INVENTIVE NON-CONTACT DRIVER DROWSINESS DETECTION SYSTEM FOR VITAL SIGNAL MONITORING

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Abstract:

This paper describes an in-vehicle non-intrusive bio-potential measurement system for driver health monitoring and fatigue detection. Previous research has found that the physiological signals including eye features, Electrocardiography (ECG), and their secondary parameters such as HR and HRV 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, 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 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: Micro controller (LPC2148), Eye blink & ECG sensor, Alcohol sensor, GSM/GPRS, GPS Module, Dc motor (Engine)

I. 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 ECG is one of the most important features. 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. 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 (NHTSA). 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. The sustained mental or physical fatigue can eventually result in sleepiness. Some studies considered sleepiness and fatigue as similar mental conditions. In this paper we also used the general concept of sleepiness, drowsiness, and fatigue.

II. The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

III. Design of Proposed Hardware System

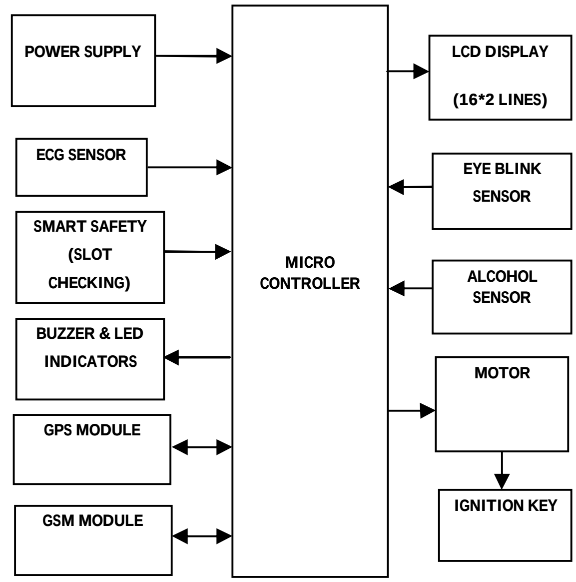

Fig.1.Block diagram

In this project we have two monitoring steps; by this we can provide a more accurate detection. For the detecting stage, the eye blink sensor always monitoring eye blink moment. It continuously monitoring eye blink moments and where collected data will be transmitted to a micro controller and the micro controller digitizes the analog data. If the warning feedback system is triggered, the micro controller makes a decision which alert needs to be activated.

And the second application in this paper is to detect the alcohol detection and also to track the vehicle to find the culprit and in intimation to the Control Room with their location, and also the vehicle can be stopped. In this we use of GSM modem to trace the vehicle and also to inform to the control room. There is also an indicator is fixed in the front and back of the vehicle to show to the opposite vehicle by means of this the driver can able to identify that driver was drunk.

The third application of the project is to provide security to the driver. ECG sensor is used to detect the pulse of the driver. The entire driving assistance system is shown in (fig.2). If the driver is in abnormal condition that is pulse rate of the person is high then the vehicle is stopped and the position of the vehicle is traced by GPS this information is sent to the concerned doctor.

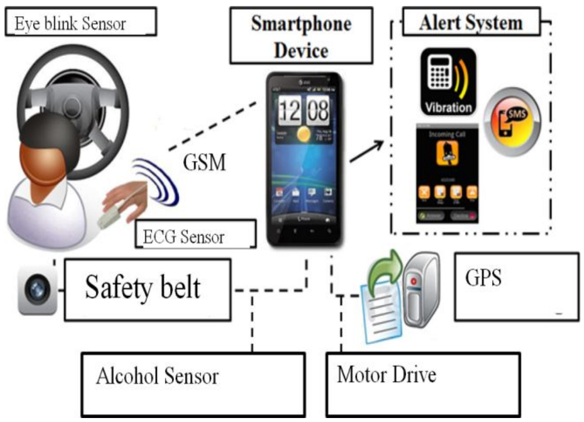

Fig.2.Driving Assistance System

IV. Board Hardware Resources Features:

***Alcohol Sensor*:**

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC.

Fig.3.Alcohol Sensor

***Eye Blink Sensor*:**

The eye-blink sensor 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.

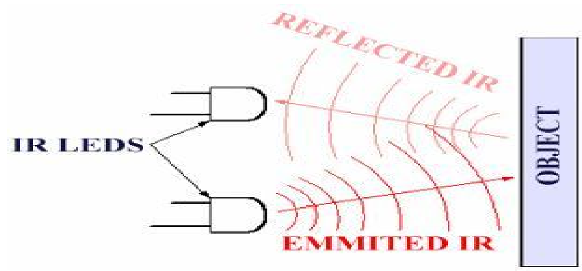

Fig.4.Eye Blink Sensor(IR Led's)

ECG:

The ECG sensor measures electrical potentials produced by the heart (Electro-cardiogram). These small voltages are measured at the skin of the wrists and elbow through electrodes. The ECG sensor can also be used to measures the electrical potentials generated by muscle cells when these cells contract and relax (Electromyogram). For safety reasons the sensor uses an optical coupler to avoid any direct electrical contact between the person whose ECG is measured and the measurement interface or computer. The ECG sensor is delivered together with a package of 100 electrode patches.

Fig.5.ECG Sensor

GPS:

Global Positioning System tracking is a method of working out exactly where something is. A GPS tracking system, for example, may be placed in a vehicle, on a cell phone, or on special GPS devices, which can either be a fixed or portable unit. GPS works by providing information on exact location. It can also track the movement of a vehicle or person. So, for example, a GPS tracking system can be used by a company to monitor the route and progress of a delivery truck, and by parents to check on the location of their child, or even to monitor high-valued assets in transit.

A GPS tracking system can work in various ways. From a commercial perspective, GPS devices are generally used to record the position of vehicles as they make their journeys. Some systems will store the data within the GPS tracking system itself (known as passive tracking) and some send the information to a centralized database or system via a modem within the GPS system unit on a regular basis (known as active tracking) or 2-Way GPS.

GSM

An embedded system is a special-purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale.

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. The standard is used in approx. 85 countries in the world including such locations as Europe, Japan and Australia.

Motor Drive:

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

Fig.6.Gear Motor

In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively. Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

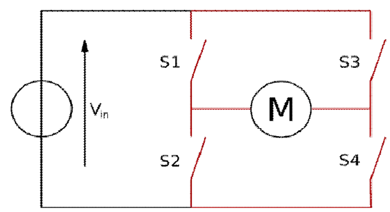

Fig.7. H-Bridge

CONCLUSION

In this paper, we developed an innovative non-invasive driver assistance system. The system features high sensitivity in the measurement of bio-potentials on human body and requires no physical contact with skin. This method causes less mental or physical loads to the drivers and is advantageous for long term driver monitoring purpose. The system can measure physiological signals such as eye blinking activity and ECG signals in the real time, which are widely accepted vital signals for health monitoring and drowsiness measures. The performance of the system was verified on a high-fidelity driving simulator. Experiments were conducted on subjects with different alertness and sleepiness conditions. The eye activity and ECG features were recorded on the alert and drowsy drivers using the non-intrusive system. Results showed that the blinking duration, and the LF, HF components from HRV are significant physiological measures between alertness and drowsiness, which are consistent with other studies. Our long term goal is to develop this technology into a robust in-vehicle driver diagnosis and medical assistance system to improve the health and safety of drivers.

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