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A FEASIBILITY STUDY ONMONITORING SYSTEM FOR PASSENGER SAFETY AND DRIVER BEHAVIOR THROUGH VANET

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Abstract

The system comprises two Electronic Control Units (ECU) - Active Vehicle Control (AVC) to measure the driver's driving behavior and Passenger Safety Control (PSC) for ensuring the safety during traveling in private vehicles. The AVC module is a Global System for Mobile (GSM) based ECU which consists of multiple sensors that measure the driver's abnormal or race driving behavior and correspondingly report to the call taxi company through GSM. The PSC module enables the passenger to stop the vehicle by pressing the emergency stop button. The Vehicular Ad-Hoc Network (VANET) also known as Vehicle to Vehicle (V2V) communication shares the real time traffic related information between the vehicles to reach the destination on time thereby avoiding accidents and traffic congestion. The proposed system is found to be superior to ensure security for passengers than traditional approaches.

Keywords: **AVC, ECU, GSM, Novel Surveillance System, PSC, VANET.**

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A. **INTRODUCTION**

In Today's world of an increasing population, public transport remains the primary mode of transport for most of the population but there is a problem in reaching the destination on time. Nowadays most of the people such as employees, business persons, school and college students, etc., are mostly using the taxi for their transportations. So many private companies provide taxi services to the public. Large metropolitan areas offer an alternative transport of taxis services in that they often provide mass transit systems such as buses and subways. As these mass transit systems are designed to move large numbers of people efficiently, they do not provide privacy for their occupants[1]. However, security is the main concern in taxi transportation since business persons and ladies sometimestraveled alone in Taxi. Especially more concerns on ladies using the taxi services at night times. In recent times the taxi services are misused for criminal activities such as kidnaps and murders. Therefore, for the above reason, the need arises to provide securetraveling to the passengers by providing the emergency stop control system which stops the vehicle without aid of the driver. Along with passenger safety the driver's driving behavior needs to be analyzed because the drivers are becoming more important to vehicle control, safety and performance.

Jianqiang Wang et al. [2] suggested a Forward Collision Warning (FCW) Algorithm with Adaptation to Driver Behaviors that can adjust its warning thresholds in a real-time manner according to driver behavior changes, including both behavioral fluctuation and individual difference. This adaptive FCW algorithm overcomes the limit of traditional FCW with fixed risk evaluation models and fixed triggering thresholds by continuously monitoring driver braking behaviors in multiple lanes.

Yi Han, Yuan Yao and HaiyangLiu[3] represented the design and implementation of Driving Behavior Analysis System that depicts the characteristics of driving behavior and improves road safety. This system could acquire and analyze drivers' driving behavior. The hardware system is made up of two computers. The software system includes Speed Dreams engine, the Monitor program and the Data Analysis program.

Jiangpeng Dai, Jin Teng, XiaoleBai, ZhaohuiShen and Dong Xuan[4] proposed mobile phone based drunk driving detection systems. This system places the mobile phone in the vehicle, collects and analyzes the data from its accelerometer and orientation sensor to detect any abnormal or dangerous driving maneuvers typically related to driving under alcohol influence.

MamidiKiran Kumar, V. Kamakshi Prasad [5] discussed their survey on driver behavior analysis and prediction models. Their survey revealed the fact that a more precise definition of driver behavior analysis models would focus on various methods to understand the driver behavior, and also give information regarding driver driving information. The driver behavior prediction models give predictions of the drivers' driving nature whether the driving is safe or not.

Joel C. McCall and Mohan M. Trivedi[6] proposed a work on driver behavior and situation aware brake assistance for Intelligent Vehicles. This is a novel method for fusing predicted driver behavioral information with vehicle and surround information for braking assistance. The framework allows for the assessment of the criticality of the current situation and the need for intervention by an intelligent vehicle safety system.

