SLEEP SENSING AND ALERTING SYSTEM FOR DRIVERS

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To my beloved father, mother, and all my siblings and friends.

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ABSTARCT

Driving while drowsy is one of the factors of road accidents. The development of technologies for preventing drowsiness is a major challenge in the field of accident avoidance. The main purpose of this study is to detect the drowsiness in drivers to prevent the accidents and to improve the safety on the highways. Various technologies can be used to try to detect driver drowsiness such as steering pattern monitoring, vehicle position in lane monitoring, driver eye and physiological measurement. The technique used in this project is a human physiological measurement based on accuracy. The system uses a webcam that points directly towards the driver's upper body and monitors the driver's eyes in order to determine the condition of eyes. The webcam captured 2 images in 2 second and if the 2 images is in open eyes the system consider the driver is in normal condition while if the 2 images are in closed eyes the system considers the driver is in sleepy condition. When the drowsy is detected, an output which is buzzer will activate to alert the driver.

ABSTRAK

Memandu dalam keadaan mengantuk adalah salah satu faktor kemalangan jalan raya. Pembangunan teknologi dalam usaha untuk mencegah rasa mengantuk adalah merupakan cabaran utama dalam bidang mengelakkan kemalangan. Tujuan utama kajian ini dijalankan adalah untuk mengesan rasa mengantuk ketika memandu untuk mengelakkan kemalangan dan meningkatkan keselamatan di jalan raya. Pelbagai teknologi boleh digunakan untuk mengesan pemandu berada dalam keadaan mengantuk seperti pemantauan keadaan stereng, pemantauan kedudukan kenderaan di lorong, keadaan mata pemandu dan pengukuran fisiologi. Teknik yang digunakan di dalam projek ini adalah pengukuran fisiologi manusia berdasarkan ketepatan teknik. Sistem ini menggunakan kamera yang memaparkan bahagian atas badan pemandu dan memantau mata pemandu untuk menentukan keadaan mata tersebut. Kamera menangkap 2 gambar dalam masa 2 saat dan juka 2 gambar tersebut adalah gambar mata terbuka sistem menbuat konklusi pemandu berada dalam keadaan normal manakala jika 2 gambar tersebut adalah gambar mata tertutup system membuat konklusi pemandu berada dalam keadaan mengantuk. Apabila keadaan mengantuk dapat dikesan, penggera akan diaktifkan untuk memberi amaran kepada pemandu.

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LIST OF ABBREVIATIONS

MLL	-	Machine Learning Library
IPP	-	Integrated Performance Primitives
EOG	-	Electrooculogram
DC	-	Direct Current
IR	-	Infrared
LCD	-	Liquid Crystal Display
RGB	-	Red Green Blue
IDE	-	Integrated Development Environment
USB	-	Universal Serial Bus

CHAPTER 1

INTRODUCTION

This chapter will explain the introduction of this project and also contains of the project background, objectives, problem statement, scope of project, and expected outcome.

1.1 Project Background

The focused of this project is to develop a kind of system which can help road user to stay alert while driving and at the same time to reduce the number of road crashes or road accident cause of drowsy driver. Drowsy means sleepy and drowsiness is position of near to sleep.

Generally, when someone driving for a long time, the eyelids of the driver will become heavy and feel sleepy. Usually many drivers are not realizing that they are in falling asleep during driving. They can suddenly fall asleep at any time during their driving and at the same time the vehicle is not in under control and then cause of accident. So, in order to overcome this problem, driver need such a system which can alerting them from feel sleepy.

There are too many system technologies in this world related to the changes of human behavior. The system depends on the efficiency since the detection systems have too many methods. So, this project focused on how to develop the monitoring system that can determine the state of driver's eyes in real-time or in other words to develop a kind of sleep sensing system.

Sleep sensing system is one of the safety manufactures technology which can helps us to reduce the number of road accidents caused by the drowsy driver. Many of technologies can be used in this project in order to detect driver drowsiness during driving such as steering pattern monitoring, vehicle position in lane monitoring, driver eye and physiological measurement.

