REAL TIME OF DROWSINESS RECOGNITION SYSTEM BASED ON ELECTROOCULOGRAPHY

ANIS ATIQAH BT MOHAMED

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Real time of drowsiness recognition system based on Electrooculography

ANIS ATIQAH BT MOHAMED

This report is submitted in partial fulfillment of the requirements for the award of the Bachelor of Electronic Engineering (Electronic Wireless Communication) with Honors

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

June 2016

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : **REAL TIME OF DROWSINESS RECOGNITION SYSTEM BASED ON ELECTROOCULOGRAPHY**

Sesi Pengajian :

1	3	/	1	7

Saya ANIS ATIQAH BT MOHAMED mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

☐	**SULIT***	*(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD****	**(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

(COP DAN TANDATANGAN PENYELIA)

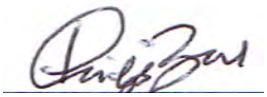
Tarikh: 2 JUNE 2017

Tarikh: 2 JUNE 2017

DR. ABDUL MAJID BIN DAUD
Ketua Jabatan Kejuruteraan Telekomunikasi
Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
Universiti Teknikal Malaysia Melaka (UTeM)
Hang Tuah Jaya
76100 Durian Tunggal, Melaka

Declaration

"I hereby declare that the work in this project is my own except for summaries and quotations which have been duly acknowledge."

Signature : 

Author : ANIS ATIQAH BINTI MOHAMED

Date : 2 June, 2017

Approval

"I acknowledge that I have read this report and in my opinion this report is sufficient in term of scope and quality for the award of Bachelor of Electronic Engineering Wireless Communication with Honours."

Signature : 

Supervisor's Name : DR. ABD MAJID BIN DARSONO

Date : 2 June, 2017

ACKNOWLEDGEMENT

I would like to thank for ALLAH S.W.T. because of his witness and abundance on me to complete the project within the time provided. Foremost, I would like to express my sincere gratitude to my supervisor Dr Majid Bin Darsono for the continuous support for my Bachelor Degree study and research, for his patience, motivation, enthusiasm, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better supervisor for my Bachelor Degree study

Special “thank” to all my peers, my family, and siblings for their moral support in completing this project. For my lovely husband, thank you for understanding the difficulties faced during the completion of this project and all sacrifices towards my success. Lastly, thank you to everyone who had been to the crucial parts of realization of this project

ABSTRACT

One of the major reasons for road accidents now a day is due to driver fatigue. Be it long distant travelling or drunk driving drowsy state leads to risky crashes which are hazardous to lives as well. To overcome such accidents some method has to be developed that is feasible to all vehicle drivers. The eye has a lot powerful communication power. Here, electrooculography (EOG) based alertness detection system for a vehicle driver is present. Electrooculography (EOG) is an efficient bio-electrical signal that can be used to measure the change in eye positions. Normal time duration between eye blink patterns is measured by several observations .The algorithm is based on measure of time duration between blink movements of eye. Algorithm is set such that If the time duration between blink patterns is more than normal than person may napped or not in alert stage. The basic electrooculography (EOG) system with (PSL iEOG2) is build and time duration algorithm set through signal processing tool kit in mat lab and arduino. Time duration between blink signals crosses the sated reference time that means driver is obviously in abnormal stage maybe in napped or fatigue condition. However, both condition dangerous for driving. In this project, we design simple hardware, just measuring time duration between two consecutive picks of blink signal which is as same as measure of Electrooculography (EOG) interval circuit and when we find time duration just beyond reference time we have to trigger on devices that make driver alert and that can easily prevent threats of sudden accident.