Scott Schnelle and Junmin Wang [7] presented a sensitivity analysis of a human driver model under various road and driving conditions. A systematic simulation study conducted revealed how the vehicle y-position tracking error is related to the driver steering characteristics under various operating and road conditions in common maneuvers.

Aaqib Khalid et.al.[8] discussed that the prime interest of research in Vehicular Ad hoc Networks (VANETs) is road safety through vehicular control. The main concern for vehicular safety is the diagnostic analysis of In-vehicle sensors.

TiborPetrov, Peter Pocta, Ján Roman, ĽubošBuzna and Milan Dado[9] states that with the implementation of VANET, has laid the emergence of transport safety and the relevant applications efficiently.

Thus Driving style has various impacts on hazardous driving behavior detection and fuel economy. Driving styles differ among drivers. Drivers who are less prone to sudden maneuvers will have a lower possibility of suffering a dangerous situation thus fuel consumption will also decrease. Hence driver's driving conditions need to be analyzed for warning the drivers if there are any abnormal driving conditions detected.

The monitoringsystem denotes monitoring and observing the behavior or activity analysis of vehicle driving conditions and implementation of passenger safety in private vehicles such as taxi and tourist travelers. The main focus of this study is to provide a secure travel to the passengers by providing the emergency stop control system which stops the vehicle without the aid of the driver.

METHODOLOGY

A. *Existing Method*

Some of the existing studies reveal the fact that Naturalistic Driving Studies (NDS) captures large volumes of drive data from multiple sensor modalities which are analyzed for critical information about driver behavior and driving characteristics. Also, NDS data usually contain video-recordings of the driver and the traffic environment, as well as a large number of time-history measurements (e.g., speed, acceleration, operational responses). A similar data collection approach is used for evaluations of advanced driver safety systems (ADAS). But, this method is a database method. The driving behavior is measured and stored in the database, then it will be analyzed on a frequentbasis. It does not immediately report on real time.

The next existing method is the Personalized Driver Model established for evaluating the driving style for each driver. The personalized driver model using the real world vehicle test condition and locally designed neural network. The method is designed and implemented in the Drive Assist System after evaluating the driver's real environment driving condition for some period of time.

The above mentioned studies do not report the taxi driver's driving behavior such as abnormal driving and unsafe driving behaviors on time.

B. *Proposed System*

The Novel Surveillance System in this work will act as a digital interface utilized on various applications by providing security and protection in transportation. This system will be housed on a single microprocessor board; virtually all appliances that have a digital interface utilize this system. In addition to that, the application can also be extended for vehicle safety measures to examine the vehicle behavior, monitor the vehicular speed and driver's behavior. A centralized system will collect and analyze all the information from various sources and take the appropriate decision. The overview of the system proposed is given in Fig. 1.

The system as shown in Figure 1 consists of three sections such as Input unit, Control unit and Output unit. The Input unit consists of multiple sensors which continuously measure their corresponding parameters then it feeds to the control unit.

The Control unit constructed by microcontroller is programmed as per the requirement. It received the measured raw data from the sensor unit then compared with programmed set value and based on the result it controls the corresponding output unit. The output unit consists of LCD, warning lights, vehicle speed control and GSM module. Further, the system comprises Active Vehicle Control module (AVC) which measures the driver's driving behavior and Passenger Safety Control module (PSC) for ensuring the safety during traveling in private vehicles.

