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Abnormal Behavior Detection In Intelligent Transport System For Intelligent Driving

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ABSTRACT

Vehicle Ad hoc Networks (VANET) emerged as an application of Mobile Ad hoc Networks (MANET), which use Dedicated Short Range Communication (DSRC) to allow vehicles in close proximity to communicate with each other, or to communicate with roadside equipment. Applying wireless access technology in vehicular environments has led to the improvement of road safety and a reduction in the number of fatalities caused by road accidents, through the development of road safety applications and facilitating information sharing between moving vehicles regarding the road. This paper focuses on developing a novel and non-intrusive driver behavior detection system using a context-aware system in VANET to detect abnormal behaviors exhibited by drivers, and to warn other vehicles on the road so as to prevent accidents from happening. A five-layer context aware architecture is proposed which is able to collect contextual information about the driving environment, perform reasoning about certain and uncertain contextual information and react upon that information. The detection behavior architecture based on detection behavior mechanism for real time inferring four types of driving behavior (normal, drunk, reckless and fatigue) by combining contextual information about the driver, vehicle and the environment is presented. The dynamic behavior model can capture the static and the temporal aspects related to the behavior of the driver, thus, leading to robust and accurate behavior detection. The evaluation of behavior detection using synthetic data proves the validity of our model and the importance of including contextual information about the driver, the vehicle and the environment.

General Terms
VANET, driver behavior, safety application

Keywords
ITS, Board Unit Architecture

1. INTRODUCTION

At the present time cars and other private vehicles are being used daily by large numbers of people. The biggest problem regarding the increased use of private transport is the rising number of fatalities that are occurring as a consequence of accidents on the roads, the associated expense and related dangers have been recognized as a serious problem that is being confronted by modern society. The two reasons for occurring accidents, they are first one in vehicle fault due to breakdown maintenance and second one is driver errors due to affected by fatigue, being drunk, or reckless driving are the main factors responsible for most road accidents. The vehicle fault based accidents can be reduced by using several accurate models (antilock breaking system, adaptive cruise, speed governing module for commercial vehicle) they have been developed by the several manufacturing companies (BOSCH, PRICOL, CRAYSOL).The second one driver error based accidents can be reduced by using in our project(ITS-Intelligent transport system), it can detect driver behavior and communicate to other vehicle due to this process be reduced the accidents up to 25 percent. In this project operating based on wireless communications and mobile computing. Wireless communications and mobile computing have led to the enhancement of an improvement in the intelligent transportation systems (ITS) that focus on road safety applications. As a core component of ITS, Vehicle Ad hoc Networks (VANET) have emerged as an application of Mobile Ad hoc Networks (MANET), which uses Dedicated Short Range Communication (DSRC) to allow nearby vehicles to communicate either with each other or with roadside equipments. These forms of communication offer a wide range of safety applications to improve road safety, traffic efficiency and provide a clean environment. VANET safety applications are considered represent a vital step towards enhancing road safety and improving traffic efficiency by preventing accidents from occurring; for example, Intersection collision avoidance, Warning about violating traffic signal and Approaching emergency vehicle warning. Many researchers have been working in the area of driver monitoring and detection over recent decades, and therefore multiple systems have been proposed to monitor and detect the status of drivers. Some researchers have tried to monitor the behavior of the vehicle or the driver in isolation, while others have focused on monitoring a combination of the driver, the vehicle and the environment, so as to detect the status of the driver in an attempt to prevent road accidents. However, there is still no comprehensive system that can effectively monitor a driver's behavior, the vehicle's state and environmental changes to perform effective reasoning regarding uncertain contextual information (driver's behavior), so as to alert other vehicles on the road by disseminating warning messages in time to the relevant vehicles in the vicinity, including implementing practical corrective actions to avoid accidents. In this work we propose a five-layer context-aware architecture for a driver behaviour detection system in VANET that can detect four types of driving behavior in real time driving: normal, fatigued, drunken and reckless driving; it will then alert the driver and other vehicles on the road by operating in vehicle alarms and sending corrective action respectively. The functionality of the architecture is divided into three phases, which are the sensing, reasoning and acting phase. In the sensing phase, the system collects information about the driver, the vehicle state and environmental changes. The reasoning phase is responsible for performing reasoning about uncertain contextual information, so as to deduce the behavior of the driver. This model combines information from different kinds of sensors so as to capture the static and temporal aspects of behavior and perform probabilistic inference to deduce the driver's current driving style. The acting phase is responsible for operating in vehicle alarms and sending corrective actions to other vehicles, via wireless technology provided by VANET.