ABSTRAK

Pada masa kini, mengantuk ketika memandu adalah salah satu punca berlakunya kemalangan di atas jalan raya. Perjalanan jarak jauh atau berkeadaan mabuk ketika memandu mendedahkan diri kepada kemalangan berisiko tinggi dan juga mengancam kehidupan. Untuk mengatasi kadar kemalangan, beberapa kaedah yang boleh dikembangkan untuk digunakan untuk semua pemandu kenderaan. Kaedah *electrooculography* (EOG) merupakan salah satu kaedah dimana bertindak untuk mengesan pemandu yang berada dalam keadaan mengantuk dan memeberi amaran kepada pemandu. Kaedah *electroculography (*EOG) merupakan satu isyarat bio-elektrik dimana untuk mengesan pergerakan serta perubhanan mata. Kelipan bagi manusia yang normal diukur dan diperhatikan berdasarkan signal gelombang yang terhasil. Algoritma ditetapkan berdasarkan ukuran tempoh diantara diantara kelipan mata serta pergerakan mata. Kaedah algoritma ditetapkan apabila seorang pemandu itu dikesan berada dalam keadaan mengantuk atau tidak fokus apabila tempoh masa kelipan lebih daripada tempoh kelipan yang normal. Sistem direka dimana *electrooculography* (EOG) sistem disambungkan bersama PSL iEOG2 bagi memproses signal didalam matlab dan arduino. Seorang pemandu itu dianggap berada dalam keadaan mengantuk atau keletihan apabila tempoh berkelip diantara dua signal yang melepasi waktu rujukan yang telah ditetapkan. Walaubagaimanapun, dua-dua keadaan adalah bahaya untuk pemanduan. Dalam project ini, kami mereka cipta sebuah sistem yang ringkas bertujuan untuk mengukur signal kelipan mata bersamaan dengan sistem *electrooculography* (EOG) dimana berfungsi dalam mengesan jika tempoh masa melebihi waktu yang telah ditetapkan, penggeran akan berbunyi untuk memberi isyarat kepada pemandu dan secara langsung kaedah ini dapat mengurangkan kadar kemalngan jalan raya.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Overview

In this project, electrooculography (EOG) is used as tracking technology and gaze estimation in detection of drowsiness. Real-time gaze-based text entry can also be a powerful means of communication and control for people with physical movement. EOG is an efficient bio-electrical signal that can be used to measure the change in eye positions. Based on our previous preliminary research, detection of drowsiness according to their type of using EOG is feasible. The classification outputs can be used alert the drivers when drowsy. As a result, the drowsiness system based on EOG can be implemented. This project is developed by using simulation, microprocessor, psliEOG2, recording electrodes and personal computer. The signal conversion process behind the application is first investigated in order to understand the working principle of EOG system. Hence this project is expected to work out by give the alertness to the driver when in drowsy by design and implement system in analyze eye movement and blinking detection based on EOG signals in real time

1.2 Project Motivation

About 20% of road accidents occur due to distraction of driver. Among that 30% is due to driver fatigue. There are many methods to monitor driver and there by alert him/her in case of distraction. Sleepiness during driving is a major cause for road accidents. Most people thought that drunken driving is the serious cause of accidents and unaware of drowsy driving which is just fatal. It also deteriorates vigilance, concentration and alertness so that the ability to perform different consciousness-based activities (such as driving) is impaired, decreases awareness, reduces judgment and increases the risk of crashing.

Road accidents caused due to driver fatigue is more serious and leads to death other than drunken driving and rush driving accidents due to drowsiness is more crucial because the driver is loss the consciousness which leads to serious injuries or death. Not only are the people traveling in vehicles the victims. The pedestrians will also get affected. The cause of a fatal crash where drowsy driving involves is nearly impossible to determine with certainty. However, the investigators tell that there are a number of clues at a crash scene that shows the person fell asleep at the wheel. For example, accidents due to drowsy driving occurs usually in vehicles where the driver is alone and the injuries seems to be serious or fatal, especially during nights the drivers drive under stress on highways and as a result, they mostly lose control over the vehicle and become the victims of accidents. One in four highway traffic fatalities are the result of momentary driver drowsiness according to the German Road Safety Council e.V. (DVR).

There various steps in drowsiness detection are image acquisition, face detection, eye area extraction, blink detection, yawning detection etc. one of the techniques is through EOG system. In 1995M.S Ghiyasvand says that the most significant feature of EOG for eye movements is that the any subject the change in peak power frequency was ±6.25 Hz when eyes were opened and closed or vice versa. Therefore this frequency shift has been used to discriminate between the states and generate a trigger command for the prosthesis or any other external device. So real time based on EOG system is feasible in helping the drivers. EOG is an also

efficient bio-electrical signal that can be used to measure the change in eye positions. EOG signal recognition technique can be developed in a low cost method. Implementation of EOG signal recognition can help to reduce the cost of the drowsiness system and thus it is affordable by many people

1.3 Project Objective

In order to complete this project, there are several objective of the project need to achieve. The specific objectives of this project are as follows:

1. To develop a new technology of real time of drowsiness detection systems based on electrooculography technique for eye writing simulators with prototype
2. To design and implement system in analyze eye movement and blinking detection based on EOG signals in real time.