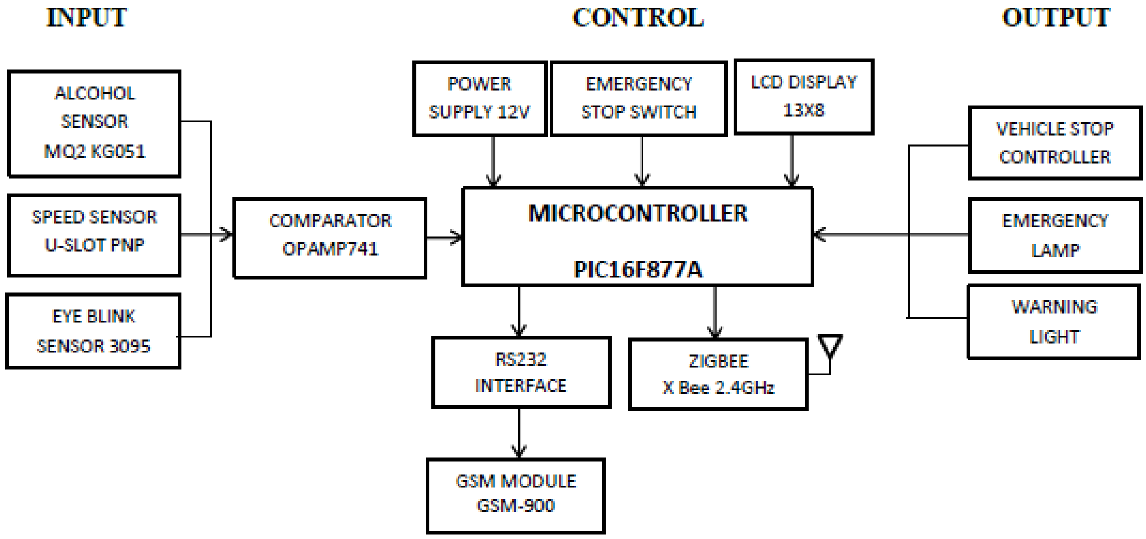

Fig. 1: Overview of the System

B. ***AVC Module:*** The Active Vehicle Control module is a GSM based ECU which constitutes multiple sensors that measure the driver's abnormal driving behavior and correspondingly report to the call taxi company through GSM. The Active Vehicle Control ECU consists of

(i). The Speed measurement sensor to measure the speed and give the warning of overspeed. The Speed measurement method is shown in Figure 2.

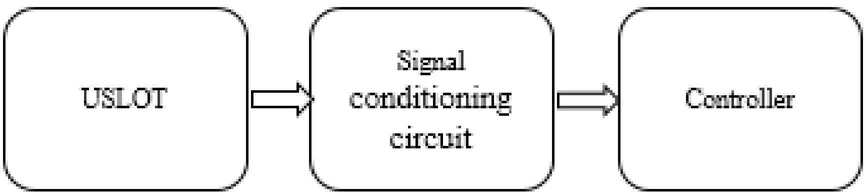

Fig. 2: Speed Measurement

(ii). A hi-sensitivity alcohol sensor is built into the transmission shift knob, to detect the presence of alcohol in the perspiration of the driver's palm as he or she attempts to start driving. Alcohol level sensing method is shown in Fig 3.

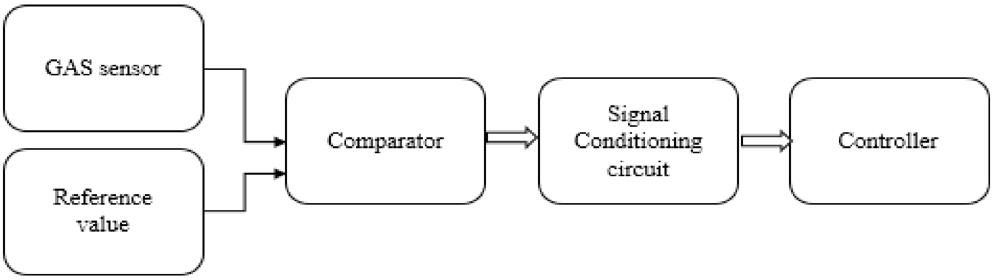

Fig. 3: Alcohol level Measurement

(iii). Eye blink sensor gives the alert signal, driver's drowsiness and driver's attention warning of unsafe driving. Eye blinking level sensing method is shown in Fig 4.

