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An Innovative Non-Intrusive Road Driver Assistance System for Vital Signal Monitoring

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Abstract:

This paper describes an in-vehicle nonintrusive bio potential measurement system for driver health monitoring and fatigue detection. Previous research has found that the physiological signals including eye features, electrocardiography (ECG), electroencephalography (EEG) and their secondary parameters such as heart rate and HR variability are good indicators of health state as well as driver fatigue. A conventional bio potential measurement system requires the electrodes to be in contact with human body. This not only interferes with the driver operation, but also is not feasible for long-term monitoring purpose. The driver assistance system in this paper can remotely detect the bio potential signals with no physical contact with human skin. With delicate sensor and electronic design, ECG, EEG, and eye blinking can be measured. Experiments were conducted on a high fidelity driving simulator to validate the system performance. The system was found to be able to detect the ECG/EEG signals through cloth or hair with no contact with skin. Eye blinking activities can also be detected at a distance of 10 cm. Digital signal processing algorithms were developed to decimate the signal noise and extract the physiological features. The extracted features from the vital signals were further analyzed to assess the potential criterion for alertness and drowsiness determination.

Keywords

Driver health monitoring and fatigue detection ECG and EEG, ZigBee, driver assistant system, Low Cost, Embedded system; Signal monitoring...

1. Introduction

Growing aging population is a global phenomenon in recent decades. The increasing number of elderly car drivers and the prevalence of chronic diseases call for driver assistance systems to monitor the health state of drivers. For medical-assistance systems, the reliable measurement of vital signals such as electroencephalography (EEG) and electrocardiography (ECG) is one of the most important features [1]. EEG, the recording of electrical activity along the scalp, reflects the brain activities and is widely used in the diagnosis of coma and encephalopathy. ECG and the secondary parameters including heart rate (HR) and heart rate variability (HRV) are key indicators of the cardiac health state. The stressful condition of driving and the possible sudden scenarios on the road, e.g., fatal traffic accidents, may cause severe effects especially on the drivers with chronic diseases [2]. Therefore, a driver assistance system that can monitor the multiple vital signals during driving is highly desirable for elderly drivers or drivers with chronic diseases.

For drivers at all ages, drowsiness is one of the most prevalent root causes of accidents. It leads to nearly 17% of all fatal crashes in recent years based on the data published by the National Highway Traffic Safety Administration [3]. In particular, truck driver fatigue is a factor in 3%–6% of fatal crashes involving large trucks. The term driver fatigue is defined as decreased mental alertness that impairs performance during some cognitive tasks such as driving [4]. The sustained mental or physical fatigue can eventually result in sleepiness. Some studies considered sleepiness and fatigue as similar mental conditions [5], [6].

In this paper, we also used the general concept of sleepiness, drowsiness, and fatigue.

A number of physiological parameters have been found to indicate the state of fatigue. Eye activity [7], [8], EEG, ECG, and HRV are the major physiological indicators used for assessment of sleepiness. Feature extraction was developed based on different types of physiological signals to classify drowsy versus awaken drivers. Therefore, the vital signals (such as ECG, EEG, and eye blinking) are not only indicators of the health state of drivers but also can be used to detect the driver fatigue.

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The conventional ECG and EEG systems use Ag/AgCl electrodes with a wet electrolyte. Skin preparation is required before placing the electrodes. For eye activity detection in driving application, video cameras are commonly used to detect the eye-related parameters such as PERCLOS and reopening time [7]. Image processing algorithms and related computation processors are necessary to extract the features from video images.

However, few other methods were explored to detect eye activities. In contrast to the conventional wet electrodes, capacitive electrode (CE) provides an alternative way of surface potential measurement without direct contact with skin. This nonintrusive electrode can sense the bio potentials outside the hair or cloth. It enables long-term monitoring without skin irritations. A number of devices using CE have been reported for health care with sensors placed on bed, chairs and wheelchair, exercise assistance, and automobiles [1].

ECG or EEG signals can be detected from these systems. In the automobile application, high interference environment (e.g., when engine is on) and severe motion artifacts are unavoidable. Wet electrodes were commonly used to guarantee good contact with skin and prevent relative motion. CEs were also attempted by several groups for unobtrusive ECG measurement.

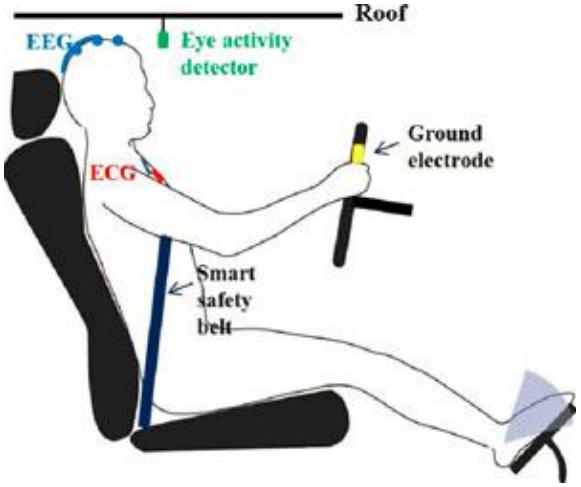

Fig. 1. Driver assistance system.

2. Project Design

Existing system:

We have various kinds of accident alert systems in which when a driver met with an accident can be informed to respective family members through an sms but also other systems like auto breakings in the case of obstacle detection but there is no system which monitors the driver conditions and avoids the accident our system will helpful in this manner.

