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Design of Intelligent Embedded System for Driver Vital Signal Monitoring

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Abstract:

The main idea behind this project is to develop a non-intrusive system which can detect fatigue of the driver and issue a timely warning since a large number of road accidents occurs due to driver drowsiness. Hence this system will be helpful in preventing many accidents, and consequently save money and reduce personal suffering. In the proposed method the Cardio respiratory Phase Synchronization technique is used for finding the driver drowsiness physiologically. This project is to monitor the driver's heartbeat and breathing rate by using ECG and Spo2 sensors respectively.

Our Embedded project is to design and develop a low cost feature which is based on embedded platform for finding the driver drowsiness. Specifically, our system includes sensors which are connected to driver to capture heart beat and breathing rate. The camera is used to capture eye movements of driver. If the driver is not paying attention on the road ahead and a dangerous situation is detected, the system will warn the driver by giving the warning sounds through buzzer, and the car will stop when drowsiness detected.

Index Terms:

Driver Drowsiness, ECG, Spo2, Camera, Cardio respiratory phase synchronization.

I.INTRODUCTION:

The Real Time dangerous behaviors which are related to fatigue whether in form of eye closing, head nodding or the brain activity.

Hence we can either measure change in physiological signals, such as brain waves, heart rate and eye Blinking or by measuring physical changes such as sagging posture, leaning of driver's head and open/closed state of eyes. The previous technique, while more accurate, is not realistic since highly sensitive electrodes would have to be attached directly on the driver's body and hence which can be annoying and distracting to the driver. In addition long time driving would result in perspiration on the sensors, diminishing their ability to monitor accurately.

A.Flow chart

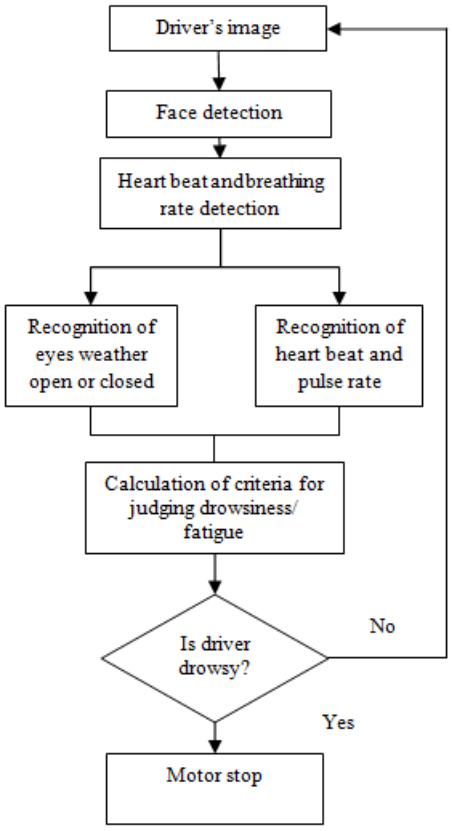

Fig1: Flow Chart for ECG and Spo2 tracking system

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The second technique is to measure physical changes (i.e. open/closed eyes to detect fatigue) is well suited for real world driving conditions since it is non-intrusive by using a video camera to detect changes. In addition micro sleeps that are short period of sleeps lasting 2 to 3 seconds are good indicator of fatigue state. Thus by continuously monitoring the eyes of the driver one can detect the sleepy state of driver and timely warning is issued.This system will detect a driver fatigue by processing of eye region and head position. As shown in flow chart in Fig.1. After image acquisition, face detection is the first stage of processing. Then symptoms of hypo-vigilance are extracted from the eyes. If eyes are blinking normally no warning is issued but when the eyes are closed for more than half second and also if the head is not in straight position i.e., if the head in different angle then this system issues warning to the driver in form of alarm and vibration.

II.BLOCK DIAGRAM:

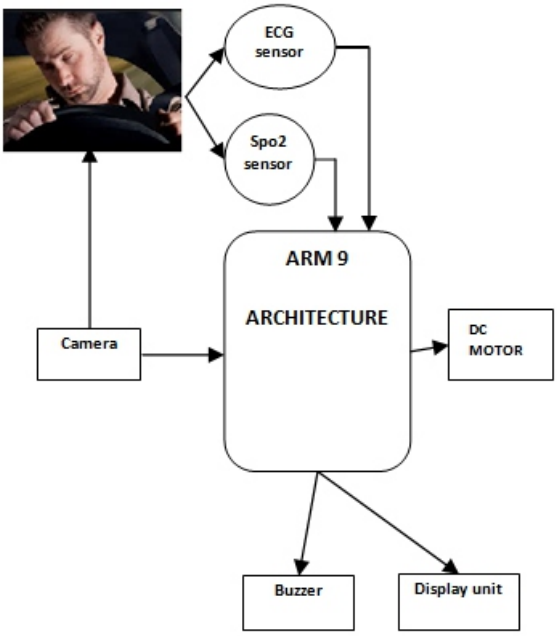

Fig. 2 ECG and Spo2 based driver Fatigue Monitoring and Warning system.

