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Driver Tracking System

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Abstract: Improving the way of driving will have a considerable impact, in terms of reducing costs such as fuel expenditure, insurance and wear and tear, whilst enhancing levels of operational efficiency, environmental responsibility and duty of care. Moreover, positive driving behavior can help achieve better public perception of your business and prevent costly damage to its corporate image. This new feature of all vehicles has numerous benefits. It helps determine not just the location of the car, but also about the whereabouts of the person in charge of the car.

Keywords: Driver, Risk, Tracking, Risk

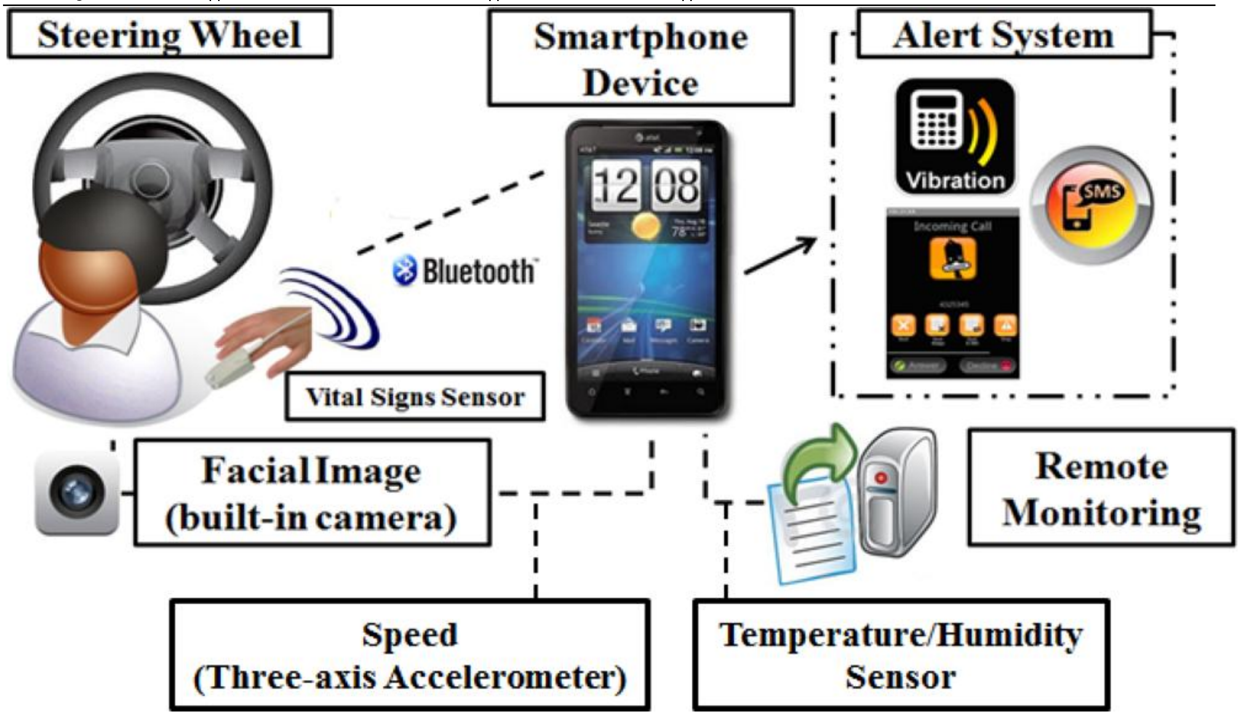
Introduction

Driving an automobile is a major sign of independence and mobility for people. Loss of driving privileges and resultant dependencies are greatly feared, and this population may continue to drive even if they are at high risk of crashes and accidents.As the elderly become aware of their growing limitations, they may repay by adopting behaviors that avoid high-risk situations such as nighttime or rush hour driving. The absence of such awareness, or denial of limitations, coupled with the need for driving independence, may lead to a delay in changing driving behaviors that put this population (and others) in danger.

