International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 05 | May-2016 www.irjet.net p-ISSN: 2395-0072

Advanced Driver Assistance for Vehicle Monitoring

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Abstract- *Present Automobiles are being developed by more of electrical parts for efficient operation. The fast growing technology leads to the demand of automotive electronics field. Maximum numbers of the luxurious cars are facilitated with automatic controls for different parameters present in the car surrounding. In automobile industries, CAN protocol is essentially used for communication. The proposed system presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver- vehicle network and can provide technological development for future applications in vehicle's information system. This approach also aims to provide a reliable indication of driver drowsiness based on the character of the driver-vehicle interaction. The development of Advanced Driver Assistance Systems (ADAS) supports the driver in safe, comfortable and economic driving are of major importance to the automotive industry. The system is able to monitor Drowsiness and Alcohol with the help of sensors which can minimize road accidents. The system contains controller block designed using ARM, alcohol sensor and Eye-blink sensors, CAN controller, GPS and GSM modules.*

Keywords— ARM-LPC1768 (Advanced RISC Machines), Eyeblink, Vehicle system, Control Area Network (CAN), Sensor.

1. INTRODUCTION

In the daily life cars and other private vehicles are being used daily by large numbers of people. The increased use of private transport leads to the rising in a number of fatalities that are occurring as a consequence of accidents on the roads; the associated expense and dangers have been identified as a serious problem that is being opposed by modern society. In India maximum number of people losing their life mainly due to the road accidents. As many as 139,671 people lost their lives on India's roads during 2014 – 382 deaths every day.

Earlier work proposed a five-layer context-aware architecture for a driver behavior detection system in VANET that can detect four types of driving behavior in real time driving; normal, fatigued, intoxicated and inattentive driving; it will then alert and monitor the driver and other vehicles on the road by operating in vehicle alarms and sending corrective action respectively[1]. The architectural functionality is divided into three phases, which are the sensing, reasoning and acting phase. The system collects information about the driver, condition of vehicle and changes in the environment in the sensing phase.

Performing reasoning about uncertain contextual information is the responsibility of reasoning phase, so as to deduce the behavior of the driver. The behavior of the driver is considered as uncertain context (High-level contextual information) therefore, effective reasoning techniques about uncertain contextual information must be performed. Driver behavior is developed over the course of driving; therefore, a Dynamic Bayesian Networks model is designed to perform a probabilistic reasoning to infer the behavior of the driver. To capture the static and temporal aspects of behavior and perform probabilistic inference to deduce the driver's current driving style, our model combines information from different kinds of sensors.

However, sensors are arranged with different standards throughout the entire vehicle, the data within an automotive system are varied such as complex data format, heterogeneous data etc... It is facing a challenge that the gap among different systems is hard to fulfill. One solution, a gateway is a bridge to connect various CAN bus with different speed ratio [4]. Moreover, the vehicle system needs the detailed information for the owner and driver. The CAN bus system in an automotive system is introduced firstly. Secondly, the gateway system based on ARM is proposed. Finally, the control system utilized uC-Linux is reported in terms of software design and network architecture.

In order to reduce and control the number of road accidents caused by various driver errors and to improve the safety and efficiency of the traffic, the researchers and companies on Intelligent Transportation System (ITS) are conducted a worldwide survey for many years. In order to avoid the road accidents intelligent vehicle (IV) system designed to assist drivers in any dangerous situations. A new and updated system is introduced which combines the features like obstacle detection, alcohol detection and drowsiness detection. This system detects the mentioned parameters and makes the vehicle advanced by maintaining the parameters within specified safety conditions and avoiding road accidents caused by drowsiness and traffic rules are also not violated. This proposed system enables the passengers to know about the driver condition and if the driver is alcoholic or if the driver is in wrong mood passengers can plan for an alternative.

The main objective of the proposed system is to develop an intelligent vehicle system to avoid road accidents mainly caused due to the negligence of the driver.

2. RELATED WORK

A variety of approaches for detection of driver drowsiness, alcohol and obstacle detection are presented below.

In "Context-Aware Driver Behavior Detection System in Intelligent Transportation Systems" [1] Saif Al-Sultan proposed a context-aware system which detects driver behavior. A VANET (Vehicular ad hoc networks) was introduced to detect abnormal behaviors of drivers and to warn other vehicles on the road to prevent accidents. A model based on Dynamic Bayesian Networks (DBNs) in real time is proposed which is used to detect four various types of driving behavior which are normal, drunk, reckless, and fatigue. By considering 35 pieces of evidences the differentiations made between different types of driver's and their behaviors are observed.

In, "Detection of Driver Fatigue Caused by Sleep Deprivation"[2]. Ji Hyun Yang proposed driver drowsiness indications which are based on the driver–vehicle interaction characteristics. The experimental setup was conducted in a test bed where 12 men participated and have performed the test in two different sessions. This session includes different levels of sleep such as partial sleep deprivation versus no sleep deprivation. This experiment shows that sleep deprivation had a greater effect on skill based cognitive functions. When the drivers were sleep-deprived, their reaction for responding to unexpected disturbances degraded, which caused distractions in vehicle following, and lane changing. In addition to this drowsy driver detection systems were added to the networks based on the paradigm of Bayesian network.

In, "The automatic control system of anti-drunk-driving" [3], Wang dong proposed a phenomenon which mainly aimed at drunk driving in a society, MCU electronic circuit board is used in the system. Alcohol detection system is developed which consists of an alcohol sensor connected to ADC and this ADC is interfaced to a Microcontroller which performs control action. When alcohol consumption is detected by the sensor, it will be directed to MCU .The car will be controlled automatically, can't be able to drive after the driver drinking.

In [4], Minoru Sakairi has developed a system that detects drunk and drowsiness. In this system, to works on breath detection the water-cluster-detecting (WCD) sensor is designed. In the form of water clusters, the WCD breath sensor is used to detect breath in which measuring of positively or negatively charged particles of an electric current present in breath are separated by using an electric field. The WCD breath-alcohol sensor couples the WCD breath sensor with an alcohol sensor and simultaneously detects the electrical signals of both breath and alcohol in the breath. The WCD sensor consists of alcohol sensors which detect the alcohol contents and simultaneously test the electrical signals of breath, which ensures that the sample is not an artificial source but from a person's breath. The designed WCD sensor is highly sensitive to detect alcohol vapors and drowsiness of the driver by measuring breath peaks due to which drunk and drowsy driving is prevented.

In [5], H.Singh attempted to detect the fatigue level of the driver using a video camera to extract different signs like eye state, eyelid movement, gaze movement, head movement and facial expression to measure the fatigue level and warn the driver vain vehicle alarms. The driver's eyes are monitored by the system with the help of a camera and an algorithm was developed to detect symptoms of driver fatigue early enough to avoid an accident. To develop a non-interfering system which can detect fatigue of the driver and issue a timely warning is the main target of this project. Now a day's large number of accidents occurs due to the driver drowsiness. Hence, this work will be helpful in reducing and controlling many accidents, and it will save money and eliminates personal suffering. This will monitor the driver's eyes using the camera and by developing an algorithm we can detect symptoms of driver fatigue early enough to avoid an accident.

In, [6], Chunru Xiong and Jufang Hu developed system uses an ARM controller as the main control unit and double gateway in a control system in a car. ARM is used to obtain high performance, it controls the high speed of the CAN bus control networks and an instrument control to obtain data transfer between nodes and improve their collaborative work; it helps a lot in practical applications.

In, [7], Fernando Garcia proposed that the demanding requirements of safety applications require trustable sensing technologies. Fusion allows providing trustable detections by combining different sensor devices, fulfilling the requirements of safety applications. High-level fusion scheme is presented, is able to improve classic ADAS systems by combining different sensing technologies. The performance of the classic ADAS detection systems is enhanced by means of powerful Data Fusion (DF) algorithms. Fusion is performed in a decentralized scheme (high level), allowing scalability, hence new sensing technologies can easily be added to increase the reliability and the precision of the overall system

3. PROPOSED SYSTEM

The proposed system is divided into two parts as Master, Slave as shown in the figure1. For detecting various parameters like driver drowsiness, driver's alcohol content the ARM controller slave is used. The data which is received from the slave are collected and to provide control action such as alerting the driver is the responsibility of the master block. GPS and GSM modules are also used to provide the location of the vehicle which is useful for tracking the vehicle's position. For exchanging the information and for communication both the ARM controllers (master and slave) are connected to CAN bus protocol. CAN is used for fast and good communication.