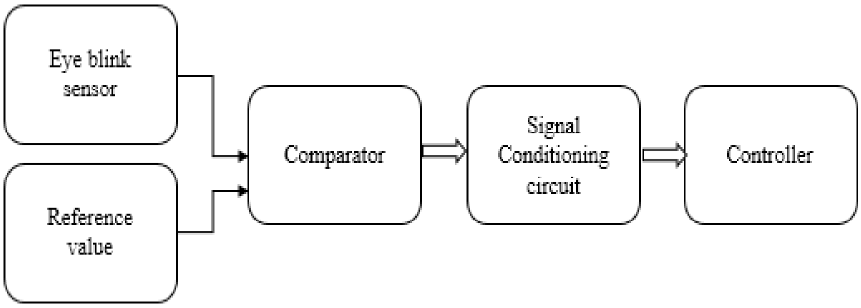

Fig.4: Eye blinking level Measurement

(iv) GSM module which sends driver behavior report to Call Taxi owner or company. GSM module interfacing method is shown in Fig 5.

Fig. 5: GSM module interface

C. ***PSC Module***

When a passenger suspects the driver's behavior or character is wrong while traveling or suspect that driver going on the wrong route, the passenger can stop the vehicle by pressing the emergency stop button which is placed in the rear seat roof.

Now the ECU detects emergency stop instructions and it automaticallyreduces the vehicle speed and stops the vehicle. Simultaneously flashing the Emergency stop warning light on the rear side to indicate another vehicle that is going to stop. It also unlocks all the doors so the passenger can come out of the vehicle. The PSC ESC module is shown in Fig 6.

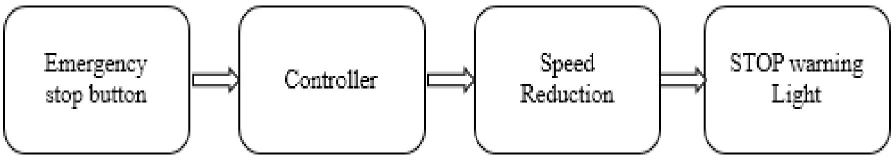

Fig. 6: PSC ECU

The PSC ECU consists of

(i) Emergency STOP button which is placed in the rear seat roof.

(ii) Emergency STOP warning light which is placed on the rear end.

(iii) Automatic speed reduction and stop control unit.

D. ***VANET Module***

The Vehicular Ad hoc Network also known as Vehicle to Vehicle (V2V) communication shares the real time traffic related information between the vehicles to reach the destination on time. They can be effective in avoiding accidents and traffic congestion. The VANET module is shown in Fig 7.

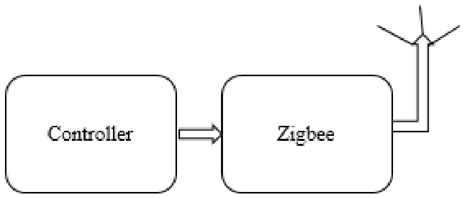

Fig. 7: VANET

System Level Architecture

The System level architecture describes the hierarchy level of operation which is shown in below Fig. 8. The lowest level is the data layer constructed by hardware units such as sensors and signaling and conditioning circuits.

This data layer section measures the driving behavior such as speed and other parameters. The next hierarchy level is the control layer which is constructed by both software and hardware units. The measured parameters in the data layers are monitored and controlled through the controller layer.

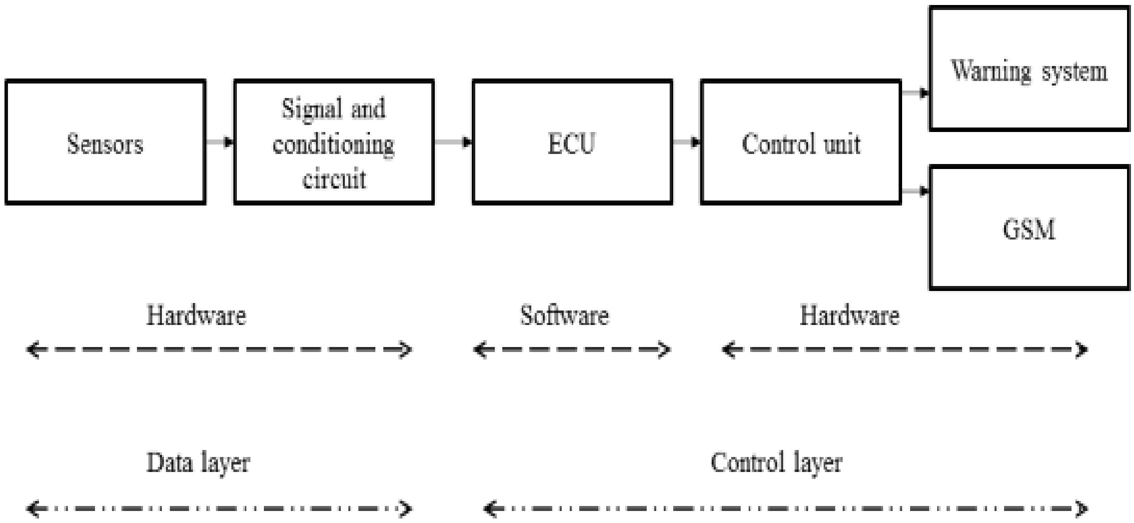

Fig. 8: System Level Architecture

RESULTS AND DISCUSSION

The experiment has been conducted as a bench level test to ensure the efficiency of the proposed system. The experiment shown in Fig. 9 consists of The Proposed Novel Surveillance System, two ECUs constructed with multiple sensors to measure the driving behavior condition. The sensed signals are sent to the PIC Microcontroller. If there is any abnormality detected in the driving, it will warn the driver using some warning indicators and the same warning information is sent as SMS to the vehicle owners through the GSM module.

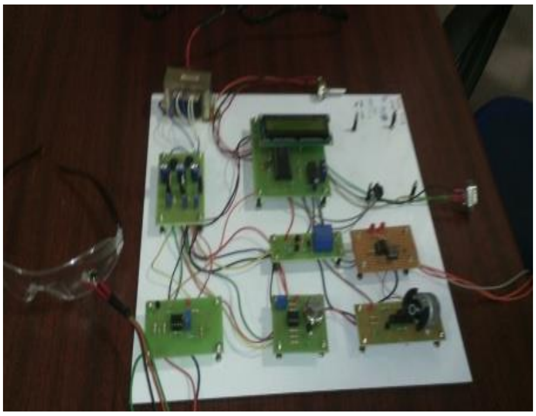

Fig. 9: ECU Hardware Setup

The proposed Novel Surveillance System includes the above hardware setup and is found to be superior to its ancestor systems. The vehicle speed measurement, detection of drunk and drive, drowsiness driving concluded the abnormal driving behavior. Emergency stop control system stopped the vehicle without the aid of the driver. The real time traffic related information was shared between vehicles through the V2V communication network.

CONCLUSION

Road environment, vehicles and road users are all part of the road transport system. Among them, the human factor is the most complex and dynamic. Whether the road users follow traffic rules and adopt a careful and considerate driving attitude has a great bearing on road safety. The simplicity and robustness of this model makes it ideal for driver behavior sensing a safer and better driving environment. This is especially designed for the rented vehicle where the driver does not care about the vehicle condition and doing some rash driving which causes the passenger to feel unpleasant as well as the unsafe traveling. Moreover the rash driving of sudden acceleration and deceleration also decrease the fuel economy. The Active Vehicle Control ECU is designed to measure such an abnormal driving behavior and it not only gives warning to the driver it will also send an abnormal driving status to the vehicle owner. Along with the Intelligent Passenger Safety ECU enables the passengers especially ladies to have safe traveling even during night times. In the near future, these two ECUs can be implemented in the Drive Assist System to enhance vehicle systems for safety and better driving.

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