The Embedded project is to design and develop a low cost feature which is based on embedded platform for finding the driver drowsiness. Specifically, our system includes a webcam placed on the steering column which is capable to capture the eye movements and head movement. If the driver is not paying attention on the road ahead and a dangerous situation is detected, the system will warn the driver by giving the warning sounds through buzzer.

When our application starts running it first check all the devices and resources which it needs are available or not. After that it checks the connection with the devices and gives control to the user. The GUI for the user has the following options. An optional label is used for displaying the image taken from the camera. A status box is for representing whether drowsiness is detected or not. We cannot get S3C2440 microcontroller individually. We will get it in the form of FRIENDLY ARM board otherwise we can call it as MINI 2440 board. Our ARM board comes with integrated peripherals like USB, ADC and Serial etc. On this board we are installing Linux operating system with necessary drivers for all peripheral devices .In this Visual analysis of heart beat and pulse rate, we are using USB camera to detect the EYE STATE, ECG and SPO2 values to calculate heart beat and pulse rate which are connected to the ARM controller. These values will be calculated by implementing some image processing algorithms.

III.HARDWARE IMPLEMENTATION:

A.Mini2440 Development Board:

Mini2440 is a practical low-cost ARM9 development board, is currently the highest in a cost-effective learning board. It is for the Samsung S3C2440 processor and the use of professional power stable core CPU chip to chip and reset security permit system stability.

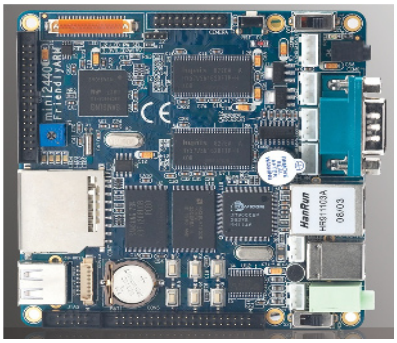

Fig3. Mini2440 Development board

The mini2440 Immersion Gold PCB using the 4-layer board design process, professional, such as long-wiring to ensure that the key signal lines of signal integrity, the production of SMT machine, mass production; the factory have been a strict quality control, with very detailed in this manual can help you quickly master the development of embedded Linux.

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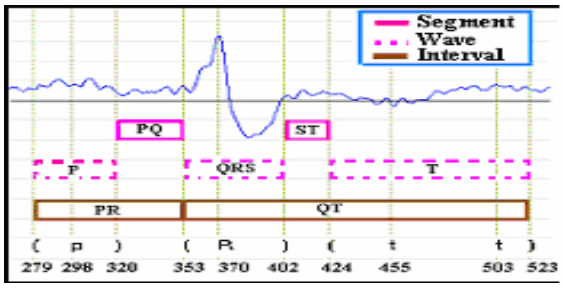
B.UVC Driver Camera:

Fig4. UVC Driver Camera

A UVC (or Universal Video Class) driver is a USB-category driver. A driver enables a device, such as your webcam, to communicate with your computer's operating system. And USB (or Universal Serial Bus) is a common type of connection that allows for high-speed data transfer. Most current operating systems support UVC. Although UVC is a relatively new format, it is quickly becoming common.

C.ECG Sensor:

Electrocardiography is a transthoracic (across the thorax or chest) interpretation of the electrical activity of the heart over a period of time, as detected by electrodes attached to the surface of the skin and recorded by a device external to the body. The recording produced by this noninvasive procedure is termed an electrocardiogram (also ECG or EKG). An ECG is used to measure the heart's electrical conduction system. It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into a waveform.