Among these methods, the techniques that are best, based on accuracy are the ones based on human physiological measurement. The system uses a camera that points directly towards the driver's upper body and monitors the driver's eyes in order to detect drowsy driver. When the drowsy is detected, a warning signal as an output of this system will activate to alert the driver like using a buzzer or something else. The function of this system is to find the location of driver's eyes and to determine if the eyes are in open or closed position. If the eyes are found closed for a certain time, the system consider that the driver is falling asleep and a warning signal will be activated.

1.2 Problem Statement

Half a million of Malaysian people died because of road accidents and the highest cases of road accidents are caused by the driver's behavior, equipment failure, the road conditions and infrastructure. As we can see one of the factors cause of road accidents is driver's behavior. The behavior of the driver can be determine by looking at the body position, head position and condition of eyes and mouth.

The question is how long we as a driver can stay focused on the road? It is impossible to control or determine the actions and reactions of other drivers but as the driver of our own vehicle, we need to make sure that we are in full control during

driving. Most of road users are not aware of the general rules such as lack of seat belt use, fatigue, speed driving, drowsy driving, alcohol and drugs use while driving which higher possible cause accidents and crashes. The important thing that needs to take care during driving is our eyes. The driver needs to stay focus on the lane and traffic by using the eyes. So, the focused of this project is to monitor the behavior of driver in order to maintain the position of driver.

1.3 Objectives

The purpose of project:

i. To develop a drowsiness detection system that can detect drowsy or sleepy in drivers.
ii. To designing a system that will accurately monitor the open or closed state of the driver's eyes in real-time

1.4 Scope of Work

The scopes that need to be proposed in this project:

i. Monitoring driver's face in real time by using image acquisition.
ii. Develop eye detection system by using Viola-Jones algorithm.
iii. Determine the state of eyes either open or closed by using real-time image processing.

1.5 Expected Outcome

i. Hardware contains of camera as an input, Arduino as a microcontroller and buzzer as an output.
ii. The system that can detect the state of eyes in real-time.
iii. This system can be applied in vehicle.

CHAPTER 2

LITERATURE REVIEW

This chapter will focus on previous method used in this project and researchers.

2.1 Introduction

The main purpose of writing this chapter is to get more information and knowledge related to the project which is the ideas to develop the sleep sensing system in real-time. The methods for detect driver drowsiness are generally related to the measurement of the driver's state, driver performance and a combination of the driver's state and performance.

For detection of driver's state method, for example like head position, state of eyes and yawning while the detection of driver's performance, for example like lane tracking, condition of vehicle, and tracking distances between vehicles. Based on researches below, the most accurate and high efficient technique towards driver fatigue detection is on physiological measurement like measure brain waves, eye blinks, heart rate, pulse rate and respiration. But, these techniques are intrusive and require the attachment of some electrodes on the driver.

Therefore, another technique which suitable to driver likes computer vision can be used. This techniques focus on monitoring behavior of the driver like condition of eyes, head and face. This techniques is more suitable because it never disturb the driver while driving.

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2.2 Previous Research

There are many research has been done in order to develop a real time monitoring system for drivers to increase the safety while driving and decrease the number of accidents caused by drowsy drivers.

The first journal is “Prototype Drowsiness Detection System” by Abinash Dash and Birendra Nath Tripathy. The focus of this journal is using OpenCV system as a main method. OpenCV was intended for computational proficiency and having a high concentrate on real-time image detection. OpenCV is coded with enhanced C and can bring work with multicore processors. OpenCV automatically uses the Integrated Performance Primitives (IPP) library which is have a library installed in the device. The main purpose of OpenCV is to provide a simple computer vision infrastructure which is can helps people to develop a fast process intelligent vision system.

The OpenCV library has many types of function that containing at least 500 functions. OpenCV also has a complete general purpose also known as Machine Learning Library (MLL). The focused of this library is on statistical pattern recognition and clustering.