Nowadays, the risk of driving a vehicle has reached its peak. Advancements in Technology have lead to availability of high speeds in vehicles, henceforth increasing the risk and possibility of accidents due to reckless driving. This is not just harmful to the public driving on the same road , but also to the driver. This has posed a need to monitor the driving of vehicles. Information such as rash driving and driving anomalies becomes crucial to two categories of people, first being the law enforcement officials, insurance companies and several other such organizations, and the second being the individual himself, that is if the driving is monitored and the vehicle state details are saved, it can help determine the condition of the vehicle while selling or buying the same.

Several key features for the driver monitor system (DMS) are:

- It is both robust and small enough to fit inside a standard vehicle without obscuring the driver’s view.
- System components are relatively inexpensive.
- It records key features under specific conditions such as night driving or driving in bad weather.
- It is able to store a week’s worth of data on the driver so that reasonable statistics could be constructed from the same.



Driver Monitoring System

Scope of Work

Work done till date have focused on a long term analysis of the monitored data to provide results. Further work on this field has either implemented simple or no processing of data gathered from the Engine Control Unit(ECU). Recent developments in this field of research has lead to the need for a real time analysis and an immediate alert system to avoid problems.

There are several ways in which one can monitor the driving, If the driver is not paying attention to the road ahead and a dangerous situation is detected, the system will warn the driver by flashing lights, warning sounds. If no action is taken, the vehicle will apply the brakes. This mainly focuses on aspects like vehicle tracking and fault detection.

Work done in this field uses several ways to monitor driving, one of which uses a TELEMATIC box, which was developed to monitor a vehicle's location, velocity and driver behavior and transmitting relevant data to a centralized web-server. Details such as acceleration, speed and tilt angle of the vehicle were measured and used to characterize driver behavior. But this system had its own Drawbacks like:

1. It used micro controller, in which you have to purchase a separate hardware unit ie TLEMATIC box.
2. It used to calculate only longitudinal acceleration. It was not concerned with lateral acceleration.
3. The location of vehicle was calculated manually via GPS tracker.[1]

Another advancement in Monitoring driver behavior was using an electronic unit which had two sensors [2], a GPS and accelerometer, and theoretical models, which include both acceleration and speed data, to detect and report erratic driving of a minibus taxis. Acceleration data was captured on the prototype's SD-card, and post-processed with MATLAB. Accidents due to drowsy drivers were prevented using eye blink sensors and an alert message would be sent to the driver.

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Applications of Driver Monitoring

Driver monitoring systems have been a part of almost all the high-end and latest cars. It can useful in several different ways. This system seems to be of more help to fleet owners that to stand alone owners. It becomes necessary for them to keep track of a number of vehicles. It is a tedious task to check on the behavior of each vehicle with traditional or manual methods. These automated arrangements have proven to be a one stop solution for the same.

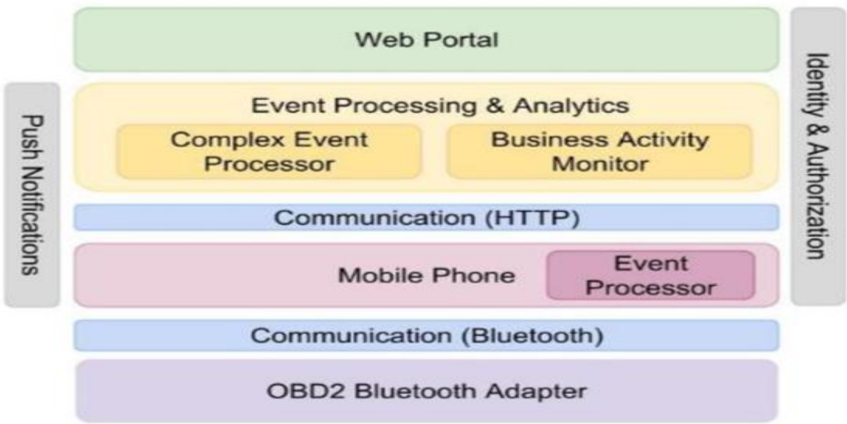
The primary need of detection of vehicle on time and when in need is accomplished here. Since these asset tracking devices use GPS tracking systems. It becomes easier for police officials to track down the thieved vehicle's location faster than usual.

