An approach to detect dangerous driving behavior through in Car system

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Abstract— In this paper, a scheme of moving-vehicles behavior detection based on accelerometer is proposed. Three-axis accelerometers are installed on vehicles to capture the moving car postures. A fuzzy interpretation system is developed to infer states of vehicle posture, such as normal driving, left/right turning, departure, accelerate, braking and bumping. Based on the appreciation of vehicle postures, the unsafe driving behaviors of car will be detected. In this paper, the strategy and development of hardware, vehicle stance measurement and dangerous driving behavior inferences are presented and realized. Additionally, a Window APP is developed to offer human machine interface. The system sends message to related user if dangerous driving behavior is detected. The noticed data is stored to cloud for further application.

Keywords— Vanet, Smartphone, Sensors.

I. INTRODUCTION

There was lot of researches related to driving safety presented in the past decade. According to a research report, there are 1 billion vehicles sold in 2014. Although car bring people the Convenience of mobile life. Bad driving atmosphere, jamming of traffic flow and lack of good vehicle maintenance threaten peoples' life and property.

Road traffic accidents occur frequently in our everyday life. Recent studies have shown that it is one of the biggest causes of death in many countries around the world [1]. One of the major causes is human factors where speeding is one of the biggest factors contributing the risks of road accidents [2].

In several nations different consultants have set up a call center where motorists and public transport users are able to report dangerous driving behavior and make a complaint .Outdated unsafe driving report scheme is usually carried Out by telephone calls, SMS, emails and websites in order to report or make a complaint regarding bad driving behavior. Latest findings from Google reveal that at least 14 countries around the world, such as the UK, USA and Australia, have more than 40% of their population on smartphones. To address the

aforementioned drawback in the lack of evidence Using the traditional call center approach for reportingdangerous driving, this paper proposes a novel methodology by using smartphones mainly due to their ability to collect, store and send data to be used as evidence in real-time while at the same time being easily accessible. A Vehicular Ad Hoc Network or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 m of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is generated. It is assessed that the first schemes that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. In order to detect dangerous driving behavior, we employ in this paper three-axis accelerometer is connected to vehicle to collect acceleration variations to derive the vehicle posture.

II. RELATED WORK

In recent times, there has been significant work in the field of road safety using portable devices such as mobile phones. Nericell [2] a system developed by Microsoft helps in the detection of bumps, vehicle braking etc. using multiple sensors such as GPS, accelerometer, microphone etc. Pothole Patrol [3], a system used for monitoring road conditions utilizes accelerometer and GPS for the same. . Dai et al. [4] proposed a technique using a mobile smartphone to detect various driving patterns of a drunk driver. A pattern recognition approach for characterizing drivers on the basis of their skills was presented by Zhang et al. [5] Mohamed Fazeen et al.[1] mentioned various factors that account to unsafe driving and demonstrated applications for evaluating a vehicle's condition based on these factors. Zhenguo Yi et al. [6] used the technique of clustering neural networks for road safety. This method first learn the historical data, after it is stable, it can be used to evaluate the road safety. University of California Berkeley's Mobile Millennium project uses GPS sensor to obtain information about vehicle location. Thereafter processing of data is taken place. Finally route information I sent back to the server [11].Volvo City Safety [12] is a system designed to prevent low speed rear end collisions by way of automatic braking. It utilizes an infrared sensor to monitor the area ahead of the vehicle when moving at speeds of 2-19 miles per hour. Lange et al. in his paper" Are you a Safe Driver" [13] differentiates between safe ad unsafe driving on the basis of sensors embedded in Google phone. Honda Collision Mitigation [14] system uses grill housed radar sensor which monitors the speed and distance. When the system detects the risk of a crash with vehicles in front, it will flash a warning light, tug the driver's seat belt and begin braking to lessen the severity of the collision. The presented work takes into account various factors leading to unsafe driving [1] and presents a technique for evaluating the driving condition using fuzzy logic. Fuzzy logic enables us to take into account every factor that could contribute to/unsafe driving and evaluates the driving condition based upon it. It follows a holistic approach.

