

Software Proposal Document for Project BREACTOR

Nader Elsheikh , Doaa Hamid, Ahmed Hany , Abdelrahaman Shahata

May 20, 2018

Abstract

Most of Drivers can be affected by many abnormal behaviors while they are driving, which can cause accidents. As Driver can drive for too many hours, which It can make the driver feel sleepy or carry a mobile phone that leads to have a lack of focus in the road and the surrounded environment can cause the driver or passenger death. We searched about a solution to this problem to avoid or reduce the amount of accidents and loss of lives in accidents and we found that the brain signals of driver is the best way to detect state of driver like the driver is feeling drowsy or not , by reading driver's brain signals , The System can compare between normal behavior and drowsy behavior and send alerts to warn the driver to take an action to concentrate on the road. We found that the best processing technique that can be used to recognize mental states from EEG signals in brain computer interface. The EEG signal reflects activation of head musculature, eye movement, interference from nearby electrical devices and changing conductivity in electrodes due to movement. The Main focus of our system is to read the EEG signal and get rid of noise from the signal (pre-processing) and then classify signal and detect the abnormal behavior by Significant Vector Machine (SVM) Algorithm and we detect and begin to send warning messages to driver to stop or to take care of road.

1 Introduction

1.1 Background

The aim of this study was to evaluate the effect of variables such as personality traits, driving behavior and mental illness on road traffic accidents among the drivers with accidents and those without road crash, Due to its perception as a disease of development, road traffic accident and related injuries tend to be under recognized as a major health problem in developing countries. However, majority of the world's fatalities on the roads occur in low income and middle income countries. Since the main cause of road traffic accident is attributed to human risky behaviors, it is important to identify significant factors for risky behaviors of drivers.

1.2 Motivation

People still need kind of project in every type of transportation. According to Association for Safe International Road Travel (ASIRT) [1] Nearly 1.3 million people die in road crash per year. Road traffic crash ranks as the 9th leading death and acquire 2.2 percent of all death globally. So with that project we can save at least half of that death which is a big change and so, it will affect the market with a good feedback. According to academic needs, the project and the algorithms are still in need for improvements in detection and in real-time Actions

1.3 Problem Definitions

In most of car accidents are caused by abnormal behavior from the driver, So we will be working on how to detect the percentage of drivers concentration by reading their electro-grams signals specially the EEG signals from the brain, and we will alert the driver to increase his concentration level.

2 Project Description

2.1 Objective

Along many years, we have not found solution for avoiding car accident as all the experiments on car safety as brakes, Tires, etc. But we havent found an experiment that can make interaction between car and driver. We have focused in our project on real-time interaction between driver and the system. Also we have focused on detecting abnormal behavior from driver as driver can be holding a mobile device or getting drowsy while driving, so we detect all these behaviors and detect environment around car.

2.2 Scope

Our project Scope starts from reading signals from drivers brain and most of these signals need to be filtered from noise to detect main signal we need, The second Step is the pre-processing as we begin to filter the signal from any type of noise that make interruption to extract the signal. The Third Step is to make the signal readable by Computer which leads us to the Forth step that classify all types of signals by specific algorithm then, Fifth step that we start to compare between the extracted signal and the data-set of abnormal behaviors, The Sixth Step is interacting with driver such as sending warning messages and alerts at same time of detecting the abnormal behavior of driver. The last Step is if the type of behavior does not exist in data-set and Signal was detected as new behavior so it have to be updated in the data-set as a new Behavior, System will compare between the new behavior detected with two types of behaviors in data set and according to the result system will assign the new behavior to be abnormal behavior or normal behavior.

2.3 Project Overview

Some extra details about our project is interacting with Driver as in the setup phase for our program their will be some questions for user to take a survey about what user prefer the way to pay attention to traffic and road if system detect that he/she is getting asleep or feeling stressed system will allow user to choose from options as to play music or giving some instructions.

3 Similar System Information

3.1 Similar System Description

The motivation of EEG-based motor imagery classification in BCI system by using unscented Kalman filter [11] paper work is to improve the feature data extraction accuracy. It briefly detect the driver behavior using UKF classification with CSSP filter applied to extract features. There are various results as the system is tested using different algorithms with the CSSP. They used BCI competition IIIa dataset with CSSP + LDA + UKF and the best accuracy was 93.3 % with 30.1s training time and 82.8-100 % confident interval. The first run was CSSP + LDA with best accuracy of 86.1 % and training time 0.7s. The second run was CSSP + LDA + UKF which gave us the accuracy of 99.7 % in 5.6s training time. This paper is one of the important papers Ive read because it includes many resources I needed as the Algorithm used and filters.

Another paper called A Real-time Brain-Computer Interface Based on PDA[10] had a good motivation which was that BCI research involved in many fields and its still in its earliest stages so it is not clear how far the field can or will go. Nowadays EEG is the most commonly used to detect BCI signals. They provided the technique in a wireless connection instead of using traditional wired one. the architecture was very close to Real-time detection. For signal Acquisition, it was converted into digital EEGs. it was recorded from 32 electrode using EEG/ERP system from NeuroScan Inc. The signals were amplified using band-pass(0.05-100 Hz) with sample rate of 250 Hz. The was cool and it opened for me some new ideas to think about in my project.

In paper Use of Brain Computer Interface to Drive: Preliminary Results [9] . Its motivation was Driven in-part by growing societal recognition for the needs of people with physical disabilities, BCI gives the opportunity to perform activities that traditionally depends on nerves or muscles. The objective of this project was to create an EEG-based BCI using the available Cleveland Medical Devices BioRadio 150 and OKTAL SCANeR. in addition, they used virtual reality to create a suitable environment. SSVEP algorithm is used at a particular frequency and there was a distinct peak in power spectral density. They didnt mention any results to be written in the paper. In my point of view, this paper

is also cool enough to help in what we need around the BCI signals.

In "STRATEGIC BEHAVIOR IN A LIVING ENVIRONMENT" [3], the motivation is that the main reason is not driver himself but his internal preferences, his attitude and his perception determine the traffic. The main problem is pointing about a driver with a high affinity for public transport for instance might change his means of transportation when confined with extreme whether condition near a subway station and available parking. What the developers were doing was about seeking to integrate those for traffic simulation. To do this they first have to examine a simuss main Characteristics. They use the example above to emphasize their approach. The results in that paper, they only Gabe little attention to the actual simulator engine and instead but particular emphasis on the realization of the concept of the applied agents and the model of the infrastructural. The paper is important for us because they determine the human behavior while driving and his attitude.

According to "Research on Decision Risk of Driving Behavior Based on Traffic Information Asymmetry Degree" [7], its motivation is that the road traffic inform searching and judgment is different for the drivers of different vehicle type in the same road section which also lead to different running risk degree in some extent. Drivers will be apt to search road environment information and make divisions timely when he is not familiar to the road very well in that driving behavior decision depends on his experience more and more. They setup decision risk Evolution model of driving behavior to reflect cognition characters and its risk diff. of the drivers sufficiently who is the principal part in road traffic system. The investigation result is that the integrated risk of heavy truck and large bus is the highest, while the minibus is lowest and the light truck is middle which has fully verified the effectiveness of the model. This is important to us to know how is the driver deal with road environment with different type of vehicles and different speed.

According to "A survey on driver behavior detection techniques for intelligent transportation systems" [4] their motivation is to improve the efficiency and safety of human agility were is affected by experience, distraction, fatigue, drowsiness etc. . Improper driving behavior is one of the main reasons for car accidents so in this paper they were caring to detect the driver behavior, they discuss some techniques to monitoring the behavior of the driver in addition they used real time and non-real time techniques to classify the behavior as a results. The real time technique helps our project as when it is detect abnormal behavior of the driver it interact with the driver spontaneously .