2. RELATED WORKS

The study of vehicular ad-hoc networks (VANETS) requires efficient and accurate simulation tools. As the mobility of vehicles and driver behavior can be affected by network messages, these tools must include a vehicle mobility model integrated with a quality network simulator. We present the first implementation of a well-known vehicle mobility model to ns-3, the next generation of the popular ns-2 net- working simulator. Vehicle mobility and network communication are integrated through events. User- created event handlers can send network messages or alter vehicle mobility each time a network message is received and each time vehicle mobility is updated by the model. To aid in creating simulations, we have implemented a straight highway model that manages vehicle mobility, while allowing for various user customizations by High Way Mobility And Vehicular Ad-Hoc Network In Ns 3B.Johansson, S.Jain, J.Montoya-Torres, J.Hugan, and E.Yücesan(2010).We present a novel methodology based 011 a Dynamic Bayesian Network for the estimation of tall drivers stress produced due to specific driving events. The proposed methodology monitors driver's stress using selected bio signals and provides a probabilistic framework in order to infer the driving events resulting in stress level increase. We conducted a series of experiments under real driving conditions. The extracted results indicate a strong correlation between the level of the stress as reported by the drivel' and the outcome of uur modeled by A Reasoning-Based Framework For Car Driver's Stress Prediction George Rigas, Christos D. Katsis, Penny Bougia and Dimitrios Fotiadis. Real –Time System For Monitoring Driver Vigilance presented by Marfa Elena Lopez Jesus,Nuevo Miguel,A.Sotelo Rafael, Barea Luis and M. Bergasa, a nonintrusive prototype computer vision system for monitoring a driver's vigilance in real time. It is based 011 a hardware system for the real-time acquisition of driver's images using an active IR illuminator and the software implementation for monitoring some visual behaviors that characterize a drivers level of vigilance. Six parameters are calculated. Percent eye closure (ERCLOS), eye closure duration, blink frequency, nodding frequency, face position, and fixed gaze. These parameters are combined using a fuzzy classifier to infer the level of inattentiveness of the driver, The use of multiple visual parameters and the fusion of these parameters yield a more robust and accurate in attention characterization than by using a single parameter. The system has been tested with different sequences recorded in night and day driving conditions in n motor way and with different users. Driver Identification Using Driving Behavior Signals Itakura,T. Wakita, K. Ozawa, C. Miyajima, K. Igarashi, K. Itou, K. Takedain (2005) this paper, we propose a driver identification method that is based on the driving behavior signals that are observed while the driver is following another vehicle. Driving behavior signals, such as the use of the accelerator pedal, brake pedal, vehicle velocity, and distance from the vehicle in front, are measured using a driving simulator. We compared the identification rate obtained using different identification models and different features. As a result, we found the nonparametric models are better than the parametric models. Also, the driver's operation signals were found to be better than road environment signals and car behavior signals. The identification rate for thirty driver using actual vehicle driving in a city area was 73%.In Graphical Models For Driver Behavior Recognition. In A Smart Car N. Oliver And A. P. Pentland, Dearborn (2000),this paper we describe our Smart Car test bed: a real-time data acquisition system and a machine learning framework for modeling and recognizing driver maneuvers at a tactical level, with special emphasis on how the context affects the driver's performance. The perceptual input is multimodal: four video signals capture the contextual traffic, the driver's head and the driver's viewpoint; and a real-time data acquisition system records the car's brake, gear, steering wheel angle, speed and acceleration throttle signals. Over 70 drivers have driven the Smart Car for 1.25 hours in the greater Boston area. Graphical models, HMM and coupled HMM, have been trained using the experiment driving data to create models of seven different driver maneuvers: passing, changing lanes right and left, turning right and left, starting and stopping. We show that, on average, the predictive power of our models is of 1 second before the maneuver starts taking place. Therefore, these models would be essential to facilitate operating mode transitions between driver and driver assistance systems, to prevent potential dangerous situations and to create more realistic automated cars in car simulators. Development Of Drowsiness Detection System H.Ueno, M.Kaneda, And M.Tsukino represents the development of technologies for preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Preventing drowsiness during driving requires a method for accurately detecting a decline in driver alertness and a method for alerting and refreshing the driver. As a detection method, the authors have developed a system that uses image processing technology to analyze images of the driver's face taken with a video camera. Diminished alertness is detected on the basis of the degree to which the driver's eyes are open or closed. This detection system provides a noncontact technique for judging various levels of driver alertness and facilitates early detection of a