Considering the contribution of each factor and not just deciding based upon a single factor like in Boolean logic. Thus the presented technique aims at creating a safe and secure environment by making the number of road accidents reduce to appreciable amount. A massive research effort is recently going in the direction of interfacing cars with smart phones to offer value added services to driver and passengers. Such an interest is motivated by the large popularity of smart phones and by the observation that vehicles can act as effective collectors of information from the surrounding environment. Indeed, modern cars are

endowed with several sensors forming an in-vehicle network, which provides kinematics information, automotive diagnostic services, etc. in this paper a smart phone-based platform is designed that exploits low-cost dedicated hardware to interact with sensors on board and in the vehicle surroundings[10]. This paper proposes a novel dangerous driving report system using a smart phone platform. By collecting a stream of data through built-in GPS receiver, a time sequence of pace profile can be obtained for a quantified voyage. A system is proposed to identify variance in speed profile in order to detect whether a van is racing. Along with the facility to aware travelers in real-time in the event of fast-moving, the projected scheme too records the journey data to be used as evidence when making a report [11]. Researchers have also studied other approaches In spite of several technical advances made in recent years by the automotive industry; the driver's behavior still influences significantly the overall fuel ingestion.

By the increase of smart phones acceptance there are also novel chances to raise the awareness to this issue. The key goal of this paper is to present a new smart phone application that will help drivers reduce the fuel consumption of their vehicles. This is proficient by using the smart phone's sensors and the vehicle state to detect the driving pattern and suggest new behaviors in real time that will lead to a more efficient driving experience [12], [13], and [14].

In this paper, the design and improvement of hardware, vehicle attitude dimension and hazardous driving behavior inferences are presented and realized. The system sends message to related user if dangerous driving behavior is detected [15].

In addition to image processing to identify dangerous behavior of vehicles, there were various approaches to solve this problem. More and more sensors are designed to detect the state of the vehicle. Inertial Navigation System (INS) is a typical approach in which a system of autonomous sensors such as three-axis accelerometer and gyroscope is constructed to obtain the position of the carrier, the speed and path of movement. It can be used to detect the driving path of the vehicle and to determine whether the vehicle has an unusual driving state. Because inertial navigation system sensors required a very high accuracy, the sensor is costly and makes the inertial navigation system not popular in the automotive market and only for high-intensity action detection.

Furthermore Smart phones natively support several radio interfaces, for example both Wi-Fi and 3G technologies, which could be also cooperatively used to improve data retrieval, as demonstrated in [16].

A smart phone-based solution has the additional benefit of a short-to-medium time-to-market compared to other ad hoc-designed technologies like Vehicular Ad hoc Networks(VANETs) that require time and the identification of a killer application [17] to adequately penetrate the car market.

In spite of numerous technical improvements made in recent years by the automotive industry, the driver's behavior still influences significantly the overall fuel consumption. With the rise of smart phones acceptance there are also new occasions to increase the cognizance to this issue. The main aim of this paper is to present a new smartphone application that will help drivers reduce the fuel consumption of their vehicles. This is proficient by using the smart phone's sensors and the vehicle state to detect the driving pattern and suggest new behavior in real time that will lead to a more effective driving experience [17].

III. PROPOSED SYSTEM

The propose system is a fuzzy-based driving behavior detection. Here we combine the mobile network and three-axis accelerometer to acquire the signals, to analyze and to derive the dangerous driving behaviors of vehicles. The three-axis accelerometers are installed on the vehicle body, to capture the variation of acceleration of the moving vehicle. Through a proposed fuzzy inference system, vehicle body posture is identified. We develop a driving behavior analysis process to determine vehicle status, and detect whether the vehicle for the dangerous driving behavior. Once the system realizes the dangerous state driving behavior of vehicles it starts broadcasting the alert message to all vehicles in the range. As the system is already connected through mobile network with each other it can be used to share different vehicle statistics with other vehicles in the range.

The proposed system has is mainly divided in to two main modules of process.

1. Primarily detection of type of motion is carried out
2. Analysis of the readings obtained in the detection part is done.

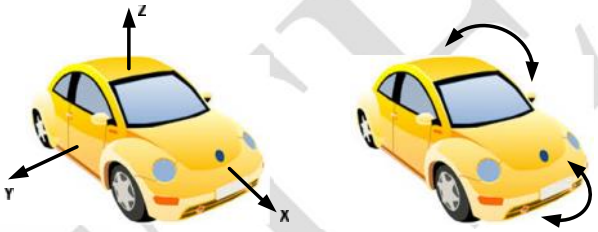


Figure 1.0 vehicle state in co-ordinate system.

Here, three-axis accelerometers are used to measure the acceleration variation of vehicle body in X, Y and Z-axis. Current driving states including lane-departure, turning, acceleration, braking, and bumping are derived from the measurements. The presented system detects the dangerous driving behavior presented in this paper are from the recognition of driving states. There are two stages in the proposed scheme. The first is the measurements of three-axis acceleration and the second is the derivation of dangerous driving behavior.