This " Driver Behavior Analysis for Safe Driving: A Survey " paper [5] is

one of the most remarkable studies of the last 5 years that detects the basic pros and cons of the recent driver monitoring technique. The main problem is the driver drowsiness and distraction are two main reasons for traffic accidents and the related financial losses.

In "Developing a Body Sensor Network to Detect Emotions During Driving" paper [8] they care and enhance the car safety which leads to decreasing the car accidents by using the body sensor networks (BSNs). The paper detects some human emotions like tiredness and stress which leads to car accidents, they ended up by detecting one emotional state in real time using the BSN and according to their results they can communicate with city emergency services via onboard unit in a vehicle by using middleware architecture that is able to detect emotions. The middleware architecture can help us in our project for detecting each emotion separated so it will make the result more accurate.

In "Brain Signals-Based interface between drivers and in-vehicle devices" [7], the motivation is that Drivers often perform a secondary in-vehicle task while driving which can distract driving and thus lower driving safety. The main problem To address this issue some new types of driver vehicle interface have been developed by using speech recognition and gesture recognition techniques which is leading to better driving performance compared to traditional interfaces such as touch pad or touch screen in other hand this can lead to un concentrate for driver to road. The solution of the problem is Brain Computer Interfaces (BCI) provide a direct pathway between human mind and the external world. BCIs do not depend on illumination and can protect drivers privacy issues since BCIs only record drivers electronic brain waves without recording any other personal information, aim at exploring driver-vehicle interface based on BCI to perform secondary tasks while driving. The main results BCI performance the threshold and accuracy of the SSVEP algorithm Detection model. The best result of Threshold was 0.60 and the average of control command was 64.03 % and non-control command was 75.61 %. While in-vehicle secondary task performance the average of task success rate was 73.44 %, the average of false alarm rate was 11.58 %, and average of response time 1.59. This paper is very important because this paper support more information about detecting brain signals with best results and best algorithms used.

In "Detecting Slow Eye Movement for Recognizing Drivers sleep Onset Period with EEG Features" [6] The motivation is Numerous drivers admit that they have fallen asleep at the wheel, this issue increased percentage of risk of crashing. The main reasons are If driver lapses into asleep onset period without realizing it when performing some critical driving task is needed at same time. The solution is Finding a reliable physiological signal indicator for drivers Sleep onset period is very meaningful, it is worth noting that slow eye movement is

regarded as a reliable indicator for sleep onset period in a lot of sleep related studies. Slow rolling eye movements are mentioned appearing in transition from wakefulness to sleep in many sleep scoring manuals. The results are We have two results: First the Characteristics of Slow Eye Movement (SEM), Such that it have 3 kinds of Eye Closure Event (ECE) as appearing during simulated driving. First kind is ECE-W which is including all ECE (more than 1s) without SEM, has lowest duration distribution with median value 2.31, Second Kind is ECE-S which is including all ECE with SEM and continuous alpha wave has the moderate duration distribution as it represent sleepiness level, Third Kind is ECE-A which is including all ECE with SEM and alphas attenuation, has highest duration distribution median value 9.92. Second the classification Performance, Which SEM detection algorithm was done within each individual in addition because SEM tend to occur in ECE but number of each of three kinds of ECE was not fixed for each fixed due to complicated and repetitive driving fatigue state transform. The ration between time length of all SEM epoch and that of non-SEM epoch varied about from 1:90 to 1:23 among ten subject. This paper is important to me because results demonstrate that adding EEG feature group to HEOG feature group improves the accuracy of algorithm for detecting SEM.

