acceleration of gravity (a constant value 9.81).

The speed value obtained from the GPS sensor by using Location.getSpeed() that provide by Android API.

The actual calculation are from (2); where ∅s, λs, ∅f, λf are the latitude and longitude of two points and ▪ represent their differences and combine distance and time to get the accurate ground speed. This value not only detects the ground speed of the vehicle, but serious crashes. We assume there are serious crashes when the speed has a zero value with an extreme accelerometer and magnetometer values obtained.

D ▪ radians (arcos (sin∅ssin∅f▪ ▪ ▪ cos∅f▪ ▪ cos▪ ▪)) ,(2)

NOTE: We use 50 km/h, as a speed limit, and 12 feet for the standard road width to determine the maximal value lean angle for vehicle. Using (1), we obtain the maximal lean angle in turning is around 34°. Therefore, we use 34°is our maximal limit of turning behavior.

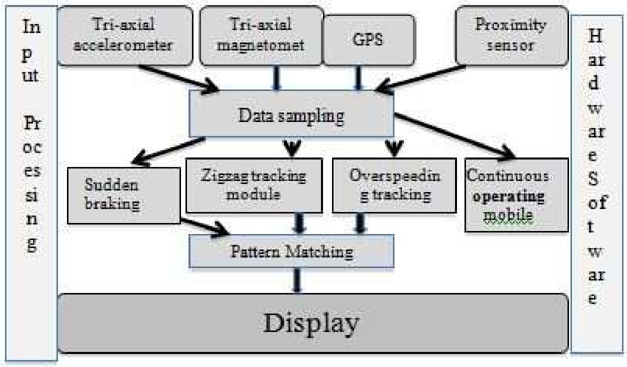
Proximity :To detect if driver is continuously operating mobile while driving.

System Design

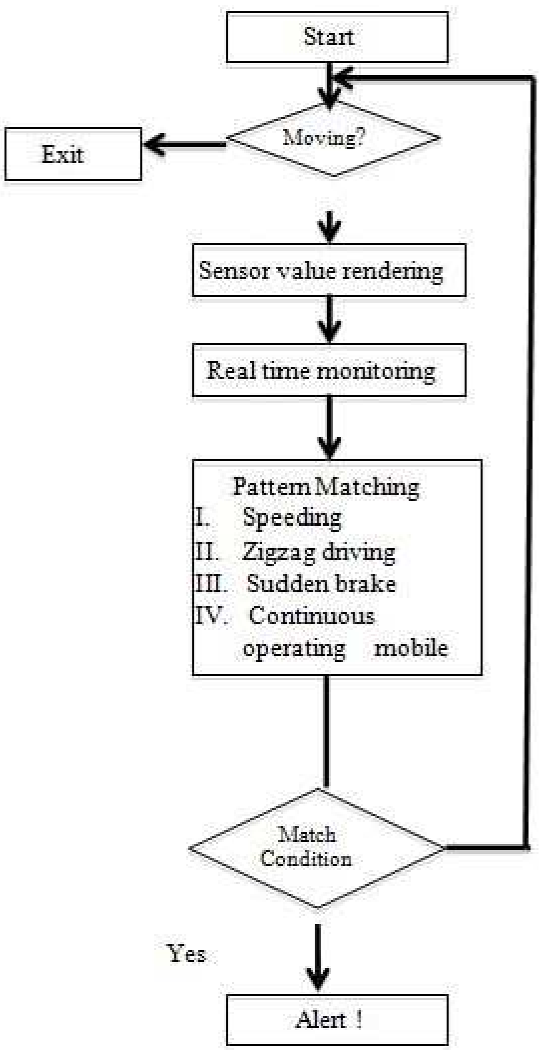
To achieve our proposed work, we present some patterns of high-risk vehicle maneuvers: over speed, high-speed sudden turning (zigzag driving or lane changing), or sudden breaking,operating mobile while driving.

The accident detection alert system is made up of three modules.

- The monitoring module,
- Pattern-matching module
- Alert module as describe in Above Figure



Implementation Design



The prototype implemented in Java that consists of 4 classes, which includes one Activity class, one Timer Task class and two View classes.

The main components of this prototype divided into five parts: user interface modules, sensor listener module, pattern matching module, traffic data recorder module and the notification module.

We use accelerometer sensor, magnetometer sensor, GPS sensor and proximity sensor, which are available in Android Smartphone to implement this system- monitoring module as presented in below figure.

Current prototype is deployed on operating system Android 4.1Jelly bean manufactured by Samsung.

Simulated Steps

- This system obtains the smartphone position before the monitoring is run and doing adjustment to get the accurate value.
- The pattern-matching module will keep reading the data obtained from sensor listener module.
- It will show an alert in the screen when the dangerous maneuvers are detected.
- This alert show a different color based on the dangerous level such as green color for normal condition, blue color for low risk condition, yellow color for high risk and red color for dangerous condition.
- The menu contains four options: start, stop, roll view, pitch view, and exit.

Result and Conclusions

In this paper, we present the system that provides solution to reduce accident rates in the urban area. Without any extra device, we use smartphone to develop dangerous detection system for driver. By attaching smartphone to vehicle, our system collect, record, and analyze all data from sensors to detect any high risk riding maneuvers.

The proposed work is an indicator mechanism, which just warns the driver for any danger. In future, we can integrate this to control the vehicle via control unit. This will allow the driver to be in safety limit while driving. A good example can be, not allowing the driver to speed the vechicle beyond 40km/hr when in city range.

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