An Integrated Driver Monitoring and Adaptive Assistant Security System

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***Abstract*---- This paper is proposed to implement several related concepts of driver vigilance and driver safety in the field of cognitive vehicles. It provides superior safety by integrating the driver monitoring system into the vehicular control system. The existing system uses eye blink sensor technology alone for driver fatigue detection. Since it has some drawbacks, this paper suggests valuable solution to such problems by employing various features like Mobile Baseband Monitoring, Hands Free Auto Reply SMS, Driver Fatigue Warning, Drunk and Drive Prevention, Collision Pre safe Activation, GSM and GPS Based Accident/Panic Alert. So it is not only important to develop more active safety features to avoid accidents but it is equally important to develop cost-effective technological solutions that can accurately identify the driving behavior of drivers and to assist them.**

***Keywords*---Short Messaging Service (SMS), Global System for Mobile Communication (GSM), Global Positioning System (GPS).**

I. INTRODUCTION

According to experimental and real-world study, the root cause of majority of accidents can be traced back to the behavior of the one who drives the vehicle, the driver himself. The existing system provides a very narrow solution to this problem of monitoring the behavior of driver. It alerts the driver who is drowsy using eye blink sensing technology. It uses a wearable eye blink sensor which checks the eye blink of driver and if the count of eye blink decreases, it means that the driver is drowsy and alerts him using buzzer alarm and locks the ignition system of the vehicle.

But it has the drawback of passing continuous stream of IR signals from eye blink sensor which may affect the eye sight of driver and it does not prevent the driver's other malfunctions such as using mobile phones, consuming alcohol, feeling drowsy or fatigue while driving which pose danger to his life. So it is vital to develop solution for these problems which is done using the proposed system. It also has improved efficiency of ARM Cortex M3 than ARM 7 in existing system.

This paper [1] presents a low-cost and simple distributed force sensor for measuring grip force and hand position on a steering wheel for detecting driver's fatigue, to prevent road accidents. Driver fatigue detection using face recognition [3] has the main disadvantage of variation of face with age and the detection in color images are plagued by poor performance in the presence of scale variation, variation in skin color, complex backgrounds. The drowsiness warning system using artificial intelligence [8] involves eye detection by image processing and artificial techniques like fuzzy logic, but lack of proper light after sunset can cause problems in reading the images where infrared light source could be a better solution. A study on the HRV [14] provides accurate results for driver fatigue detection by obtaining minimum number of samples to obtain valid results that requires a minimum number of beats. The proposed system avoids using of mobile phones, drunk and driving and has provision for driver fatigue warning, collision pre-safe activation, GSM/GPS based accident/panic alert.

This paper is organized as follows: Section 1 is an introduction, section 2 explains the proposed system, section 3 illustrates design analysis of hardware prototype, section 4 shows the integration and development of software module, section 5 presents the experimental results and section 6 concludes and gives future enhancement.

II. PROPOSED SYSTEM

A. Mobile Baseband Monitor Unit

Any activity in driver's mobile phone such as attending incoming calls, making outgoing calls and SMS texting will be monitored using the built in Mobile Baseband Sensor circuit while the vehicle is running and it will be slowed down to a halt by applying the brakes automatically if such activity is detected.

The driver can regain the vehicle control by simply pressing the brake pedal. The Accelerator Pedal Sensor and Brake Pedal Sensor along with DC Motor controlled wheel are used to demonstrate a running vehicle.

B. Hands Free Auto-Reply SMS Mode

The system has a GSM modem with a SIM card. The driver needs to activate call divert to this number before entering this mode. In this mode, upon receiving an incoming call while driving, the GSM modem automatically sends an SMS to the calling number with a fixed message indicating that the person is driving. The system has a dashboard

graphics LCD that can show the calling number. This makes the driver 100% hands free.

C. *Driver Fatigue Detection System*

Heart rate variability (HRV) and steering-wheel grip pressure are used to estimate the driver's fatigue level.

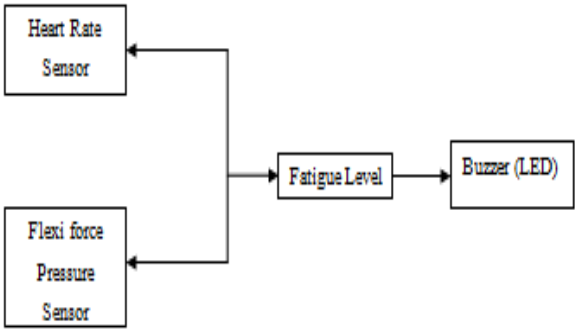

Fig.1. Driver Fatigue Detection

A digital pulse output Heart Rate Sensor measures HRV and an analog output Flexi Force Pressure Sensor measures the steering-wheel grip force and the warning is issued with buzzer and LED lights. If the driver ignores this warning and continues to drive then the system will apply brakes automatically to slow down and halt the vehicle. Additionally the system can set for periodic wake-up call using keypad buttons and the dashboard graphics LCD. This feature provides a method for detecting the early signs of fatigue/drowsiness during driving.

D. *Drunk and Drive Prevention Mode*

The alcohol detection system involves the ignition circuit of the vehicle being controlled by interfacing a set of sensor, logic circuit and a microprocessor. It would instruct the driver to blow air into the sensor unit and checks the alcohol content present in the drivers breathe. If the value has crossed a certain limit the vehicle ignition will be locked which prevents a drunken driver from starting the vehicle. An Alcohol Sensor unit is integrated into the system for this purpose.

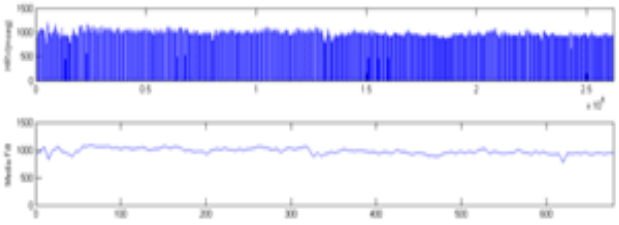

Fig.2. HRV of Relaxed Driver

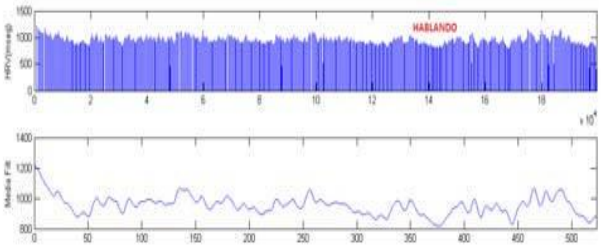

Fig.3. HRV of Fatigue Driver

E. *Collision Pre-Safe Activation Phase*

It uses pulse output SONAR to detect an imminent crash and has two warning stages in this project. If there is any collision detected by the SONAR, the system enters into first warning stage and produces audible and visual warnings. If first warning is ignored, and if the system predicts the collision is unavoidable, then it tightens the seatbelt using the inbuilt Servo Motor mechanism providing seat belt protection, and automatic application of brakes to lessen severity of predicted crash.

F. *GPS and GSM Based Accident/Panic Alert System*

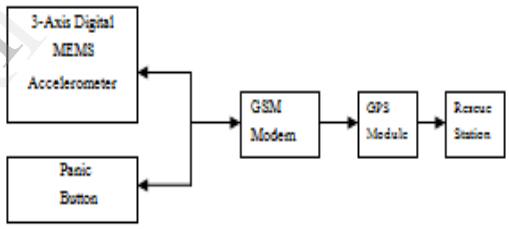

Fig.4. Accident Alert System

During an emergency situation the driver can indicate his location to outside world using a simple panic button.By pressing this button, the driver can send an SMS about his current location information to a pre stored number. Also in the event of a crash, the system senses that using 3-Axis Digital MEMS Accelerometer sensor and will automatically generate a similar SMS to a pre stored number about the crash location information.

III. DESIGN ANALYSIS OF HARDWARE

ARM Cortex-M3 (LPC1313) is a microcontroller for embedded applications featuring a high level of integration and low power consumption. It operates at CPU frequency range of 72 MHz, containing 32KB of on chip flash memory. It is of low cost and supports download limit of 128 KB.

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field. When it is then placed in an external magnetic field, it experiences a force proportional to the current in the conductor and to the strength of the external magnetic field.

The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. .In most common DC motors the external magnetic field is produced by high-strength permanent magnets.

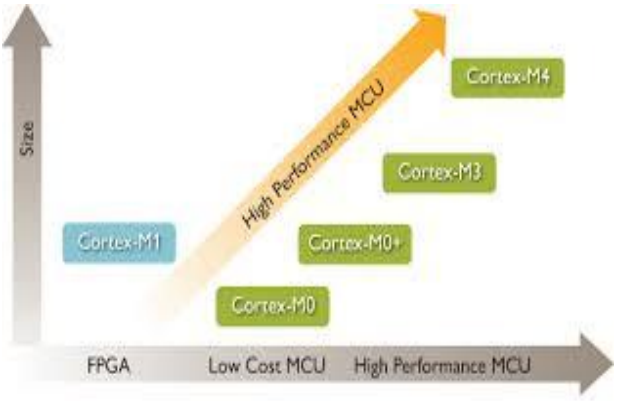

Fig.5. Perfomance Comparison

GSM is an open, digital cellular technology used for transmitting mobile voice and data services. GSM phones require a small electronic chip, called a SIM card, to be inserted into a slot in the handset. GSM is an international roaming and 78% of world market uses GSM.

Alcohol Sensors operate on the heat transfer principle to measure mass air flow. They consist of micro bridge microelectronic and micro electro mechanical system (MEMS) with temperature sensitive resistors deposited with thin films of platinum and silicon nitride. The nitride MEMS sensing die is located in a precise and calculated air flow channel to provide repeatable flow response. A 3.3V dc operating voltage option and low power consumption allow for use in battery-driven and other portable application.

Flexi force pressure sensor is a robust polymer thick film device that exhibits a decrease in resistance with increase in force applied to the surface of sensor. This force sensitivity is optimized for human touch control of electronic devices such as an automotive electronic device. Actuation force is as low as 0.1N and sensitivity range up to 10N. It is simple and easy to integrate.