3.1. Master section

The Master block is responsible for monitoring alcohol and drowsiness. In the above figure 1, the lower part shows the master section of the ARM controller. Whenever alcohol or drowsiness of a driver is detected, the controller monitors and provides control action like interlocking the vehicles ignition system, alerting the driver. The Master is connected with GPS and GSM module which are interfaced to the controller to track the vehicle and it sends the location information (latitude and longitude information) to the tracking section.

3.2. Slave section

In the above figure 1, the upper part shows the slave section of the ARM controller. This block is responsible for detecting the driver's fatigue like Alcohol content and Drowsiness. This driver fatigue can be detected using MQ303 alcohol sensor and an eye-blink sensor for alcohol content and drowsiness respectively.

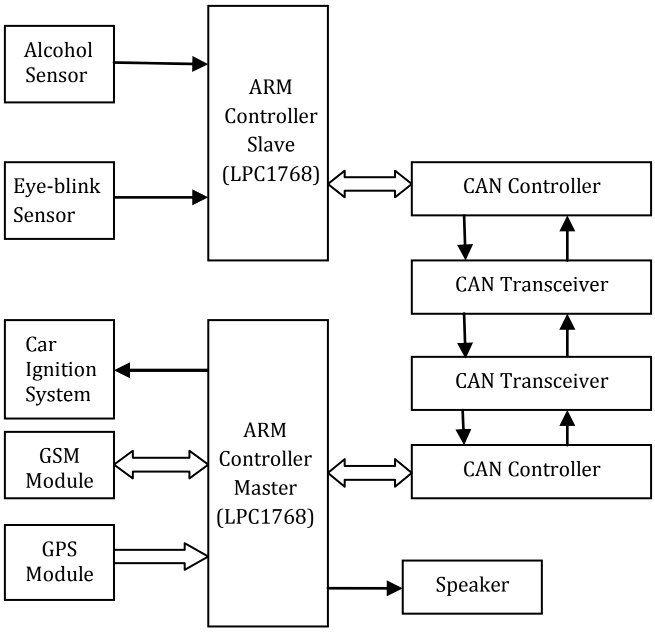

Fig-1: Proposed block diagram

3.3. Alcohol Sensor

This alcohol sensor shown in figure.2 is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. This sensor has the high sensitivity and fast response time. It provides an analog resistive output based on how much alcohol is present in the driver body. The circuit is very simple with only one resistor. 0-3.3V ADC could be a simple interface.

Fig-2: Alcohol Sensor

3.4. Eye Blink Sensor

The eye blink sensor is shown in the figure.3 works by illuminating the eye and/or eyelid area with infrared light, then monitoring the changes in the reflected light using a phototransistor and differentiator circuit. The exact functionality depends greatly on the positioning and aiming of the emitter and detector with respect to the eye.

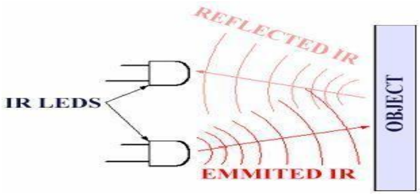

Fig-3: Eye Blink Sensor (IR Leds)