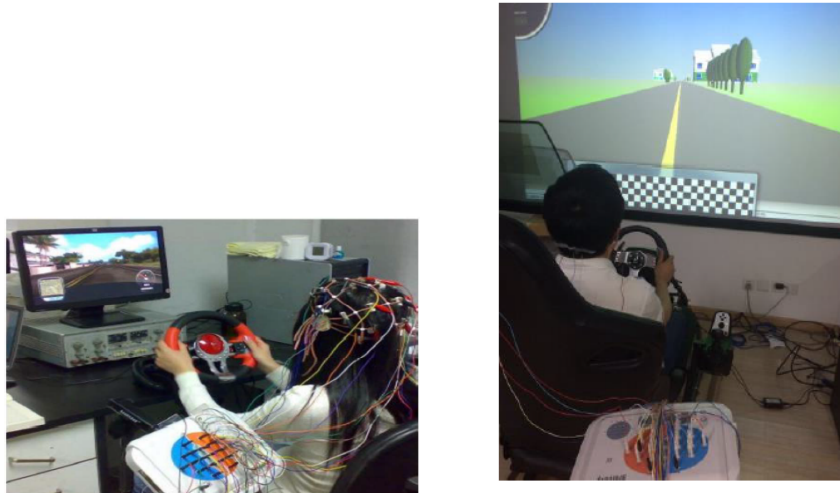
In "Abnormal Driving Behavior Detecting using Sparse Representation "[2] The motivation is Recent Statistical reports from National Highway Traffic Safety Administration of USA show that more than Five million traffic accidents occur annually in USA including about 30 thousands fatal crashes and reports showed that more than half of crashes caused by drivers. The main reasons are reducing the chance of traffic crashes many drivers monitoring systems have been developed. A DMS warns driver under abnormal driving conditions which is requires enumerating abnormal driving conditions. The solution is proposed DMS compares drivers statuses with his/her personal normal driving status model and identifies abnormal driving statuses that greatly change drivers appearances. The result is The Method makes decision independently in every frame however drivers motions are continuous in the video temporal information may help to better represent drivers driving status. This system is important Because they found a way to safe driver.

3.2 Comparison with Proposed Project

Paper Name	Pre-processing	Feature Extraction	Classification	Results
BREACTOR	ICA	ICA	SVM, KNN	No results yet
Driver Behavior Analysis for Safe Driving: A Survey	FFT	DWT	SVM, ANN, LDA	90%
A Brain Signals-Based Interface Between Drivers and In-Vehicle Devices	power-line notch filter and band-pass filter	SSVEP , Threshold	CCA	64.03%
EEG-based motor imagery classification in BCI system by using unscented Kalman Filter	Unscented Kalman Filter	CSSP	LDA	55.5%
Automatic detection system of micro sleeps of car drivers based on EEG analysis	Band-pass filter , ICA	FFT, AR, LD	CSP	able to visualise brain-patterns micro-sleeps

3.3 Screen Shots from previous systems

Figure 1: Driving Simulator and reading brain signals



4 Project Management and Deliverable

4.1 Tasks and Time Plan

Tasks will be handled according to the waterfall model since we have abundant time and this is a graduation project. We will go through its 6 phases which consist of the following:

Phase 1 : Proposal Evaluation 26 Sep 2017

Phase 2 : SRS Evaluation After Mid-term within 3 Days

Phase 3 : SDD Evaluation After Final Exam within 3 Days

Phase 4 : Evaluation Implementation After Mid-term within 3 Days

Phase 5 : Technical Evaluation 1 week of May

Phase 6 : Final Thesis After Final Exam by 2 weeks

4.2 Budget and Resource Costs

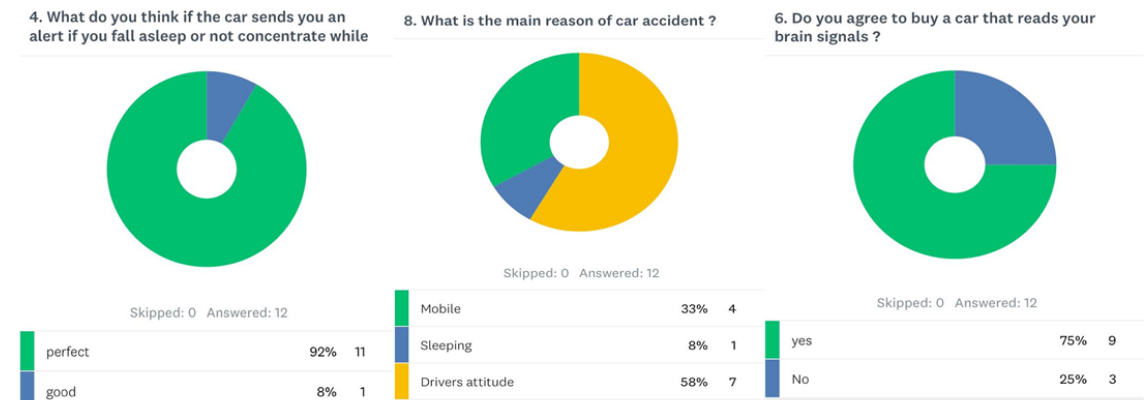
Currently Our Budget includes the following :

Emotiv epoc+ : 299 \$

MYO Device : 250 \$

Output Device : 2000 LE

4.3 Supportive Documents



5 References

References

[1] <http://www.asirt.org/>

- [2] Kyung-Moo Huh, Yeon-Mo Yang , Nik Khadijah Nik Aznan , "EEG-based motor imagery classification in BCI system by using unscented Kalman filter" (2016) "<http://dl.acm.org/citation.cfm?id=3013771>",
- [3] Derong Jiang , Jinghai Yin, "A Realtime Brain-Computer Interface Based on PDA", (2010) "<http://ieeexplore.ieee.org/document/7858507/>",
- [4] "Deanna Hood, Damian Joseph ,Andry Rakotonirainy, Sridha Sridharan, Clinton Fookes", "Use of Brain Computer Interface to Drive Preliminary Results " (2016) "<http://dl.acm.org/citation.cfm?id=2390272>"
- [5] Marco Lutzenberger Sebastian Ahrndt, Benjamin Hirsch , "STRATEGIC BEHAVIOR IN A LIVING ENVIRONMENT ", (2016) "<http://ieeexplore.ieee.org/document/6147755/>"
- [6] "Yuanyuan Ren , Xiansheng Li, Hongfei Liu , "Research on Decision Risk of Driving Behavior Based on Traffic Information Asymmetry Degree ", (2016) "<http://ieeexplore.ieee.org/document/5522890/figures?part=1>"
- [7] Rishu Chhabra,Seema Verma, C. Rama Krishna," A survey on driver behavior detection techniques for intelligent transportation systems ",(2017)," <http://ieeexplore.ieee.org/document/7943120/>",
- [8] Sinan Kaplan, Mehmet Amac Guvensan , Ali Gokhan Yavuz , "Driver Behavior Analysis for Safe Driving: A Survey ", (2015)," <http://ieeexplore.ieee.org/abstract/document/7225158/>"
- [9] Genaro Rebolledo-Mendez, Anglica Reyes, Sebastian Paszkowicz, Mari Carmen Domingo, and Lee Skrypchuk , "Developing a Body Sensor Network to Detect Emotions During Driving ", (2016), "<http://ieeexplore.ieee.org/document/6869114/>"
- [10] ,Tenghuan He, Luzheng Bi, Jinling Lian, Huafei Sun , " Brain Signals-Based interface between drivers and in-vehicle devices ",(2016), "<http://ieeexplore.ieee.org/document/7535563/>"
- [11] Yingying Jiao, Bao-Liang Lu , "Detecting Slow Eye Movement for Recognizing Drivers sleep Onset Period with EEG Features ", (2016) "<http://ieeexplore.ieee.org/document/7591766/>",
- [12] chung-Rong huang, Ming-fang chang , " Abnormal Driving Behavior Detecting using Sparse Representation ", (2016) "<http://ieeexplore.ieee.org/document/7858507/>",