ONLINE PREDICTION OF DRIVER DISTRACTION BASED ON BRAIN ACTIVITY

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Abstract: Driver drowsiness and cognitive detection is a vehicle safety technology which prevents accidents when the driver is getting drowsy or due to a diminished driver's vigilance level. Traffic accidents became a serious concern to society and driver-related fatigue, drowsiness and due to cognition, which are a significant cause of these traffic accidents. Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads. Monitoring physiological signals while driving provides the possibility of detecting and alerting drivers to dangerous driving conditions and behavior. Several bio-behavioral signatures have been developed to monitor drowsiness of automobile drivers, including eye movement analysis and head inclination. However, sometimes false alarms are possible since these visual attributes are not always accompanied by drowsiness. Related studies in recent decades have shown that Electro Encephalography (EEG) is one of the most reliable and effective sources to detect sleep onset while driving. The aim of this paper is to propose a system for automatic driver drowsiness detection based on EEG and a suitable wireless technology is designed to send the important notifications. A dry EEG sensor is incorporated to record EEG signals from hairy regions of the driver conveniently.

Keywords: Bio-behavioral signature; Distractions; EEG sensor; Bluetooth module; Brain activity; Brain waves; Electroencephalogram- graphic (EEG) signals; Traffic; Driver-distraction prediction; Online adaptive predictions; Beep alarm.

1. Introduction

Especially during long trips, attention of the drivers can be scattered, drivers can be encountered with sleep problems and the result of all of them can lead the traffic accidents. It is observed that the traffic accidents are mostly sourced from the drivers and according to the statistics, a rate of 25% to 50% of all traffic accidents are realized due to the distractions. Distracted drivers cannot observe the traffic flow and traffic accidents occur as a result thereof. While taking the food during the journey, talking on the phone and drowsiness condition raise the possibility of the accidents. However, the stress also causes the traffic accidents.

Various security systems are developed for cars to prevent the traffic accidents. When the car safety monitoring systems are considered, drifting from the main road detection systems, detection the facial expressions of the driver and many image discrimination techniques are seen. While the image discrimination systems can be affected by external factors, Electroencephalography (EEG) systems are a new research area that can provide more accurate results on this issue. Brain signals are one of the electrical signals produced by the body. Electroencephalography (EEG) is a method that enables measuring signals produced by the brain via electrodes or other electrical methods. Brain signals are converted through algorithms developed by the company and they are presented as a form that people can understand through their EEG devices.

2. Related work

K. Shabna1, Nibin Thomas, et al. [1] EEG Based Method for Detecting Driver Drowsiness and Distraction in Intelligent Vehicles. This paper discusses about how EEG can be used to implement drowsiness detection in intelligent transportation system. Nilay Yildirim, Asaf Varol,et al [2] Warning system for drivers according to attention and meditation brain using computer interface with the proposed system, it is aimed to measure and analyze the attention and meditation status via brain signals of the drivers. In case of the drivers' attention has been dispersed, it is aimed to provide the audio alerts to the drivers. It is proposed to use NeuroSkyMindwave Mobile as EEG device because of the wireless and easy to use options. Shouyi Wang, Yiqi Zhang, Changxu Wu, et al[3] Online Prediction of Driver Distraction Based on Brain Activity Patterns This paper presents a new computational framework for early detection of driver distractions (map viewing) using brain activity measured by electroencephalographic (EEG) signals. The proposed prediction algorithm was tested on a data set of continuous EEG signals recorded from 24 subjects. The experimental results demonstrated that the proposed algorithm can predict the start and end of map viewing with relatively high accuracy and can be generalized to individual subjects. Manoj kumar k1 , Surya J2 , Dr. V.G .Siva Kumar3, S.Karthikeyan4, et al [9], The proposed system contains the use of a wireless and wearable EEG device to record EEG signals from hairy regions of the driver competently. Additionally, the proposed system can process EEG recordings and translate them into the vigilance level. The study compares the system performance between different regression illustrations. Mayuresh Adhikari*1, Pradnyesh Bhalange #2 Anand Bhanvase#3, Chaitanya Bharambe*4, et al [8] The study indicates that wireless devices, passenger related

distraction (mostly conversation), and invehicle distraction sources are the most frequent reasons for incidences. Consequently, the automotive industry has paid more interest in controlling in-vehicle human– machine interface (HMI), including third-party products, in order to make driving more comfortable and more importantly to accentuate traffic safety. Amjad Hashemi1, Valiallah Saba2*, Seyed Navid Resalat3, et al[6] The purpose of this study is development of driver's sleepiness using Visually Evoked Potentials (VEP). VEP computed from EEG signals from the visual cortex. We use the Steady State VEPs (SSVEPs) that are one of the most important EEG signals used in human computer interface systems. Roop kamal kaur, Gurwinder kaur, et al [10] in the present work, drivers drowsiness detection system is formed using information from using 25 channels EEG.