So, the question is why this journal focused on OpenCV method compare to other method to develop the drowsiness system. OpenCV was designed for system that has image processing. Each function and data structure has been designed with an Image Processing application. If this method compared to other method like using Matlab software to develop image processing system, the OpenCV method is more fast when process the system than using Matlab. Matlab itself was built by Java and Java was built by C. So, this is the main factor why process on Matlab will be slow

because when a program on Matlab is run, the computer gets busy trying to interpret, compile and convert all that complicated Matlab code. Based on efficiency, Matlab uses too much system resources compare to OpenCV which is it can get away with as little as 10mb RAM for a real time application. This is the OpenCV structure and content.

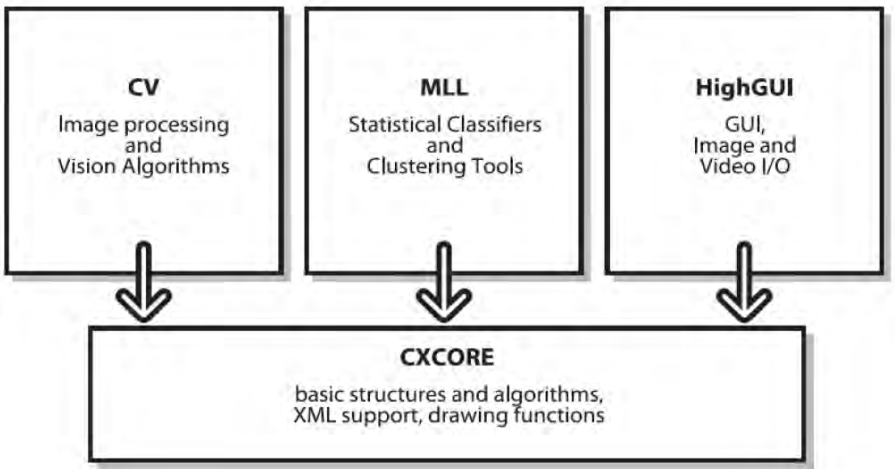

Figure 2.1 Block Diagram for OpenCV [9]

OpenCV contains five primary components and four components that are shown in the Figure 2.1. The CV component contains the fundamental image preparing and larger amount PC vision calculations while MLL segments that is the machine learning library incorporates measurable classifiers and bunching instruments. HighGUI segment contain info and yield of the video and picture. CXCore part contains all the fundamental structures and calculations, XML support and drawing capacities.

The second journal is “Detecting Eye Blink States by Tracking Iris and Eyelids” by Huachun Tan and Yu-Jin Zhang (2005). This journal depends on the esteem force and edge data which is the esteem get from perceiving the eye state and furthermore the record of the cases of eyelids before closing for taking after the restored eyes. Recognizing the eye state and what's more the record of the cases of eyelids before closing for taking after the resuscitated eyes. [14].

There are bit problems for this project which is when the iris is redetected, through the inside purposes of the upper and the lower eyelids can be tracked by eye

boundaries. According to the line model, the focus purposes of the upper and the lower eyelids are a similar point. The two center points are same pattern, which are the following frames is lead to the two points moving to the same point. So, there is one of the eyelids that upper or lower trackers will be in error and the error would be propagated by following image sequences. Figure 2.2 shows that when the system monitor the eye is reopened, the upper eyelid is cannot be detected because of the change of pattern of center point of upper eyelid. The error is propagated in the following sequences, even enlarged [14].

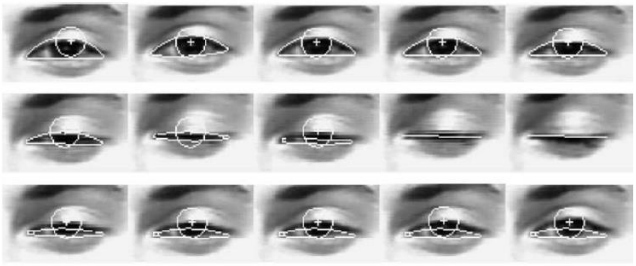

Figure 2.2 Sample of eyes tracking [14]