D.Spo2 Sensor:

Pulse oximetry is a non-invasive method allowing the monitoring of the oxygenation of a patient's hemoglobin. A sensor is placed on a thin part of the patient's body, usually a fingertip or earlobe, or in the case of an infant, across a foot. Light with red wavelengths and light with infrared wavelengths is sequentially passed from one side to a photo detector on the other side. Changing absorbance of each of the two wavelengths is measured, allowing determination of the absorbance's due to the pulsing arterial blood alone, excluding venous blood, skin, bone, muscle, fat, and (in most cases) fingernail polish. Based upon the ratio of changing absorbance of the red and infrared light caused by the difference in color between oxygen-bound (bright red) and oxygen-unbound (dark red or blue, in severe cases) blood hemoglobin, a measure of oxygenation (the per cent of hemoglobin molecules bound with oxygen molecules) can be made.

IV. SOFTWARE IMPLEMENTATION

A.Linux Operating System:

Linux or GNU/Linux is a free and open source software operating system for computers. The operating system is a collection of the basic instructions that tell the electronic parts of the computer what to do and how to work. Free and open source software (FOSS) means that everyone has the freedom to use it, see how it works, and changes it. There is a lot of software for Linux, and since Linux is free software it means that none of the software will put any license restrictions on users.

This is one of the reasons why many people like to use Linux. A Linux-based system is a modular Unix-like operating system. It derives much of its basic design from principles established in UNIX during the 1970s and 1980s. Such a system uses a monolithic kernel, the Linux kernel, which handles process control, networking, and peripheral and file system access. Device drivers are either integrated directly with the kernel or added as modules loaded while the system is running.

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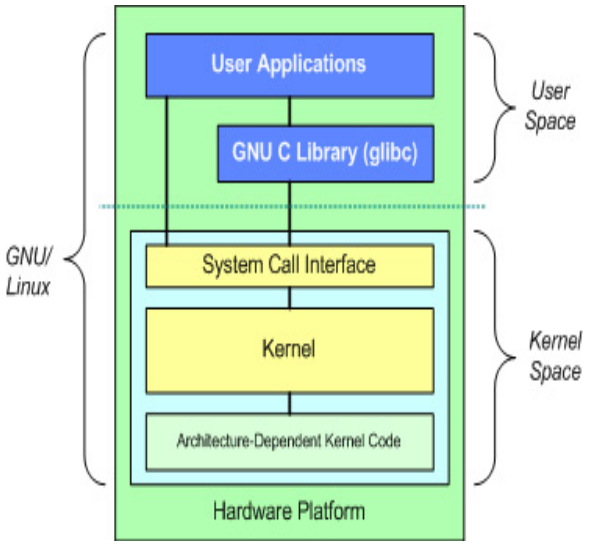

Fig.5: Architecture of Linux Operating System

B.Qt for Embedded Linux:

Qt is a cross-platform application framework that is widely used for developing application software with a graphical user interface (GUI) (in which cases Qt is classified as a widget toolkit), and also used for developing non-GUI programs such as command-line tools and consoles for servers. Qt uses standard C++ but makes extensive use of a special code generator (called the Meta Object Compiler, or moc) together with several macros to enrich the language. Qt can also be used in several other programming languages via language bindings. It runs on the major desktop platforms and some of the mobile platforms. Non-GUI features include SQL database access, XML parsing, thread management, network support, and a unified cross-platform application programming interface for file handling.

C.OpenCV Library:

Computer vision is a rapidly growing field, partly as a result of both cheaper and more capable cameras, partly because of affordable processing power, and partly because vision algorithms are starting to mature. OpenCV itself has played a role in the growth of computer vision by enabling thousands of people to do more productive work in vision. With its focus on real-time vision, OpenCV helps students and professionals efficiently implement projects and jump-start research by providing them with a computer vision and machine learning infrastructure that was previously available only in a few mature research labs.

V. RESULTS:

1. Successfully implemented and tested basic driver alert monitoring on ARM9 Hardware.

2. The ARM 9 architectural support to Haar and Viola Jones algorithm is explored to detect objects in project.

3. Captured the images and displayed it on TFT screen on real-time basis using ARM9, Webcam.

4. Using algorithms driver movement is monitored continuously like nodding head, tilting etc.

6. When sensors activated then ARM generates signal to stop the motor.

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VI.CONCLUSION:

This system will detect eye and head movement to detect the fatigue state of driver and gives warning in half second. It has been developed by integrating features of all the hardware components and software used. By monitoring the eyes and head positions using camera and using this new algorithm we can detect symptoms of driver fatigue early enough to avoid an accident. It uses highly advanced ARM9 board and with the help of growing technology the project has been successfully implemented.

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