4. STEP BY STEP PROCEDURE OF THE SYSTEM

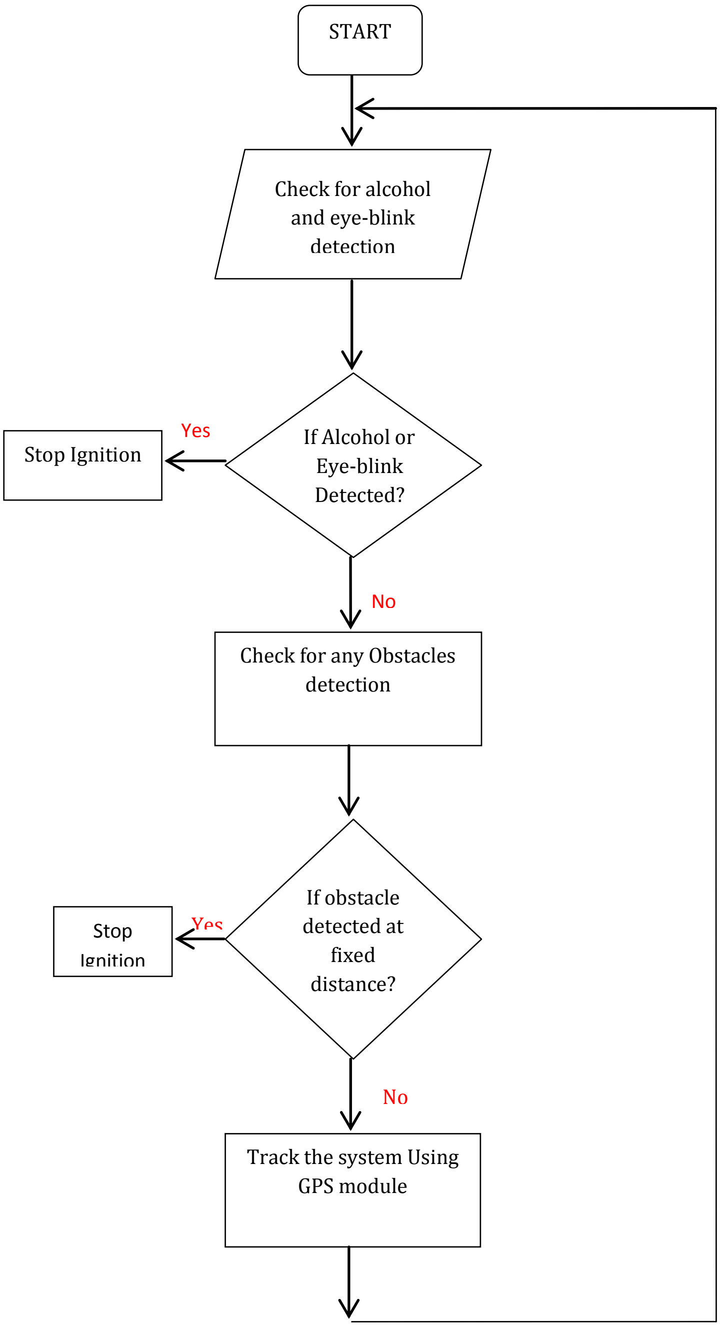

Fig-4: Logic Flow for the system

The flow diagram of the system is shown in figure 4. Whenever driver enters into the vehicle he is told to provide an alcohol sample which is taken with the help of alcoholic sensor MQ303 and drowsiness detection is done by Eye-blink sensor (encoder). If the value of detected alcohol is reached the threshold limit the ignition is interlocked. For drowsiness detection, an encoded circuit as an eye-blink sensor is used. The driver is able to start the vehicle when nothing is detected.

A continuous track of vehicle is carried out with tracking system which uses GPS module for locations coordinated and GSM module for reception of locations coordinated from the vehicle. This process is carried out continuously due to which the road accidents can be minimized and track of vehicle is also kept.

5. HARDWARE

- ARM LPC2129 controller
- MQ303 Alcohol sensor
- Eye-blink sensor
- GSM module
- GPS module
- CAN transceiver

6. SOFTWARE

- Keil
- MATLAB
- Visual Basics

7. CONCLUSION

The control system can be used in all kinds of vehicles, can also monitor the alcohol content of drivers, thus prevent frequent occurrence of the traffic accident caused by drunk driving. In order to detect the fatigue state of the driver and gives warning in few second, eye movements will be detected by the system. This system is able to detect normal and abnormal driving behavior of a driver thus leads to a comprehensive system. The proposed system deals with detection of Alcohol, Drowsiness and also obstacles in front of the car at a fixed distance using sensors and accordingly precautions are taken. Using GPS and GSM modules the tracking of the vehicle is also possible. The proposed system can be implemented to the cars of low and average cost also and thus, this system can serve the medium class people also.

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