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decline in alertness during driving. In order to provide applications that can fulfill this vision, approaches must be thoroughly evaluated. There are a limited number of test beds with instrumented vehicles and roadside units. As this is prohibitively expensive for most academic researchers, the majority of evaluation studies have been performed via simulation. VANET simulations have typically been segregated into traffic simulations and network simulations. Traffic simulators, such as CORSIM (Halati et al. 1997), SUMO (Krajzewicz et al. 2006), VISSIM (PTV America 2010), and Vanet Mobi Sim (Fiore et al. 2006) have been used to generate realistic mobility traces of vehicle traffic. These traces would then be fed into well-known network simulators such as ns-2 (Breslau et al. 2000), Qual Net (Scalable Network Technologies 2010), OPNET (2010), or Glo Mo Sim (Zeng et al. 1998) to measure network performance. VANET tools such as Tra NS (Piorkows-ki et al. 2008) and MOVE (Karnadi et al. 2007) have been used to facilitate this interaction between traffic and network simulators. More recently, researchers have developed integrated simulators such as ASH (Ibrahim and Weigle 2008) and Gorgorin et al. (2006) that allow feedback between the applications using the network and the traffic model.

3. PROPOSED SOLUTION

3.1 Over View Of Driver's Behavior

Several definitions of driver behavior have been proposed, it defined normal driving behavior as the majority of behavior exhibited by each driver during their daily driving, while abnormal driving behavior refer to the behavior of driver while influenced by mental or physical factors. Another definition driver behavior defined four categories of driving behavior which are as follows.

1) Normal behavior: Behavior is considered to be normal when driver concentrates on the driving task. This can be characterized by controlling the speed of the vehicle, avoiding sudden acceleration, driving without alcohol intoxication, maintaining a proper position between lane markers and the driver having his or her eyes open while driving. When the driver matches the above mentioned criteria, behavior is considered to be normal.

2) Drunk behavior: This refers to driving whilst intoxicated by alcohol and is characterized by a set of observable actions such as sudden acceleration, driving without maintaining the proper lane position, driving without controlling the speed and usually having closed eyes for more than 80% for a period of time.

3) Fatigue Behavior: It defined fatigue as an evolving process that increase during driving and which is associated with a loss of effectiveness in driving. This behavior stated that a driver driving after a period of17hours with no sleep behaves exactly as a driver who has0.05% intoxication of alcohol. A driver driving after a period of 24 hours with no sleep behaves exactly as one who has 0.1% intoxication of alcohol. Based on this argument, fatigue driving was defined as driving that exhibits the same characteristics as drunk driving, but instead of there is no alcohol intoxication in the driver blood.