.As we know that it is not possible to know the exact location of the vehicle met with an accident exactly in the way how it is happened, due which reasons the accident occurred. Whether it may be due to the alcohol consumption or else the engine problem etc or due driver illness.

Using GSM we have vehicular safety detection but it is not helpful to know the driver condition of the vehicle who is driving the vehicle. It just identifies the vehicular location met with an accident. So in order to absorb the abnormal behavior of the driver we need to know the advanced driver assistance system which helps in identifying the location of the vehicle with which condition the vehicle met with an accident.

Proposed system:

The main objective of the proposed system is to avoid accident occurrence due to driver abnormal behavior. At the time of vehicle start alcohol sensor will detects the alcohol consumption of the driver if the driver alcohol consumption is above 30mg means access for user is denied by locking of ignition. And if alcohol consumed is limited means the vehicle will be running and next the driver may meet accident due to drowsiness so eye blink sensor monitors the eye blink status of the driver if for particular duration driver doesn't blink his eyes means the vehicle is stopped. Heart strokes may be another reason for accident so the heart rate of patient is measured through Heartbeat sensor if the heart rate detected is beyond threshold value then along with vehicle stop condition the status will be informed to registered number along with location.

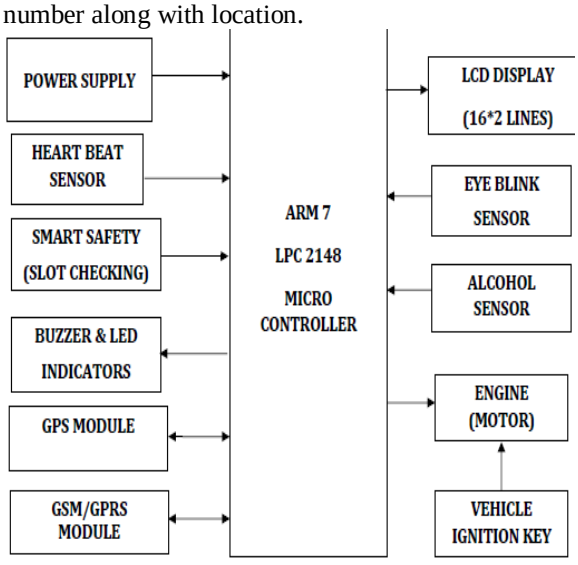

Figure 2: block diagram of the project

The objectives of the project include:
1. Automatic Vehicle to user Communication.
2. Multiple sensors based Vehicle High security.
3. Automatic emergency SMS alert to owner.
4. Auto Engine Ignition Control

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5. Multiple nearby vehicles can communicate using wireless communication.

The system has heart beat sensor and alcohol sensor which is fixed to the vehicle, this project enables the user to driver health monitoring, and abnormal conditions, and also providing theft detections, avoiding accidents with the drunk's drivers. To in any direction using a wireless communication, which is connected to a vehicle that can move with the speed and direction specified by the user.

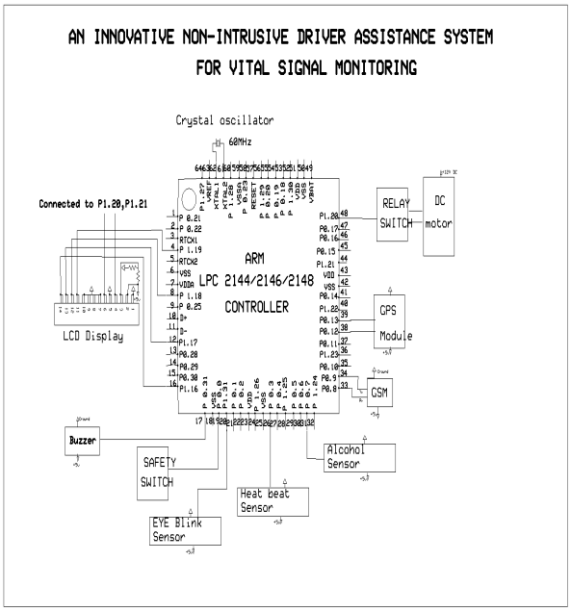

Figure 3: Schematic Diagram of the project

ARM:

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7EJ-S processor is a synthesizable core that provides all the benefits of the ARM7TDMI low power consumption, small size, and the thumb instruction set while also incorporating ARM's latest DSP extensions and enabling acceleration of java-based applications. Compatible with the ARM9™, ARM9E™, and ARM10™ families, and Strong-Arm® architecture software written for the ARM7TDMI processor is 100% binary-compatible with other members of the ARM7 family and forwards-compatible with the ARM9, ARM9E, and ARM10 families, as well as products in Intel's Strong ARM and x scale architectures. This gives designers a choice of software-compatible processors with strong price-performance points. Support for the ARM architecture today includes: Operating systems such as Windows CE, Linux, palm and SYMBIAN OS. More than 40 real-time operating systems, including qnx, Wind River's vxworks and mentor graphics' vrtx. Co-simulation tools from leading EDA vendors a variety of software development tools.

The project of "AN INNOVATIVE NON-INTRUSIVE DRIVER ASSISTANCE SYSTEM FOR VITAL SIGNAL MONITORING" was designed such that the process can be operated using GSM technology and the EYE BLINK and HEART BEAT sensors detects the human DROWSINESS and when the presence of human was DRUNK detected it stops the engine and buzzers an alarm system by sending an SMS to the saved number with location tracking of the accident..

3. Conclusion

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

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Student:

Guide: