Driver Drowsiness Detection System

Arduino Based

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1.1 ABSTRACT

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 predefined 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.

Driver drowsiness system is used to detect the drowsiness. Drowsiness is the main reasons of accident. Safe driving is a major concern of societies all over the world. Thousands of people are killed or seriously injured due to drivers falling asleep at the wheels each year. It is essential to develop a real time safety system for drowsiness related road accident prevention. There are many methods for detecting the driver drowsiness. Driver fatigue is a significant factor in a large number of vehicle accidents. It includes the measurements of physiological features like EEG, heart rate, pulse rate, eyelid movement, gaze, head movement and behaviours of the vehicle, lane deviations and steering movements.[3] After long hours of driving or in absent of alert mental state, the eyelids of driver will become heavy due to fatigue. The attention of driver starts to lose focus and that creates risks for accidents. These are typical reactions of fatigue, which is very dangerous. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes. These accidents can be controlled by development of technologies for detecting or preventing drowsiness. A real time monitoring system, to insure accuracy in detecting drowsiness of the driver and that will work in both daytime and night time conditions is required.

1.2 INTODUCTION TO INTERNET OF THINGS (IOT)

The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics , software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure.

The IOT allows objects to be sensed or controlled remotely across the network infrastructure, creating opportunities for more direct integration of the physical world into the computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IOT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities.

"Things", in the IOT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, cameras streaming live feeds of wild animals in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring, or field operation devices that assist fire-fighters in search and rescue operations, Legal scholars suggest regarding "things" as an "inextricable mixture of hardware, software, data and service".

These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. The applications for internet connected devices are extensive. Multiple categorizations have been suggested, most of which agree on a separation between consumer, enterprise (business), and infrastructure applications.

The IoT is a giant network of connected "things". The relationship will be between people-people, people-things, and things-things. The new rule for the future is going to be, "Anything that can be connected, will be connected."

The IoT can assist in the integration of communications, control, and information processing across various transportation systems. Application of the IoT extends to all aspects of transportation systems (i.e. the vehicle, the infrastructure, and the driver or user). Dynamic interaction between these components of a transport system enables inter and intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.[12] In Logistics and Fleet Management for example, The IoT platform can continuously monitor the location and conditions of cargo and assets via wireless sensors and send specific alerts when management exceptions occur (delays, damages, thefts, etc.).

1.3 OBJECTIVES OF THE PROJECT

The primary objectives of the project are:

- Collecting data from the different sensors
- Validating the data to present data
- Displaying the data through LCD module

2.1 LITERATURE SURVEY

Detecting Driver Drowsiness Based on Sensors A Review

It was produced by Arun Sahayadhas, KennethSundaraj. It describes about the following measures: (1) vehicle-based measures,(2) behavioural measures and (3) physiological measures. A detailed review on these measures will provide insight on the present systems, issues associated with them and the enhancements that need to be done to make a robust system. In this paper, we review these three measures as to the sensors used and discuss the advantages and limitations of each. The various ways through which drowsiness has been experimentally manipulated is also discussed. A number of road accidents might then be avoided if an alert is sent to a driver that is deemed drowsy.

Driver Alertness Monitoring Using Fusion of Facial Features and Bio-Signals

This paper was produced by Boon-Giin Lee and Wan-Young Chung. It describes a method to monitor driver safety by analysing information related to fatigue using two distinct methods: eye movement monitoring and bio-signal processing. A monitoring system is designed in Android-based smartphone where it receives sensory data via wireless sensor network and further processes the data to indicate the current driving aptitude of the driver. It is critical that several sensors are integrated and synchronized for a more realistic evaluation of the driver behaviour. The sensors applied include a video sensor to capture the driver image and a bio-signal sensor to gather the driver photoplethysmograph signal. A dynamic Bayesian network

framework is used for the driver fatigue evaluation. A warning alarm is sounded if driver fatigue is believed to reach a defined threshold. The manifold testing of the system demonstrates the practical use of multiple features, particularly with discrete methods, and their fusion enables a more authentic and ample fatigue detection.

A Vision Based System For Monitoring the Loss of Attention in Automotive Drivers

This paper was published by Anirban dasgupta, anjith George. It proposes a robust real time embedded platform to monitor the loss of attention of the driver during day as well as night driving conditions. The percentage of eye closure (PERCLOS) has been used as the indicator of the alertness level. In this approach, the face is detected using Haar like features and tracked using a Kalman Filter. The Eyes are detected using Principal Component Analysis (PCA) during day time and the block Local Binary Pattern (LBP) features during night. Finally the eye state is classified as open or closed using Support Vector Machines (SVM). In plane and off plane rotations of the drivers face have been compensated using Affine and Perspective Transformation respectively. Compensation in illumination variation is carried out using Bi Histogram Equalization (BHE). The algorithm has been cross validated using brain signals and finally been implemented on a Single Board Computer (SBC) having Intel Atom processor, 1 GB RAM, 1.66 GHz clock, x86 architecture, Windows Embedded XP operating system. The system is found to be robust under actual driving conditions.

Arduino based real time driver drowsiness detection and Alert System

This paper was published by Lestin Jills Joseph and Dr. Lokesha M. The goal of this propose design is to detect drowsiness in drivers to prevent accidents and to improve safety on the highways. A method for detecting driver drowsiness/sleepiness is developed on Arduino microcontroller board based on Atmega328P for real-time monitoring. The readings taken from different sensors used in this project can be seen in an Android based mobile device. It has an MQ-2 alcohol gas sensor to detect alcohol, if consumed by the driver and a relay circuit to stop him from performing the drive if alcohol consumed. MPU-6050 Micro-Electro-Mechanical-System (MEMS) accelerometer to read the head nodding conditions combined with a gyroscope and a temperature sensor to know the temperature inside the vehicle. The system is also able to monitor the driver physiological conditions such as heart pulse rate, eye blink detection using pulse sensor and eye blink sensor respectively. The alarm will be activated when the driver has consumed alcohol or driver head nods frequently or heart pulse rate goes above the limit or when driver eyes get closed. The Arduino communicates with the system connected on the board.

2.2 PROJECT SCOPE

According to available statistical data, over 1.3 million people die each year on the road and 20 to 50 million people suffer non-fatal injuries due to road accidents. Based on police reports, the US National Highway Traffic Safety Administration (NHTSA) conservatively estimated that a total of 100,000 vehicle crashes each year are the direct result of driver drowsiness.

These crashes resulted in approximately 1,550 deaths, 71,000 injuries and $12.5 billion in monetary losses. In the year 2009, the US National Sleep Foundation (NSF) reported that 54% of adult drivers have driven a vehicle while feeling drowsy and 28% of them actually fell asleep. The German Road Safety Council (DVR) claims that one in four highway traffic fatalities are a result of momentary driver drowsiness. These statistics suggest that driver drowsiness is one of the main causes of road accidents.

The growth of sensor technology and network-based information technology has expanded the reach of wireless sensor networks into numerous areas such as healthcare, remote control, wildlife habitat monitoring, military explosive detection, intelligent home monitoring,

and environment observation and forecasting system. On the other hand, the recent increase in traffic accidents is possibly caused by driver distraction and low attention during driving. Cooperative efforts between the government and private sectors have been attempted to reduce the number of traffic accidents by proposing numerous types of approaches. Intelligent transport systems are promoted by integrating the sensor technology into the transport to measure the driver alertness level.

A driver who falls asleep at the wheel loses control of the vehicle, an action which often results in a crash with either another vehicle or stationary objects. In order to prevent these devastating accidents, the state of drowsiness of the driver should be monitored.

On board monitoring of the alertness level of an automotive driver has been a challenging research in transportation safety and management. In this, we propose a robust real time embedded platform to monitor the loss of attention of the driver during day as well as night driving conditions.

The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects.

This is a small system, so we can easily embed it on any vehicle. The Eye blink sensor is fixed to the driver. The eye blink sensor senses the movement of the eyeball. The sensor output is connected to a microcontroller. The car engine starting system is directly controlled by the microcontroller. If the sensor detects the no output from the sensor because there no movement in the eyeball, it sends the signal to the microcontroller. The microcontroller immediately stops the engine or locks it from starting, also give warning signal and display the reason in a LCD.

The system is developed by interfacing a heartbeat sensor, eye blink sensor and a temperature sensor with an ADC which converts the analog readings to digital, thus extracted digital data is processed using a microcontroller. The reference values of these three parameters and the phone number are stored in the microcontroller memory. If anyone of these three parameters exceeds the reference value the microcontroller automatically calls the stored number. The microcontroller used here is Arduino Uno.

2.3 PROPOSED SYSTEM

The aim of this project is to develop prototype drowsiness detection and alerting system. The focus will be placed on designing a system that will accurately monitor the eye blink rate, heart-beat respiration rate and temperature of the driver. In this project we use sensors to measure all these factors. The values measured will be sent to the microcontroller where the measured values will be compared with the reference values. If the values measured do not match with the reference values, then the Arduino will send a warning signal in the LCD display thereby preventing accidents.

2.4 SYSTEM ARCHITECTURE

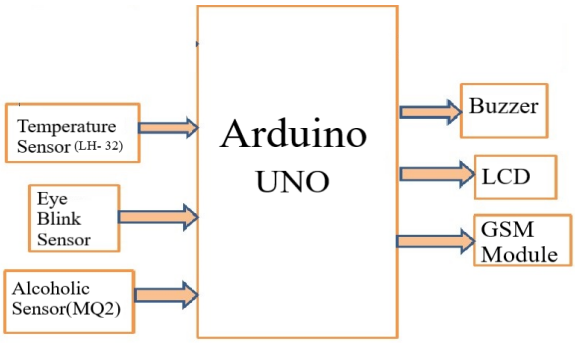

Figure : 2.4.1

The system architecture of the automatic driver alert system is shown in the figure 2.4.1. Three sensors: Temperature (LC35), eye blink (reflection sensor) and alcoholic sensors (MQ-2) are used for the drowsiness detection. These outputs from the sensors are connected to the Arduino Uno.