4) Reckless Behavior: It defined the reckless driver as a driver who drives at high speed, high degree of acceleration and put other traffic participants at risk. The driver is classified as driving in this category when there is no alcohol intoxication, the driver's eyes are opened but the following behaviors are exhibited: driving with sudden acceleration, not maintaining the proper lane position and not controlling the vehicle's speed.

3.2 System Design

ITS means intelligent transport system, in this system based on vehicle ad-hoc design network (VANET, DSRC) and board unit architecture. Board unit architecture is the heart of the system, it contains three layers there are sensing, reasoning and application layers, the sensing layers sense the behavior from the driver errors due to the fatigue, being drunk, or reckless driving these parameters are passed to reasoning phase in this phase perform the parameter process and develop the control algorithm to produce a proper behavior signal, these signal passed to the application layer in this layer monitor the behavior and also communicate to the other vehicle using DSRC. In this method used to reduce accidents, reduce traffic and increase road safety efficiency.

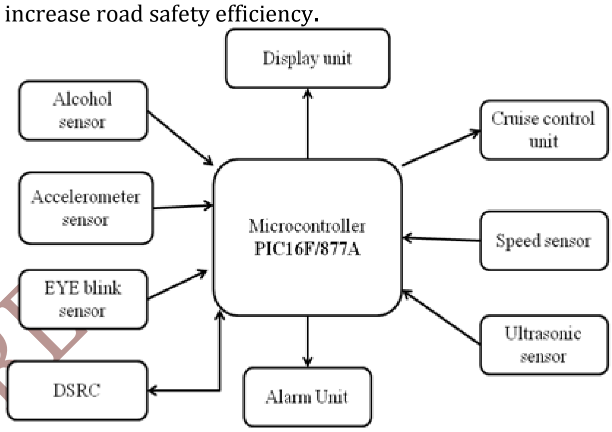

Figure 3.2 ITS Block Diagram

The block diagram contains sensing blocks, processor block and control and communication block. The sensing block sense the driver errors, it contains alcohol sensor, accelerometer sensor, eye blink sensor, ultrasonic sensor and speed sensor. In processor block microcontroller PIC16F/877A is used, the advantage of this controller have inbuilt ADC, so there is no need for separate ADC circuit. The control and communication block contains cruise control, display unit and DSRC. The display unit use to monitor the behavior and the DSRC is used to communicate the driver behavior with other vehicles.

3.3 Context-Aware Based On Board Unit Architecture

The board unit architecture contains detection architecture and detection mechanism, the detection architecture working depends on the detection mechanism. Context-aware systems are those systems that are capable of adapting their operations to the current context without user interaction, and are thus aimed at augmenting usability and effectiveness by taking into account the environment's contextual information. Context-aware systems incorporate the following three main subsystems

-Sensing subsystem:-The phase for gathering contextual information by sensors

-Reasoning (Thinking) subsystem:-The phase for employing reasoning techniques to contextual data in order to obtain high-level contextual information (for

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example user situation).

-Acting subsystem:-Depending on the current situation, the systems provide services to users.

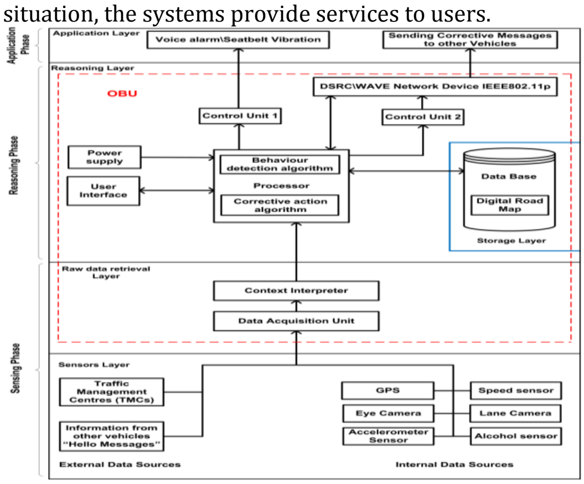

Figure 3.3.Driver Behavior Detection System Architecture

The figure3.3 architecture divided into three main Phases:- a sensing phase, reasoning phase and application phase, which represent the three main subsystems of a context aware system: the sensing, reasoning and acting sub systems. Sending corrective actions or operating the in-vehicle alarms in the third layer depends on the result of the second layer which in turn depends on receiving the information of the first layer.

A. Sensing phase

The sensing phase is responsible for gathering contextual information about the driver, vehicle and the environment and transferring the collected information into a machine executable form to be processed in the next phase. It is divided into two layers as follows:

- Sensors Layer:- This layer is responsible for acquiring the context data. It consists of a set of different sensors integrated into the driving environment in which the system operates. Different types of sensors provide executable form. Several types of modeling algorithm scan be used to abstract the received sensory data (for example ontology modeling). The received data may come from different types of sensors such as camera, GPS and speed sensor. This component transfers the data into a form that can be processed by the reasoned.

B. Reasoning phase

This phase is responsible for extracting the situation of the driver and calculating corrective actions for other vehicle son the road. There are two types of contextual information; certain information which is obtained from a single sensor, and uncertain contextual information, which can not be acquired by a single sensor and which may be incomplete or inexact. The behavior of the driver is categorized as uncertain contextual information (high-level contextual information). In this phase the behavior detection algorithm performs reasoning about uncertainty (driver behavior) by combining data acquired from different sensors to detect the state of the driver during real time driving. The corrective action algorithm is responsible for calculating the appropriate corrective action to other vehicles on the road. The reasoning phase consists of two layers as follows:

- Reasoning Layer:- This layer is responsible for extracting the current state of the driver (for example normal, fatigued, drunk or reckless) and generates corrective actions for other vehicles to avoid road accidents. This layer comprises the following components:

-Processor:-The OBU processor is responsible for managing all the components of the OBU and controlling all the tasks and activities it performs. The processor performs the following two algorithms:

*Behavior detection algorithm:- This algorithm is designed to reason about uncertain contextual information to detect the current behavior of the driver using a Dynamic Bayesian Network algorithm to combine the data collected from a sensing layer and to detect the type of behavior. If the behavior of the driver is normal no action is needed. In case of abnormal driving behavior(for example drunk, fatigued or reckless), the processor performs the corrective action algorithm. In this paper we will focus on the driver behavior detection algorithm.

*Corrective action algorithm:- The aim of performing this algorithm is to chose the appropriate in vehicle alarm and to calculate the proactive corrective action for other vehicles on the road according to their positions, velocities and directions with the use of predefined digital road maps and the information collected from the adaptive hello messages. The corrective action algorithm will be out of the scope of this paper.

-Control unit 1:- This unit is responsible for controlling in vehicle alarms such as seat vibration and audio alarm to attract the driver's attention. This unit receives the signal from the processor in case of abnormal driving behavior.

-Control unit 2:-After receiving the signal from the processor indicating abnormal driving behavior, this unit sends signals to the DSRC/WAVE device to transmit corrective messages to other vehicles on the road, or to the roadside unit.

-DSRC/WAVE network device:-The OBU contains a DSRC/WAVE network device based on IEEE 802.11p, it is responsible for connecting the vehicle to other vehicle's OBUs or with the road side unit through the wireless radio frequency based on 802.11p, The OBU can send or receive messages via this network device.

-Power supply:-The power supply is responsible for providing power to the OBU. It is rechargeable and provides power to the OBU without any constraints.

-User interface:-This contains the audio and video interface that allows the user to interact with the services provided by the OBU.

- Storage Layer:- In this layer, the data base stores predefined digital maps of the road and the historical data (past driving situations).