In order to achieve the first objectives, experiments have to be conducted to obtain EOG signal and analysis has be done to classify the features of EOG signal. An electrode is used to develop a drowsiness detection system. ARDUINO is used as microcontroller, groove base shield and MATLAB is used in recognized waveform. The duration of blinking is sets and buzzer as a prototype in produce the sound and alert is sent to a driver that is deemed drowsy.

1.4 Scope of Project

The signal conversion process behind the application is first investigated in order to understand the working principle of EOG system. Electrooculography is one of the techniques in detection of eye movement and analyze the waveform. A large number of different techniques to track eye movements have been investigated and comparison between video-based infrared (IR) pupil-corneal reflection (PCR) and Electrooculography (EOG) have been made. Electrooculography (EOG) is more preferable because IR systems only based on visible light and pupil center tracking tend to be inaccurate and sensitive to head movement.

Electrooculography (EOG) compared to video-based eye tracking is that changing lighting conditions have only little impact on Electrooculography (EOG) signals and also be measured in total darkness or when the eyes are closed. By the different potential that created by using electrodes, analyses of the waveform can be made and from Electrooculography (EOG) waveforms in real-time, based on the blinking waveform we define the duration of blinking to detect the drowsiness. By using the mat lab simulation, arduino, shield and Electrooculography (EOG) kit in getting the eye movement waveform based on potential different created. Based on the waveform the drowsiness can be recognized by use buzzer as the output. However, the classification of EOG can be either DC or AC recording.

This application is simple design for drivers. We manipulated the signal through mat lab and arduino code and measure the time duration between each blink. If it beyond 5 second, we can find the unchanged stage and drowsy is detected. At the end of the experiment, performance and quality of application will be examined based on the analyses (EOG signal output waveform) that have form based on eye movement.

1.5 Problem Statement

In modern societies, lack of sleep is often due to an increase of work pressure and abnormal work schedules, and associated with an increase in daytime drowsiness. In this thesis project, we try to give a detailed interpretation of the EOG

Signal appearance, find out the relationship between some specific EOG waveforms and the driver‟s eye movement and obtain more knowledge on how the EOG signal can be used to detect drowsiness. The method used to study the EOG signal. Electrooculography (EOG) is a widely used technique to monitor drowsiness. The EOG recording technique requires electrodes to be placed on both sides of the eyes, and this may cause some problems. It requires that a helper is present how to correctly position the electrodes. This head movement generates a signal which is sometimes picked up and misinterprets the program. Blinking, breathing and talking generate similar signals as well, which at times are also mistaken for a legitimate choice.

Besides there is an ever existing drift in the signal pickup (electrode slip, sweat, etc.), which forces us to average the signal over time. Due to this, the system detects only relative signals and cannot make any absolute eye position determination. There might substantial amount of interference within the experimental board itself (which is wire wrapped). The baseline may vary due to the spontaneous movement of ions between the skin and the electrode used to pick up the EOG voltage. The mostly commonly used electrode type is silver-silver chloride (Ag-AgCl). Large DC potentials of up to 50mV can develop across a pair of Ag-AgCl electrodes in the absence of any bioelectric event, due to deference in the properties of the two electrode surfaces with respect to the electrolytic Conduction gel. The extent of the ion movement is related to a number of variables including the state of the electrode gel used, variables in the subject's skin and the strength of the contact between the skin and the electrode. Proper preparation of the skin is necessary to maximize conduction between the skin and the conduction gel, usually by brushing the skin with alcohol to remove facial oils. Electrodes placed around the eyes may draw attention to the user's disability and compromise the user's feelings of dignity. A possible solution is to use a pair of glasses or sunglasses

1.6 Project Significance

This thesis project investigates the blink behavior and other eye movements related with automobile driver during long time driving. The main aim is to map certain events in a recorded electrooculography (EOG) to actual blink behavior. Based on the obtained knowledge, it will be possible to improve the detection method for driver‟s eyelid blink and to develop more robust measures of the driver‟s drowsiness state.