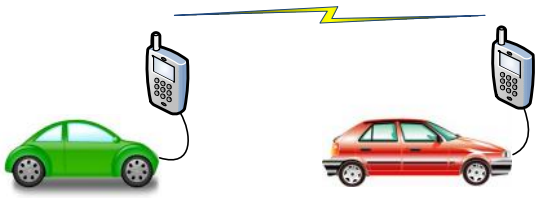


Figure 2.0 smart phone based V-2-V communication

In another part of proposed system the problem of range and limitation of communication using Wi-Fi or RF technology in vehicular ad-hoc network has been overcome by replacing it with mobile communication. The in-car system is connected to the

user's smart phone and share the vehicle information with either road side unit or the vehicle in near range.

Main benefit over using pre-implemented mobile technology as a communication media it gives all the security and wide area connectivity advantages to vehicle ad-hoc network. As every mobile phone having its registered and unique identity it can be utilized as identity of every vehicle node.

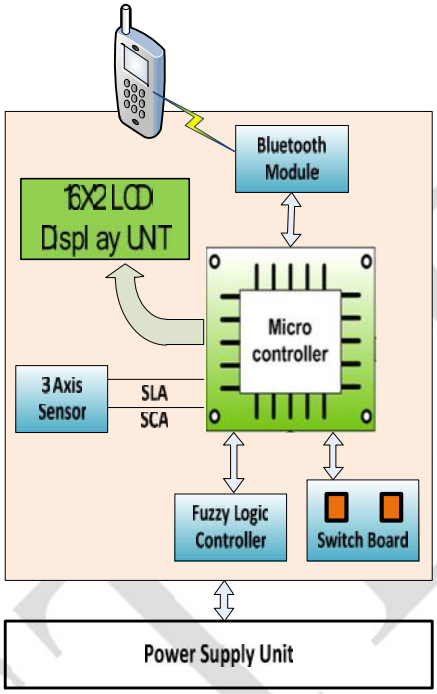


Figure 3.0 System Architecture

IV. WORKING

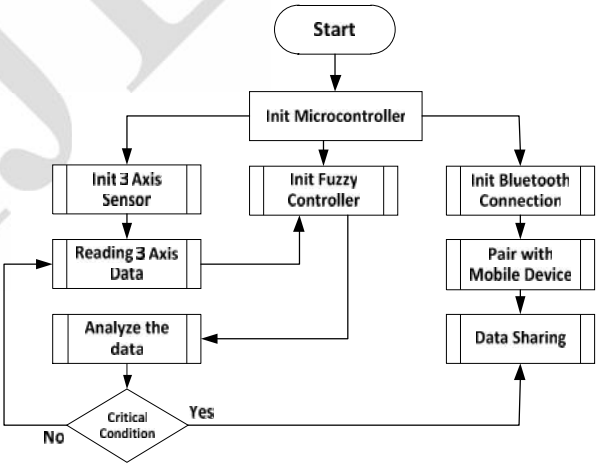


Figure 4.0 Flowchart of system flow

As per shown in flow chart execution start with the initialization of the hardware and the embedded software program. When system starts it initialize 3 Axis sensor, Fuzzy logic controller and Bluetooth connection with mobile device. Software program work in multitask mode and handles sensor reading, data analysis and data sharing. Once the all components initialized fuzzy logic controller handles the co-ordination between data communication and sensor data acquisition. Fuzzy logic controller will analyze the last recorded sensors reading and make the decision .For work to be carried out we are giving detailed description of the process

Axes Direction Type of Motion
X: - Left/Right Lane Change
Y: - Front/Rear Acceleration/Deceleration
Z: - Up/Down Road Anomalies

A. Acceleration/Deceleration

As evident from axes definition, the y axis of accelerometer gives us information about state of acceleration/deceleration of car. The work presented in [1] declares safe/unsafe acceleration by considering only acceleration in Y direction. We have taken into account other factors also for declaring safe/unsafe acceleration. Acceleration in Y direction is the prime and necessary factor for the acceleration to be detected. But the inclusion of velocity and acceleration of Z direction gives us extra advantage. The velocity will give us information about the speed of the car. Acceleration in Z direction will alert us about bumps and potholes. For instance a car passing at a speed of 60km/hr. over bumps under normal acceleration will be declared unsafe by this technique. However at the same instance the result by [1] would be safe acceleration as it considers only acceleration. There are some situations which are not vulnerable to the health of driver and the possibility of accidents under those accidents is also minimal. For example, high acceleration at low velocity. It means driver is providing excessive acceleration than desired. The presented scheme handles these situations effectively by giving the output as good/bad driving behavior. We have divided the acceleration into three main categories – low, normal and high. Low acceleration points to high negative values of acceleration whereas high acceleration includes high positive acceleration values. Normal acceleration includes the acceleration values in the middle range. Similarly, velocity is also divided into low, medium and high categories. Acceleration in Z direction is classified on the basis of variation in Z axis into the same three categories. These divisions provide us vast platform in which we can include large amount of situations related to acceleration/deceleration and give the justified output. To get around this important part we have used the concept of Fuzzy system. A fuzzy system is based on fuzzy logic which takes into account the degree of truth and false. All three factors are fed into fuzzy system the value generated out gives us an idea whether the behavior Is safe or unsafe.