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C. Application Phase

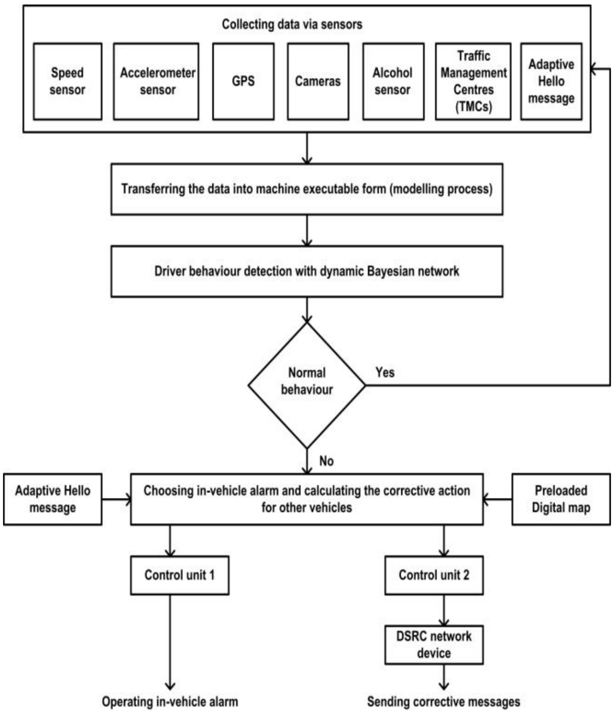

Figure3.3.Driver Behavior Detection System Mechanism

This phase represents the acting subsystem in a context aware system. It is responsible for disseminating a warning messages that includes corrective actions for other vehicles on the road. It also operates in-vehicle alarms to warn the driver to prevent the occurrence of accidents and to decrease the number of potential fatalities. Figure 3 depicts the mechanism of detecting the behavior of the driver and calculating corrective action for other vehicles on the road. The vehicle sense contextual information about the vehicle, driver and the environment from sensors which include both physical and logical sensors such as speed, accelerometer, TMC, adaptive hello message, cameras, GPS and alcohol sensors which are connected to the OBU. After collecting this information from the sensors the interpreter transfer the different kinds of data to a form that can be processed by the processor by applying one of the modeling techniques such as ontology modeling.

This will be out of the scope of this paper. The OBU processor perform the network algorithm to perform reasoning about an uncertain context (driver behavior) by combining data received from the interpreter using the probabilistic inference. If the output of the inference is normal driving behavior that satisfies all normal driving criteria, no action will be taken by the processor and the vehicle will sense new information. If the output of the inference is abnormal driving behavior, such as being drunk, fatigued or reckless, the processor performs the algorithm of calculating the corrective action for other vehicles on the road and choosing the appropriate in-vehicle alarm according to the position of other vehicles and their velocity and direction. After calculating corrective actions for other vehicles and choosing the in-vehicle alarm, the processor will send a signal to control unit 1 and control unit 2 to operate an in-vehicle alarm and send the corrective message to other vehicles through the DSRC network device. This process is based on a context-aware system and is a self organizing process in which information sensing, reasoning and acting upon this information occurs instantly.

3.4 System Working Principle

The ITS system analyses the driver behavior, and process the behavior and finally monitor the behavior and simultaneously control actions to vehicle will be done. At this time transmit the driver behavior to other vehicle by the use of dedicated short range communication network (DSRC).

-Circuit Operation:- This model consists of two units. One is at vehicle side and other is at control side. Vehicle unit monitors the driver behavior such as drowsiness, active and drunk. Eye blink sensor monitors driver whether he is active or he feels sleepy. Accelerometer senses driver is fainting or not. Alcohol detector detects drunken drive. If it is, he can't able to run vehicle. Ultrasonic sensor senses object during driving. All these sensors are connected to PIC where it is running by software program. PIC transmits the data to PC by Zigbee transceiver. The ITS is the heart of the system, it's used to detect the abnormal behavior from driver and the processor unit is used to process the behavior then produces a controlling actions, at this same time the abnormal behavior is monitored and communicated to other vehicle by the use of display and communication units.

