Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 110 (2017) 135–142

Procedia Computer Science

www.elsevier.com/locate/procedia

The 14th International Conference on Mobile Systems and Pervasive Computing (MobiSPC 2017)

Homonoia: When your Car Reads your Mind

Ahmad Bennakhi[a], Maytham Safar[a,*], Jafar Abdulrasoul[a]

[a]*Kuwait University, Kuwait City, Safat PO Box 5969, Kuwait*

Abstract

This paper aims to shed light on the possibility of applying brain waves as a mean to understand the driver's mood while on his/her everyday commutes. While there are several studies that document the relationship between brain waves and mood, none have progressed to apply it on vehicles. We experimented the use of EEG sensors to detect brain waves and recorded several correlations that could prove to be useful. After understanding the driver's mood only through a passive approach, the car could suggest ways in which it could improve or compliment the driver's mood. This could also open up a whole level of danger diversion features in cars, if both the car and the EEG sensor are integrated well enough.

Peer-review under responsibility of the Conference Program Chairs.

Keywords:
BCI, Car Interface, Mood sensing, Ambient Technology, Contextual Navigation, EEG, Smart Systems

1. Introduction

Homonoia is defined as "oneness of mind, unanimity, and concord"[1]. This word describes the relationship that we human beings are trying to achieve with our computers. The gap between computers and human beings is still a wide one, but is closing up pretty quickly considering the annual semi-exponential growth of transistor density and the ubiquitous presence of advanced microcontrollers. Sight (screens and cameras), sound, and touch are all integrated in our daily life to the point that we almost take it for granted with every smart phone released. However, brain waves are not truly well integrated in the practical course of our lives considering that they potentially could tell us more about our well-being more than any other parameter, especially while driving.

Using brain waves in a car is not entirely a new concept since it has been used to control cars[2,3]. These applications are indeed very helpful for handicapped people and could be used in the future for all people. Nevertheless, it is a long way from industrial scale implementation and will likely die out since driverless cars are the wave that is going to topple it all. Our study is not about driving cars using your brain waves, rather it is about making the computer interface in your car a travel companion that can sense your concentration, mood, and dangerous conditions such as

* Maytham Safar. Tel.: +965-99361062 Fax: +965-24839461
E-mail address: maytham.safar@ku.edu.kw

1877-0509
Peer-review under responsibility of the Conference Program Chairs.
10.1016/j.procs.2017.06.134

drowsiness, drunkenness, or an eminent epileptic seizure. Implementing this would require no safety procedure since the worst case scenario in all of that is just a misplaced suggestion.

There exists an enormous amount of studies that map every state of mind to its corresponding alterations in brain wave signals, but never has there been one to question the application of introducing brain waves to ambient intelligence presence inside cars instead of only controlling the car itself. Sensing brainwaves can also have a tremendous boost to the accuracy contextual navigation and, if perfected, can be an AI present in cars that will make cars a place where interface and user can interact tunefully.

Section 1 will be the introduction, while section 2 will discuss studies related to this paper. Section 3 will give the reader some background knowledge about both the topics of brainwaves and the state of mind corresponding to it. Moving on to section 4, we will discuss the details of the case study that this paper is going to tackle. We also will display and analyze the results of the case study with all of its implications in section 4 too. A design of the proposed system that integrates the EEG device with the car is proposed in section 5 with all of its potential applications. The study finally concludes in section 6 with a concise summary of our important findings.

Nomenclature

Delta waves	Between 1 Hz and 4 Hz
Theta waves	Between 4 Hz and 8 Hz
Alpha waves	Between 7.5 Hz and 13 Hz
Beta waves	Between 13 Hz and 30 Hz
Gamma waves	Between 30 Hz and 44 Hz

2. Related Work

A previous study[4] went through the idea of predicting distractions, using a system that the researchers have programmed to detect. What we plan to do differently from the previously mentioned study is to establish the foundations of a mood sensing system that would not only sense the mood, but also the various mental conditions that could affect the driver using real life driving data (the mentioned study used a computer driving simulator to develop and test their system).

Truck drivers were subject of continuous research when it came to driving and EEG. Most of them focused on fatigue/sleepiness during long distance driving[5]. While this paper is old (1993), it marked the beginning of research that focuses on the brain waves of drivers during their journey. More papers emerged with astounding results when it came to predicting the driver's drowsiness/fatigue[6,7]. All of the previously mentioned studies were done using simulated driving rather than real life testing. A survey was done archiving and comparing all of the studies concerned the detection of drowniness and fatigue while driving, whether it was done using EEG or by other means[8]. It is certainly a good read if someone wants to be informed of the research that was done on the field before 2009.

A study[9] had also been conducted to link brain cognition to the mood of individuals. The study also uses an EEG sensor to verify their hypothesis and record the correlation. Predicting the mood while walking was predicated in a study[10] that used electromyogram(EMG) sensors all over the body. Our method is not as intrusive, as it only requires the user to wear a comfortable headband. The use of EEGs to predict alertness and mood was present in a study[11] that wanted to detect the effect of colors on brain waves and concentration. The experiment was not performed on a driver though, since its scope was not specified for that.

3. EEG Brain waves

Brain waves have been a under research since the beginning of the 20th century, and they have been thoroughly studied until our present day. A lot of the work has been done on brain waves that researchers can pinpoint which wave lengths correspond with each state of mind. Moreover, the effects of numerous psychiatric medications have been known to produce anticipated brain wave abnormalities. Today's market offers us a wide range of EEG sensors