1.7 Thesis Outline

Chapter 1: Introduction of the project. The explanation for the project will be given in a general term. The objectives of the project will be elaborated. It is followed by the explanation in the scope of project, objective doing this project and also the problem statements.

Chapter 2: Literature review for the development of Real-Time of Drowsiness recognition based on a Electrooculography (EOG) signal system. This chapter describes the literature review of the project elaborately. Explanation will be focused on Real-Time of Drowsiness recognition based on a Electrooculography (EOG) signal system related researched and based on theory and conceptual ideas. Some literature reviews of current existing projects based on this project are also be discussed here.

Chapter 3: Methodology of the project. This chapter focusing on how the work scope is being done and that includes hardware architecture and software implementation of the project. This chapter discusses about the architecture of the project that consists the hardware design and the software implementation, along with the organization of the project.

Chapter 4: Result and Analysis. This chapter explains the result obtained regarding the performance and efficiency of the system in general term and overall systems operation.

Chapter 5: Conclusion. Conclusion and further development or future recommendation that can be applied in this project are being discussed in this last chapter

CHAPTER 2

LITERATURE REVIEW

2.1 Basic Topologies

In this section, simple concept about electrooculography (EOG) will be introduced such as the Real Time of Drowsiness recognition based on electrooculography (EOG), electrooculography (EOG) background, types of electrooculography (EOG) signal, and basic components used in obtaining electrooculography (EOG) signal will be explained.

2.1.1 Real Time of Drowsiness recognition based on electrooculography

Driver‟s fatigue is one of the major causes of traffic accidents, particularly for drivers of large vehicles (such as buses and heavy trucks) due to prolonged driving periods and boredom in working conditions. Driver drowsiness is a significant contributing factor to road crashes. One approach to tackling this issue is to develop technological countermeasures for detecting driver drowsiness, so that a driver can be warned before a crash occurs. Those who do a lot of driving know how tiring long car trips and night driving can be. And a simple fraction of a second can decide the difference between life and death. Lack of sleep is often due to an increase of work pressure and abnormal work schedules, and associated with an increase in daytime drowsiness [1].

Detecting the level of drowsiness and giving an alarm signal when this level becomes too high would thus be away to decrease the number of accidents and dangerous situations caused by drowsy driving. Based on the journal entitle Comparison between a fuzzy system and two supervised learning classifiers stated The National Highway Traffic Safety Administration (NHTSA) has in- deed enlightened that driver drowsiness is responsible for about 100,000 car crashes every year[2]. This is the reason why more and more researches are made to build auto- matic detectors of this dangerous state

In united state, it is estimated that drowsiness is the cause of four deaths and 100 injuries per day and drowsy drivers are estimated to be the cause of 7% of all traffic accidents. Additionally, 16% of all accidents with at least one casualty involve a tired driver [3]. For drowsiness detection in drivers, the best base for detection is the use of electrooculography (EOG) signals. (Borghini et al., 2012) indicate that characteristics of electrooculography (EOG) signals significantly change while performing a task that requires visual attention such as driving [4]. Often, features such as velocity, duration and amplitude are derived from the electrooculography (EOG) signal and variations in those features are used to detect drowsiness [2].

Important advances in activity recognition were achieved using modalities such as body movement and posture, sound, or interactions between people [5]. For the 'drowsiness' recognition, the proposed system first reconstructs the eye-written traces from electrooculography (EOG) waveforms in real-time then, the system recognizes waveform inputs. Electrooculography (EOG) is based on electrical measurement of the potential difference between the cornea and the retina [6]. This is about 1 mV under normal circumstances. The Cornea-retinal potential creates an electrical field in the front of the head. Hence, electrooculography (EOG) compared to video-based eye tracking is that changing lighting conditions have only little impact on electrooculography (EOG) signals [7].

Various communication methods based on eye movement have been utilize or published. Compare with electrooculography (EOG) one of the other method is video-based infrared (IR). Infrared Video System consists of a charge-coupled device (CCD) camera, an image capture card, and an LCD projector [7]. These methods are suitable for real-time extraction of the position of the pupil in the eye image [8] and