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles. It most commonly consists of a number of switches or sensors connected to a control unit. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise).

Heart rate can be determined by measuring pulse rate. The pulse rate is the rate at which a series of pressure waves travel within an artery. Heart rate sensor measures the heart rate variability. Each time blood surges from aorta, the elastic walls of blood vessels expand and stretch, causing a pulse.

Fig.6. Servomotor

A servomotor (servo) is an electromechanical device in which an electrical input determines the position of the armature of a motor. Servos are used extensively in robotics and radio-controlled cars, aircrafts and boats. The position of the armature is determined by the duty cycle of a periodic rectangular pulse train.

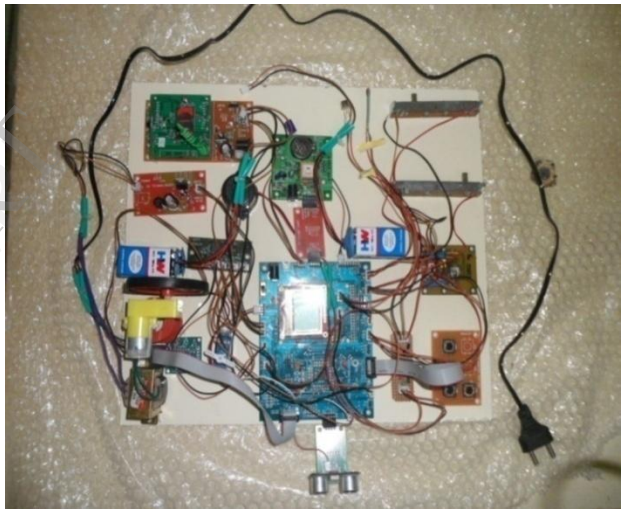

Fig.7. Hardware Prototype

IV. DEVELOPMENT OF SOFTWARE MODULE

In this project, the program codes are written using embedded c language and it is developed using LPC Xpresso v3.6.3 development tool and simulated using Proteus Design Suite 8.0 platform.

A. Proteus 8 Professional

Proteus 8.0 represents over three years continuous development and includes improvements to every area of the software suite. Major work on the application framework together with the introduction of a common database provides a much smoother workflow for users while the rich new feature set saves time and effort in the design lifecycle.

A demonstration version can be downloaded directly from the lab center website and you can then either watch getting started movies from the application home page or access the tutorial documentation for evaluation.

B. LPC Xpresso

LPC Xpresso is a new, low-cost development platform available from NXP. The software consists of an enhanced, Eclipse-based IDE, a GNU C compiler, linker, libraries and an enhanced GDB debugger. The hardware consists of the LPC Xpresso development board which has an LPC-Link debug interface and an NXP LPC ARM based microcontroller target. LPC Xpresso is an end-to-end solution enabling embedded engineers to develop their applications from initial evaluation to final production.

V. EXPERIMENTAL RESULTS

The running of a vehicle can be understood with the help of a dc motor and motor driver circuit. This paper has an important feature of automatic brake system. So it is very essential to develop the accelerator and brake system along with the dc motor and driver circuit. The speed of the dc motor can be controlled with the help of dc motor drive that has been connected to the accelerator pedal sensor and brake pedal sensor. This module can be demonstrated with the help of numeric simulation.6.

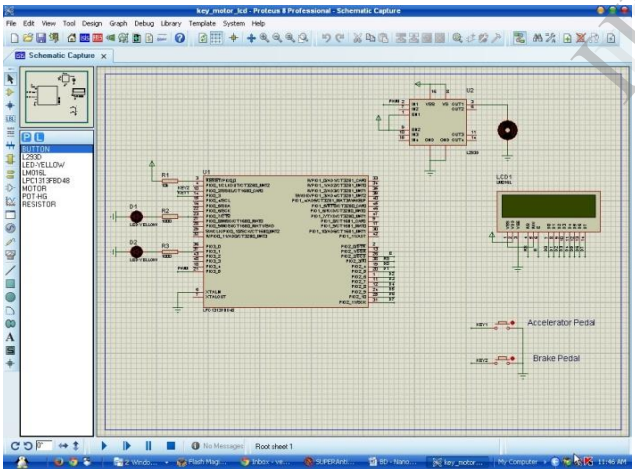

Fig.8. Screenshot of Simulation

VI. CONCLUSION AND FUTURE ENHANCEMENT

Thus the paper proposes an approach for effective designing and user-friendly for driver vigilance application especially targets at preventing accidents such as drunk and drive and collision pre-safe. It aims to design an advanced driver safety awareness and assistance system that will monitor the driver and command the vehicle to take those vital safety measures in order to overcome the serious problems.

In numeric simulation the working of dc motor along with the function of brake pedal sensor and accelerator pedal sensor has been simulated and the corresponding output can be verified using numeric simulation of Proteus 8 professional development software. The other modules will be demonstrated using hardware prototype. In future, a more advanced version of this system can also be developed according to the advancements in science and technology.

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