So, in order to overcome this problem, when the iris is redetected by system author utilize AR model to foresee the examples of focus purposes of eyelids. By using the formula below, the examples of eyelids are anticipated where Pn is stand for pattern of center point of eyelid, m is stand for the number of frames and Wi is stand for the forecast coefficient.

$$p_n = \sum_{i=1}^{m} w_i p_{n-i},$$

In this project system, the model is set order as 2. Then, the system add the formula below where w stand for the forecast coefficient.[14]

$$p_n = wp_{n-1} + (1-w)p_{n-2},$$

Figure 2.3 demonstrates a case of eyelid following utilizing the formula above, where w is set as 0.5. Both the lower and upper eyelids are followed precisely based on rightness of the examples used to track the eyelids.

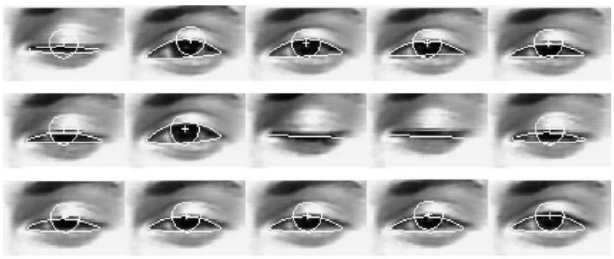

Figure 2.3 Sample of eyes tracking [14]

The third journal is "Blink Behavior Based Drowsiness Detection Method Development and Validation" by Ulrika Svensson (2004). This journal focused on method development which method used in this project is Electrooculogram (EOG).

EOG is a strategy utilized for measuring the potential contrast between the front and back of the eye ball. The EOG can be utilized for location of eye developments and squints. The eye is a dipole with the positive cornea in the front and the negative retina in the back and the potential amongst cornea and retina lies in the range 0.4 – 1.0 mV. At the point when the eyes are focused straight ahead a relentless benchmark potential is measured by cathodes put around the eyes [5]. When moving the eyes a change in potential is detected as the poles come closer or farther away from the electrodes shown in Figure 2.4. The indication of the alter relies on upon the course of the development

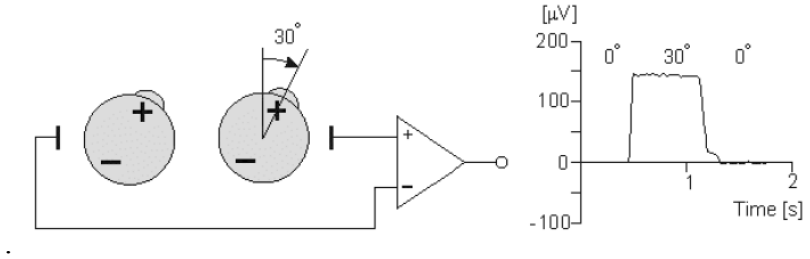

Figure 2.4 Eyes change [5]

EOG is utilized by setting cathodes around the area of the eyes. Normally silver-silver chloride anodes are utilized as they show unimportant float and grow no polarization possibilities. To augment the deliberate potential the anodes ought to be put as close to the eyes as could reasonably be expected. There are a bit issues with EOG technique which is the estimation are antiquities that emerge from muscle

possibilities and little electromagnetic unsettling influences that can be initiated in the links. To decrease the impedance amongst skin and anode, the skin need to clean precisely before estimation and cathode glue ought to be utilized. It is vital to have the capacity to separate level eye developments from vertical, and eye developments from eye flickers. The acquired recordings can be either vertical or level by utilizing various types of anode positions. In vertical recording terminals are set under or more the eye, and in even recording they are set at the external edges of the eyes. Vertical recording is normally monocular, which implies that the recording is made crosswise over one eye, though level recording more often than not is binocular.

Figure 2.5 shows the cathodes are put at the range of the eyes. Eye squints are recognized by utilizing vertical recording. When measuring squint related attributes, the examining recurrence ought to be high no less than 500 Hz as a high determination is required to gauge little contrasts in for instance flicker span [5]. DC recording is best, while separating the low recurrence segments away makes the location of long squints troublesome. One issue with DC recording be that as it may, is the danger of moderate benchmark float, which makes it essential to screen the EOG flag and change for the float amid the estimation.