3.5 . Results And Discussions

The abnormal behavior detection in ITS for intelligent driving module produce a normal and abnormal driving result. Both simulation (software) and hardware results are shown below figures.

Figure 3.5.1 Starting Screen

- Normal Driving Behavior:- In normal driver behavior the input sensors are idle mode, the output as shown in below figure3.5.2

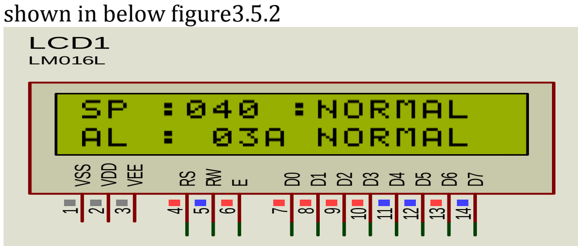

Figure 3.5.2.Normal Driver Behavior

- Abnormal Driving Behavior:-In abnormal condition sensors sense the driver behaviors,(Drunk behavior, Fatigue Behavior, Reckless Behavior).The abnormal behavior output as shown below figures.

-Drunk behavior:- The drunk behavior in driver, the alcohol sensor sense the alcohol power the system produce a control output as shown in below figure 3.5.3.

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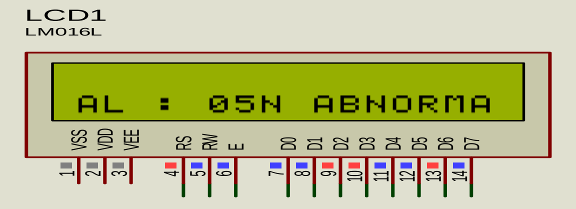

Figure 3.5.3.Drunk Behavior

-Fatigue Behavior:- The fatigue behavior in driver, the eye blink sensor sense the eye balls, the eyes are closed the system produce a control output as shown in below figure 3.5.4

Figure 3.5.4.Fatigue Behavior

-Reckless Behavior:- The Reckless behavior in driver, the accelerometer sensor sense the acceleration from lane position , its abnormal the system produce a control output as shown in below figure 3.5.5

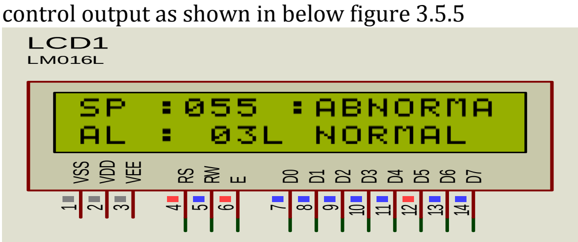

Figure 3.5.5.Reckless Behavior

4) CONCLUSION

A promising area of VANET, safety applications are attracting more and more consideration. Monitoring and detecting the behavior of drivers is vital to ensuring road safety by alerting the driver and other vehicles on the road in cases of abnormal driving behaviors. Driver behavior is affected by many factors that are related to the driver, the vehicle and the environment and over the course of driving a driver will be found to be in a particular state, the driver can then stay in this state for a period of time or shift to another state. Hence, it is important to capture the behavior take into account the contextual information that relates to driver behavior. In this paper we have presented a driver behavior detection system in VANET from the viewpoint of context awareness. Our contributions are threefold: (1) A five-layer context-aware architecture, which can detect the behavior of the driver is presented by capturing information about the driver, vehicle and the environment; (2) The algorithm for inferring driver behavior from different kind of sensors under uncertainty has been formulated, so as to capture the aspects of the behavior; (3) definitions for normal and abnormal driving behaviors results are given. In our future work ITS modeling techniques for transferring the data collected from sensors in to a machine process able format will also be developed.

5) ACKNOWLEDGMENTS

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