3. Proposed system

The proposed system is to allow drivers to control distraction, stress and sleep situations while driving utilizing EEG. The driver warning system will measure and evaluate attention and stress status of drivers using EEG frequency waves; beta waves for attention and alpha waves for stress

4. Block diagram of system and description

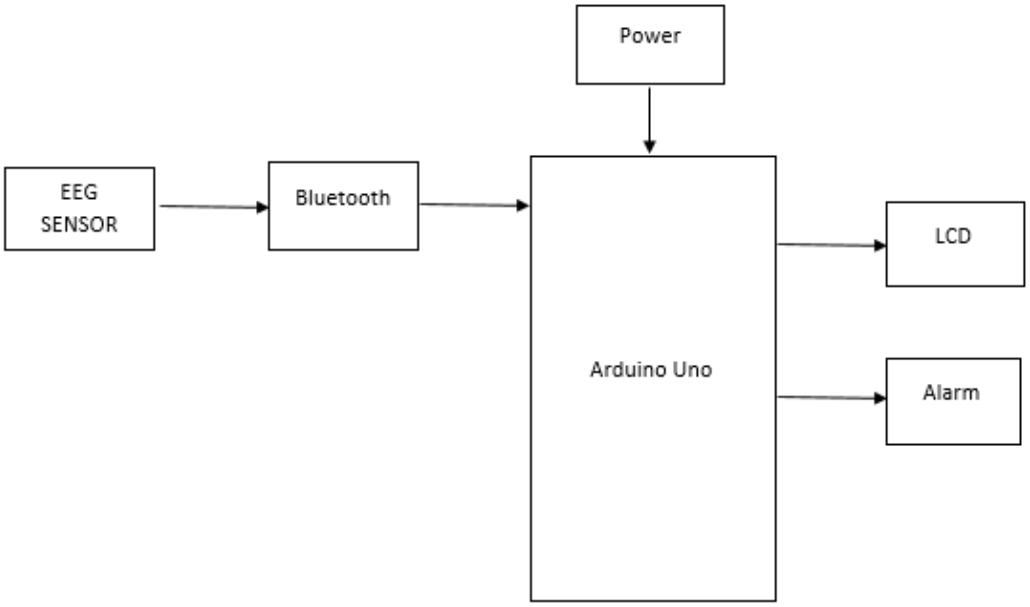


Fig. Block Diagram of online predication of driver distraction based on brain activity pattern using EEG sensor

4.1 Microcontroller (Atmega328)

It is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial convertor

Features:

1. 28-pin AVR Microcontroller
2. Flash Program Memory: 32 Kbytes
3. EEPROM Data Memory: 1 Kbytes
4. SRAM Data Memory: 2 Kbytes
5. I/O Pins: 23
6. Timers: Two 8-bit / One 16-bit
7. A/D Converter: 10-bit Six Channel
8. PWM: Six Channels
9. RTC: Yes, with Separate Oscillator
10. MSSP: SPI and I²C Master and Slave Support
11. USART: Yes

4.2 Bluetooth Module:

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data

4.2.1 Sample Hardware Installation and Sample Source Code

Below is the example of interfacing between Arduino UNO and PC via HC-05 Bluetooth Module. In this example, the communication mode is used.

*Note: For AT mode (use to change the default setting or etc.), please refer to this link Modify The HC-05 Bluetooth Module Defaults Using AT Commands.

Diagram below shows the hardware connection between HC-05 Bluetooth Module and Arduino UNO. Besides Arduino, it may interface with any microcontroller such as PIC and etc.

- ✓ VCC - Arduino 5V
- ✓ GND - Arduino GND
- ✓ TXD - Arduino Pin RX
- ✓ RXD - Arduino Pin TX
- ✓ KEY - Connect to the air for communication mode

4.3 EEG (Electroencephalogram) sensor:

Fig. Electroencephalogram sensor

One of the most versatile brain imaging techniques is Electroencephalography. In short: EEG. Literally, electro-encephalography means writing of the electric activity of the brain Why writing? Similar to a seismometer, EEG recordings were initially done on paper. Electroencephalography records electrical activity and brain waves using electrodes placed on the scalp. Measuring electrical activity from the brain is useful because it reflects how the many different neurons in the brain network communicate with each other via electrical impulses.

- EEG directly measures neural activity your brain is constantly active, generating electrical activity which of course is very subtle (significantly less than a 9V battery) but detectable with the right device. EEG sensors are able to pick up these tiny signals from the scalp surface. International brain research has been obtaining consistent findings and established well-accepted theories on how the EEG signals relate to cognitive, affective or attention processing. Techniques like MRI only measure neural activity indirectly and require a much deeper understanding of the relationship between what is measured and how it relates to cognitive processing.
- EEG has very high time resolution and captures cognitive processes in the time frame in which cognition occurs. Cognitive, perceptual, linguistic, emotional and motor processes are fast. Most cognitive processes occur within tens to hundreds of milliseconds – much faster than the blink of an eye. In addition, the events triggering cognitive processes occur in time sequences that span hundreds of milliseconds to a few seconds. Similar to a high-speed camera, EEG has a high time resolution and can capture the physiological changes underlying the cognitive processes much better than other brain imaging techniques (such as MRI or PET scanners).
- EEG is inexpensive, lightweight and portable. Have you ever tried to run a real-world study with an MRI scanner? It's simply not possible. By contrast, EEG systems are portable, lightweight and therefore allow for more flexible data collection in real-world environments.
- EEG monitors cognitive-affective processing in absence of behavioral responses. Brain processes ultimately drive behavior. However, if you're interested in mental processes such as response inhibition, creativity or meditation, the behavioral effects might be very subtle. By contrast, these processes are ideal candidates for EEG as they are accompanied by distinguishable electrical brain activation patterns.

4.4 16x2 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven

segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

4.5 Buzzer

One that buzzes; specifically: an electric signaling device that makes a buzzing sound. A buzzer or beeper is an audio signaling device, which /may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

5. Software (Algorithm and flowchart)

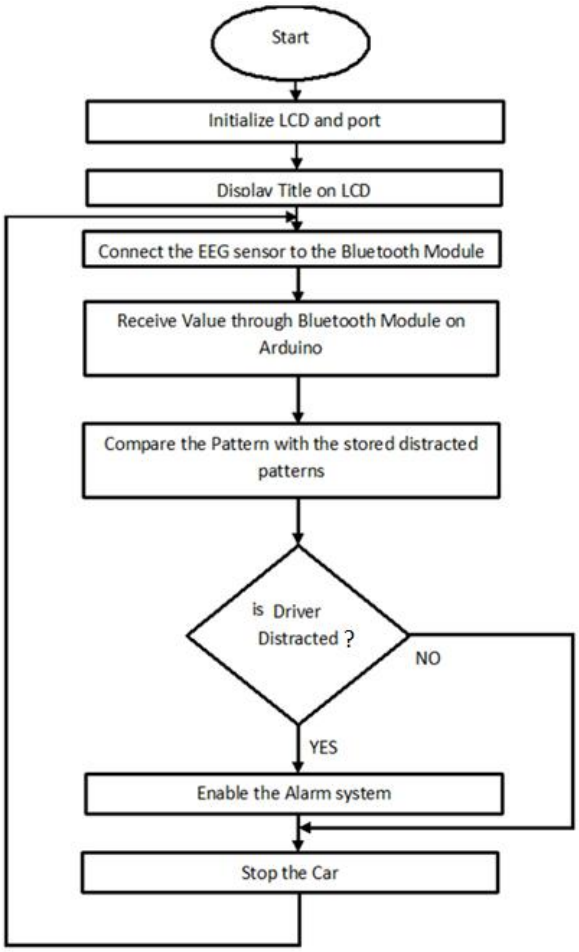
The Arduino Integrated Development Environment or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right and corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

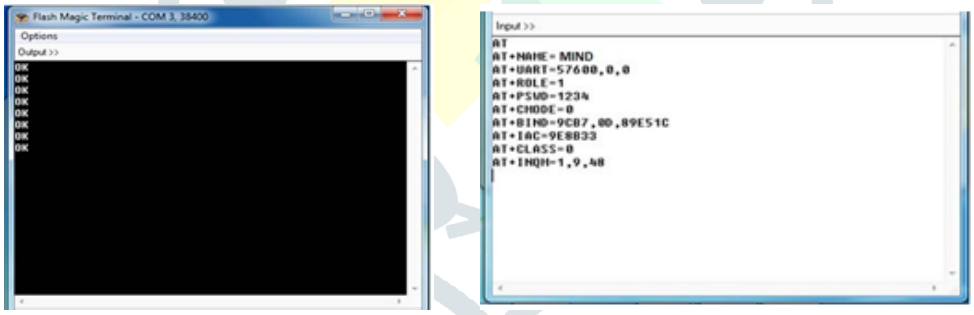
5.1 Algorithm for Driver Distraction Based On Brain Activity Pattern Using EEG

1. Start
2. Initialize LCD and port
3. Display title on LCD
4. Connect the EEG sensor to the Bluetooth Module
5. Receive value through Bluetooth Module on Arduino
6. Compare the pattern the stored distracted patterns
7. Check if the driver is distracted or not (yes/no)
8. If “YES” and “NO” enable the alarm system, else go to step no.7
9. Stop the car
10. Go to step no.4.

5.2 Flowchart for Online predication of driver distraction based on brain activity pattern using EEG



6. Results:



7. Conclusion:

We propose a driver drowsiness and cognitive detection system which can be used in intelligent vehicles for accident prevention and making the world a much better and safe place to live. If the driver is being distracted, then it will be giving an alarm in the form of voice or the beep.

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Every work is an outcome of full proof planning, continuous and organized effort. This work is combination of all the three put together sincerely

References:

[1] K. Shabna1, Nibin Thomas, "EEG Based Method for Detecting Driver Drowsiness and Distraction in Intelligent Vehicles" Electronics and Communication Engineering VVIT, Calicut University, Kerala, India. Paper code: DOI 10.4010/2015.323 ISSN-2321 -3361 © 2015 IJESC

[2] Nilay Yildirim, Asaf Varol, "Warning system for drivers according to attention and meditation brain using computer interface " 1,2FiratUniversity, Elazig, Turkey, International Journal of Advances in Electronics and Computer Science, ISSN: 2393-2835 Volume-3, Issue-9, Sep.-2016

[3] Shouyi Wang, Yiqi Zhang, Changxu Wu, "Online Prediction of Driver Distraction Based on Brain Activity Patterns" Industrial and System Engineering, Tsinghua University Beijing, P.R. China. Paper code: 1-4244-0342-1/06/$20.00 ©2006 IEEE. Published year: 2012

[4] Muhammad Awais, Nasreen Badruddin, and Micheal Drieberg, "Driver Drowsiness Detection Using EEG Power Spectrum Analysis" Department of Electrical and Electronic Engineering, Universitiy Teknologi PETRONAS, Malaysia Paper code: 10.1109/TENCONSpring.2014.6863035, 2014.

[5] Yu-Kai Wanga,b, Shi-An Chena, Chin-Teng Lina,b, "An EEG-based brain–computer interface for dual task driving detection" Brain Research Center, National Chiao-Tung University, Hsinchu 30010, Taiwan, ROC b Department of Computer Science, National Chiao-Tung University, Hsinchu 30010, Taiwan, ROC. Neurocomputing 129 (2014) 85-93.

[6] Amad Hashemi1, Valiallah Saba2*, Seyed Navid Resalat3, "Real Time Driver's Drowsiness Detection by Processing the EEG Signals Stimulated with External Flickering Light" Institute for Advanced Medical Technologies (IAMT), Tehran University of Medical Sciences, Tehran, Iran. Winter 2014, Volume 5, NO.1.

[7] K.Shabna1, Nibin Thomas2, "EEG Based Method for Detecting Driver Drowsiness and Distraction in Intelligent Vehicles" Department of Electronics & Communication Engineering VVIT, Calicut University, Kerala, India. DOI 10.4010/2015.323 ISSN-2321 -3361 © 2015 IJESC.

[8] Mayuresh Adhikari*1, Pradnyesh Bhalange #2 Anand Bhanvase#3, Chaitanya Bharambe*4 ,Prof. Shweta Koparde*5, "Driver Distraction Detection System Using Intelligent Approach Of Vision Based System." International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 02 | Feb -2017 e-ISSN: 2395 -0056 p-ISSN: 2395-0072.

[9] Manoj kumar k1 , Surya J2 , Dr. V.G .Siva Kumar3, S.Karthikeyan4, "Online Prediction of Driver Distraction Based on Brain Waves Activity Patterns" Dept. of electronics and communication.Engineering,Sathyabama University,, Chennai, India. International Journal of Pure and Applied Mathematics Volume 117 No. 21 2017, 147-154 ISSN: 1311-8080; ISSN: 1314-3395

[10] Roop kamal kaur, Gurwinder kaur, "Neural Network Based Drowsiness Detection Using Electroencephalogram" Yadavindra College of Engineering, Punjabi University, Guru Kashi Campus, Talwandi Sabo, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0180, Vol. 2 Issue 10, October-2013. IJERTV2IS10060, 2497.

[11] Ms Nanditha#1, Smt. Christy Persya A#2, "EEG-Based Brain Controlled Robo and Home Appliances" Department of ISE, BNMIT, Bangalore – 560085, Karnataka, India. ISSN: 2231-5381 , International Journal of Engineering Trends and Technology (IJETT) – Volume 47 Number 3 May 2017.

[12] Mitra Taghizadeh-Sarabi1*, Kavous Salehzadeh Niksirat2, Sohrab Khanmohammadi3 and Mohammadali Nazari4, "EEG-based analysis of human driving performance in turning left and right using Hopfield neural network" University of Tabriz, Tabriz, Iran. 4Department of Psychology, University of Tabriz, Tabriz, Iran.Taghizadeh-Sarabi et al. SpringerPlus 10.12.2013, 2:662.