B.Fuzzy Logic

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. Fuzzy logic deals with the degree of truth and false as compared to

Boolean logic which is based on truth and false. This main characteristic allows fuzzy system to have soft boundaries. The declaration of a result will depend on various other factors. The final output will be the aggregated product of the contributions made by each of the participating rules. Fuzzy inference process comprises of five parts: fuzzification of the input variables, application of the fuzzy operator (AND or OR) depending on the rules, implication from the antecedent to the consequent, aggregation of the results across the rules, and defuzzification .

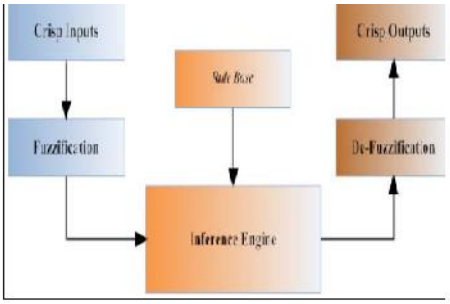
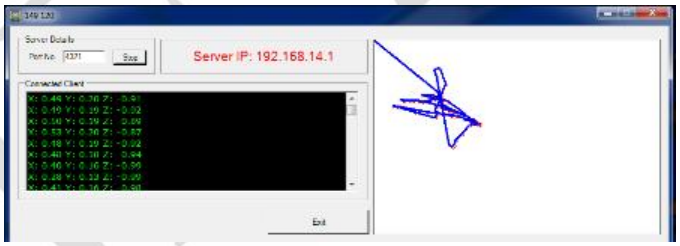


Figure 5.0 :- Fuzzy Logic Diagram

C. Lane change

lane change can be tracked with the help of x axis of accelerometer. the work presented in [1] detects lane change by considering the acceleration readings in x direction. the presented paper , besides taking acceleration also includes the velocity at which the lane change is taking place. Our implementation includes a module which detects if a lane change has occurred on the basis of patterns shown in fig



. Figure 6.0 :- Lane Change

Once occurrence of lane change is confirmed ,then we proceed towards declaring if it was a safe/unsafe lane change. Again we are not giving judgment on the basis of single factor. Another factor ,velocity will also play a crucial rule. The acceleration is divided into three parts namely low, medium and high. Similarly velocity is also divided into the same three categories. The highest acceleration value and highest velocity value is passed from the module to fuzzy system. The output of fuzzy system decides that whether a safe /unsafe lane change took place. If the behavior of driver is found to be dangerous then in that case alert message is sanded to the central authority who takes further action.

D.Road Anomalies

Detection of road anomalies like bumps and potholes is the most difficult and cumbersome part of the project. The z axis of accelerometer will check the occurrence of any bump or pothole and if any of them encounters, the variation is displayed in the accelerometer readings.

V.RESULT

Figure 7.0 :-In car system to detect value of 3-axes

In the above figure7.0 an in car system is developed which reads data received from accelerometer this system is developed in this way that it can communicate with smartphone through Bluetooth.

Figure 8.0:- Application to read X,Y,Z axes value

In the figure 8.0 as the port number is entered into the system it starts reading data from the hardware, based upon this value driving behavior is get calculated.

Figure 8.0 Window app to read 3 axis values

In the above figure8.0 a window based mobile application is developed which also reads accelerometer value and make decision of sending alert message to central authority.

Figure 9.0:-Emergency alert system

As based upon the few minute statistics if the behavior of driver is found to be dangerous then system will send an alert message to the central authority who takes further action by sending alert message to the highway patrolling party.

VI. CONCLUSION AND FUTURE WORK

Smartphone has a very significant impact in terms of performance, thus designing and developing an integrated software/hardware framework, especially for Vehicle. In this paper, smartphone-based platform is designed that exploits low-cost dedicated hardware to interact with sensors on board and in the vehicle surroundings. The achieved system records driving behavior of vehicles and uploads to the cloud server for further solicitations. For an example, If the system detects the vehicle unsafe driving behavior, the vehicle location will be updated in clouds and an alert message will be issued to precise user. They are able to track the movement of this vehicle. In addition, in a traffic accident, the system is helpful to elucidate the accountability timely. In future our main aim is to develop application on different mobile platform.

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