2.5 SOFTWARE REQUIREMENTS

- Arduino IDE

2.6 HARWARE REQUIREMENTS

- ARDUINO UNO BOARD
- LCD DISPLAY
- GSM MODULE
- GPS MODULE
- DC MOTOR
- EYE BLINK SENSOR (REFLECTION SENSOR)
- BUZZER
- ALCOHOLIC SENSOR(MQ-2)
- TEMPERATURE SENSOR(TERMISTER-103)

2.6.1 Arduino Uno Board

The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs). Programs can be loaded on to it from the easy-to-use Arduino computer program. The Arduino has an extensive support community, which makes it a very easy way to get started working with embedded electronics. The R3 is the third, and latest, revision of the Arduino Uno.

2.6.2 LCD

LCD is a displaying device used to display the sensors values and microcontroller actions. It is a flat panel electronic visual display that uses the light modulation properties of liquid crystals. In this case we are using 16x2 display.

2.6.3 Alcoholic Sensor

In this project, a gas sensor is used for measuring alcohol content released from drivers mouth. It is electrochemical gas sensor that measures the concentration of a target gas by oxidizing or reducing the target gas at an electrode and measuring the resulting current.

2.6.4 Temperature Sensor

Thermistor 103 acts as a temperature sensor for his project. It is a collection of NTC thermistors. These negative temperature coefficient thermistors are resistors with a negative temperature coefficient, and can be used as current-limiting devices & resistive temperature sensors.

2.6.5 Eye Blink Sensor

This sensor works by illuminating the eye or eyelid area with infrared light. And then it monitors 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.

2.6.6 GPS

GPS is used for recognizing the location of the measured values. Global Positioning System (GPS) technology is changing the way we work and play. The Global Positioning System (GPS) is a satellite-based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides you with information.

2.6.7 GSM

Global System for Mobile Communication (GSM) is a set of ETSI standards specifying the infrastructure for a digital cellular service. In this we are using SIM 800 module for data transmission. In this GSM module is used to sending SMS.

3.1 FUTURE ENHANCEMENTS

Majority of portable devices are aimed at providing unlimited access to internet services for data storage and synchronization with other remote devices. Hence, there is a need of faster data acquisition and quick decision making of embedded computing system for real time applications for making vehicles safe, automatic, responsive and intelligent. Interfacing of simple sensors to various micro-controller platforms enables the ease of regulating the embedded system at a sophisticated levels of automation and mediating the sensor information over a smart grid ISSN enables large amount of data acquisition for taking accurate decisions over the emergency conditions. Further, the development of smart grids fascinates the overall process of communication between human and machine rather than machine to machine communication. Hence, IoT can revolutionize the way embedded systems interact and respond for variety of applications especially in case

of vulnerable night drivers by monitoring the state of their drowsiness for a quick, safe and effective response for a safer road travel. Solution for rash driving by obstructing spark-plug. Solution for wheel grip using gravity sensor. Voice based real time advice for drivers by their loved ones when they are over-drunk or rash-driving.

3.2 REFERENCES

[1] Wheaton AG, Chapman DP, Presley-Cantrell LR, Croft JB, Roehler DR. Drowsy driving – 19 states and the District of Columbia, 2009-2010.[630 KB] MMWR Morb Mortal Wkly Rep. 2013; 61:1033.

[2] Wheaton AG, Shults RA, Chapman DP, Ford ES, Croft JB. Drowsy driving and risk behaviors—10 states and Puerto Rico, 2011-2012.[817 KB]MMWR Morb Mortal Wkly Rep. 2014; 63:557-562.

[3] National Highway Traffic Safety Administration. Research on Drowsy Driving. Accessed October 20, 2015.

[4] Masten SV, Stutts JC, Martell CA. Predicting daytime and nighttime drowsy driving crashes based on crash characteristic models. 50th Annual Proceedings, Association for the Advancement of Automotive Medicine; October 2006; Chicago, IL.

[5] Klauer SG, Dingus TA, Neale VL, Sudweeks JD, Ramsey DJ. The Impact of Driver Inattention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Study Data, *2006* . Springfield, VA: DOT; year. DOT HS 810 594.

[6] Tefft BC, AAA Foundation for Traffic Safety. Prevalence of Motor Vehicle Crashes Involving Drowsy Drivers, United States, 2009 – 2013[457 KB].Washington, DC: AAA Foundation for Traffic Safety; 2014. October 19, 2015.

[7] Stutts JC, Wilkins JW, Scott Osberg J, Vaughn BV. Driver risk factors for sleep-related crashes. Accid Anal Prev. 2003;35(3):321-31.