Work Done

One way to achieve the driver monitoring is by using OBD, which stands for On Board diagnostics. It could simply be described as a standard which allows accessing the status of sensors of a vehicle via a port referred to as the OBD port where a few of those sensors can be stated as speed, engine rpm, coolant temperature, fuel rate and oxygen. OBD-II, being the latest version of OBD is implemented in almost all the vehicles which are manufactured lately. ELM-327 is a commonly available adapter to read data from OBD-II port.

This data is further sent to a mobile application running on the smart phone which is initially paired to the adapter via Bluetooth. Since cloud is the trending or the latest infrastructure that provides dynamically scalable and virtualized resources, it is also made use of as a component in driver monitoring. Information from the smart phone is finally forwarded to the back end cloud. This data is henceforth displayed for the driver himself to see and analyze. The drivers themselves are able to get the results through the Android app in the form of notifications. Alerts generated both in the back end as well as the app due to undesirable situations are sent to the drivers. Also results of long term analyses are displayed through a web interface.

Identifying driver patterns has also become a principal research area due to the high concern about fuel efficiency and safe driving. A solution to the problem of identifying driving patterns by using fuzzy logic is the base technique. There, the main focus has been on classifying the region a driver usually drives in, regions are further considered to be of five main categories such as stop-n-go, urban, suburban, rural, and highway. Driving pattern can uniquely define a driver, thus behaving as a biometric. There, it is explained that, what is unique for each driver is the pressure distribution with time on the accelerator/brake pedals. Hence deducted that acceleration pattern helps uniquely identify a driver.



Architecture

- **Web Portal:** It is used as a permanent way of displaying data. Data that is processed in the back end is then displayed on the web portal where both the driver can other organizations can look into the state of vehicle and driver's driving methods.
- **Event Processing & Analytics:** data received by the OBD-2 port should be either realized immediately, to alert the driver of anomalies on time, that is done by Complex Event Processor, Other way is to process and analyze data before displaying, which is done by Business Activity Monitor.
- **Communication:** The Protocol used to for sending information from the mobile phone to the back end cloud is HTTP.
- **Mobile Phone:** It contains an Event Processor which processes the data received and sends the required data for analysis to the cloud.
- **Bluetooth:** It is the device used for pairing mobile phone with the adapter.
- **OBD2 Bluetooth Adapter:** It is an adapter used to receive data from the sensors connected to the vehicle.

Reckless Driving:

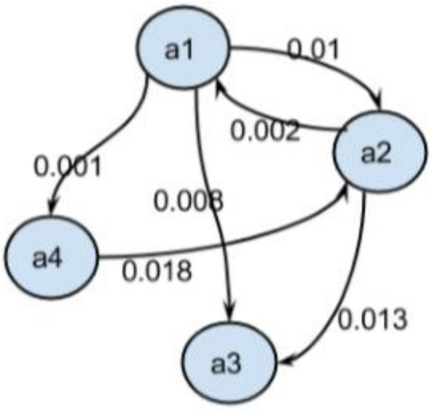
The speed of the vehicle can be read in real time from the OBD2 adapter. Since it is the acceleration/deceleration that is in concern, the Siddhi engine transforms speed streams into acceleration/deceleration streams by considering consecutive speed readings using the following Siddhi query. A sample Siddhi query is shown below.

```
from a=obd_speed,b=obd_speed
select b.speed-a.speed as speedDifference,
b.time - a.time  as timeInterval, b.time as timeStamp
insert into obd_accele_calculation;
```

Calculated acceleration/deceleration is compared with a threshold and detected whether it is reckless or not. The threshold used in the system, which is 4.5m/s2 is recommended by the American Association of State Highway and Transportation Officials. The binary number 1 and 0 are assigned to the points which have an acceleration/deceleration higher than the threshold and to normal points respectively. And the total number of 1's are counted over a predefined period of time (e.g., 2 minutes). The calculated number of counts are then classified according to the driving cycle (i.e., traffic, normal and highway) of the trip. The driving cycle is determined by the average speed of the vehicle throughout 10 minutes. The count, together with the class is sent to the back end server periodically as two separate streams for acceleration and deceleration.