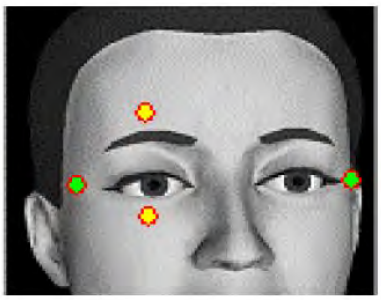

Figure 2.5 Electrodes are placed [5]

The fourth journal is “Implementation of the Driver Drowsiness Detection System” by K.Srijayathi and M.Vedachary (2013). The focused of this journal is developing the drowsiness system using hardware implementation on the driver’s eyes. The indicator that creator utilized for this venture is eye squint sensor which is the sensor is vital in their attempting to locate the flickering of eye, since it is utilized to drive the gadget and to work occasions. Next, the finder that creator utilized is IR

sensor to transmit the infrared beams in our eye by utilizing IR transmitter and get the reflected infrared beams of eye by utilizing IR collector. The microcontroller utilized as a part of this venture is ARM7LPC2148. This microcontroller depend on a 16-bit/32-bit ARM7TDMI-S CPU with ongoing copying and installed follow bolster, that consolidate the microcontroller with implanted rapid blaze memory going from 32KB to 512KB [7].

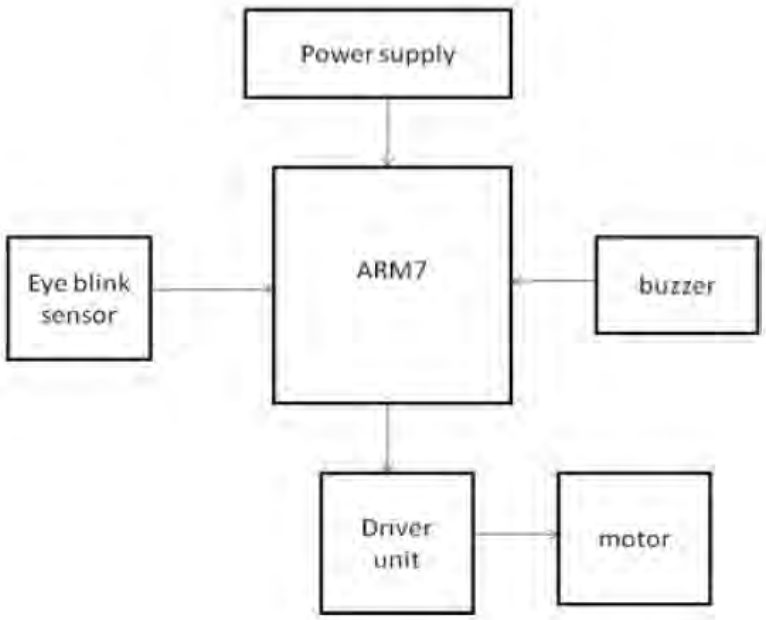

Figure 2.6 Driver Drowsiness System Block Diagrams [7]

Figure 2.6 shows the block diagram of driver drowsiness system. The operation flow of this system is implementing an automated security system which develops an eye blink sensor that consistently screens the quantity of times the eye flickers. The result for this venture is decide by if the eye squints tally diminishes that implies the driver is lethargic around then bell will actuate and after that kill the vehicle's start.

This paper includes measuring the eye blink utilizing IR sensor and the sensor have two segments. The capacity of IR transmitter is to transmit the infrared beams to our eye while capacity of IR beneficiary is to get the reflected infrared beams of eye. On the off chance that the eye is shut then the yield of IR beneficiary is high generally the IR recipient yield is low. The framework start with the transmitter segment which is eye flicker sensor is put close to the eye to detect the tally of eye squint and this information is transmitted as heartbeats and is given to the