Design

Driving Anomalies should be determined at real time and returned to the driver. Acceleration Transition Diagram can be constructed from the database available at the back end. It helps in determining the sudden acceleration/deceleration to avoid certain events from occurring. Once the acceleration drops below a certain threshold, an alert is sent to the driver.

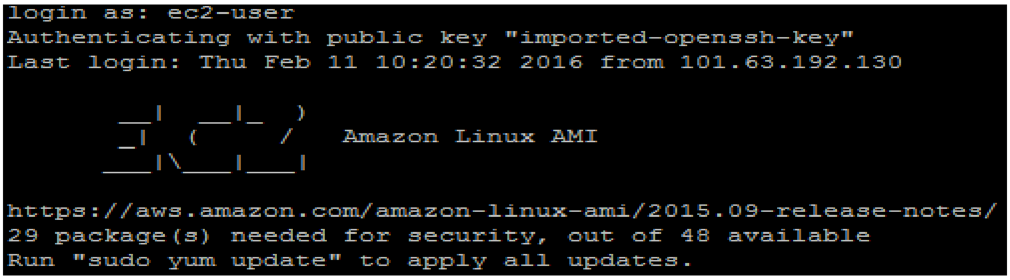


Acceleration Transition Diagram

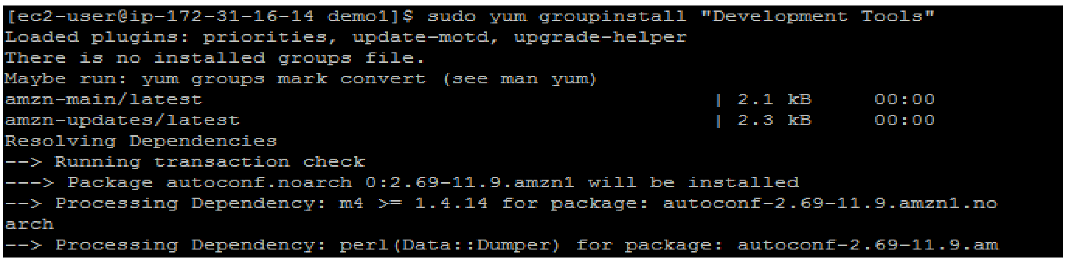
Implementation

The activity of using cloud as an infrastructure for processing the back end data is implemented here. A hands on , on the cloud provided by Amazon Web Services is shown. Amazon Web Services (AWS) is a secure cloud services platform, that offers compute power, database storage, content delivery and several other functionalities too.Initially an instance is launched for the same, either a Linux or a windows instance. Using putty and puttygen a secure communication is established using an SSH protocol and then the virtual server provided by AWS is used via puttygen. Sessions are saved for further use. In case a windows instance, and remote desktop file is used to access the cloud. A view of how working on cloud would be like along with the methodology involved in the same is demonstrated.

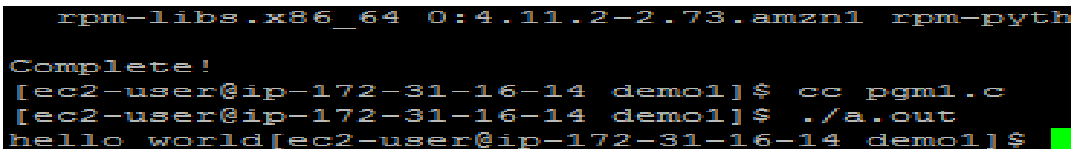
Linux instance of AWS



Logging into AWS Linux instance



Installing gcc compiler



Running a Linux Instance for executing a simple c program

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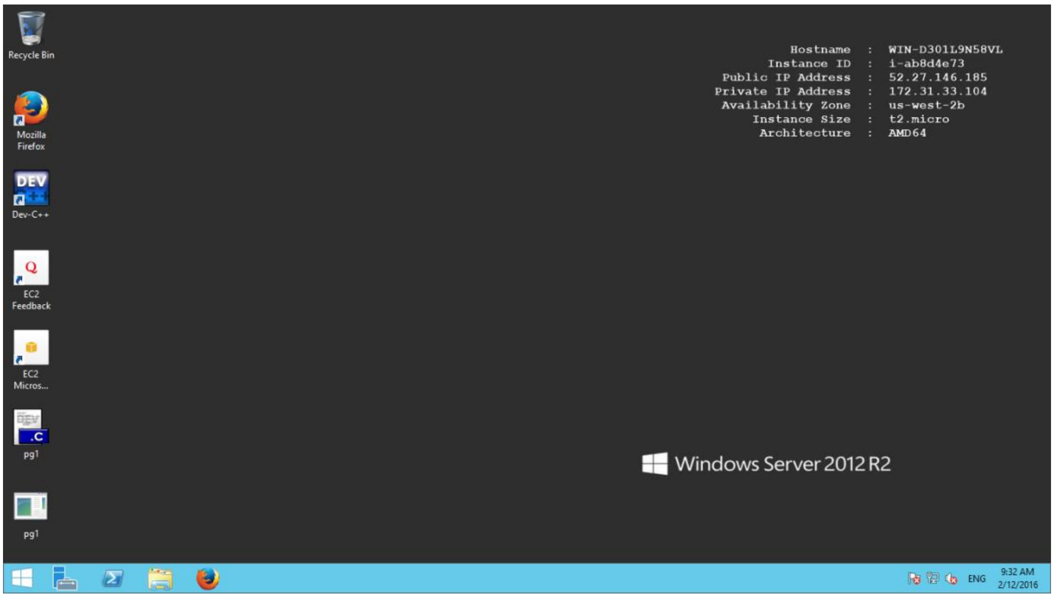
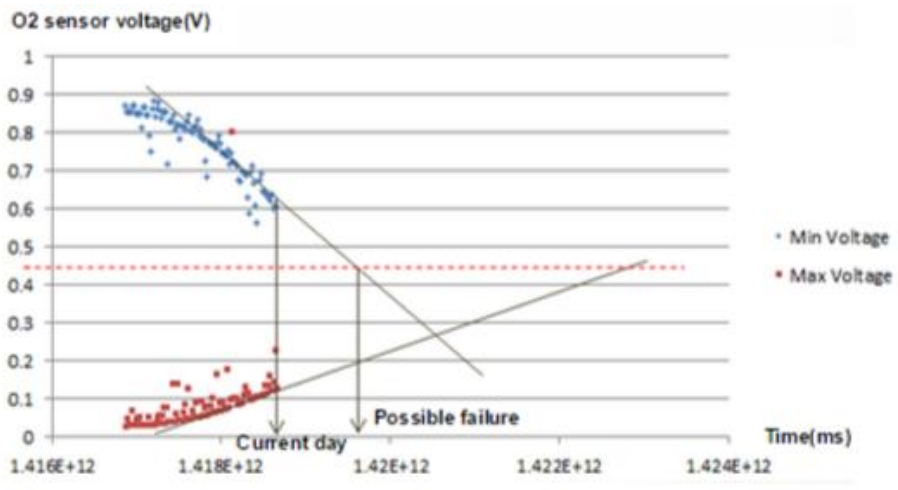


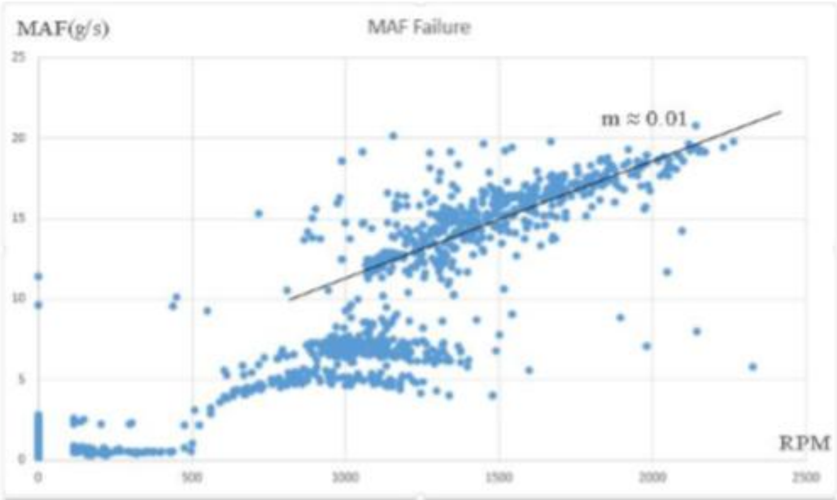
Desktop of Windows Instance of AWS

Results

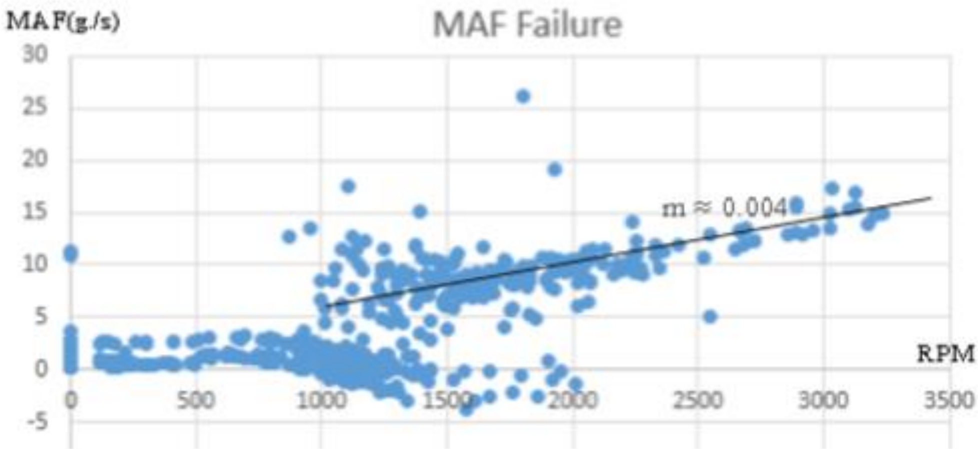
This active research field yields us an Android based app and the web interface which displays monitored data and analyzed results. App is built in such a way that it alerts the driver on time, in order to avoid accidents and anomalies.Web Portal is used to display information for user to identify. Bar graphs can be used to show Rapid acceleration counts and rapid deceleration counts which could provide an idea of his/her recklessness to the driver. Driving Anomaly test can be conducted for two users and matched upon too, when the drivers are on the same road, If the acceleration of one driver appears to be rising, while the others seems to be dropping, it indicates no harm.Oxygen Sensor Failure: It determines the amount of Oxygen left in the exhaust, which is used to balance fuel/air ratio. Its typical range lies between 0.1V to 0.9V. If any deviations an alert is sent to the driver. Similarly Mass Air Flow sensor failure can be determined to measure the amount of air entering the engine and calculate fuel delivery and spark timing.



Regression of max and min values for O2 sensors



Flow rate vs rpm in higher rpm for normal sensors



Flow rate vs rpm for faulty sensors

Conclusion

The main drawback of this system is its dependency on the data communication of the mobile phone. If the driver has not allowed data transmission on the mobile phone the system will not be useful. The same goes with carrying a smart phone. The proposed solution assumes that a driver possesses a smart phone which is capable of running an android app. A dedicated hardware device can be built in order to overcome this problem where, once the device is plugged into the OBD2 port, data will be uploaded to the remote servers autonomously. The current set of functionalities only consists of a limited number of feature which were identified as crucial. The architecture is built in such a way that new functionalities can be added whenever needed.

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