Faculty of Computer Science and Information Technology

Alert System for Drowsy Driver by Study the Eyes Closure Using IoT

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Bachelor of Computer Science with Honours (Network Computing)

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ABSTRACT

After long hours of driving or in the absence of mental alertness, the driver's eyelids will become heavy due to fatigue. The driver's concentration begins to lose focus and when this happen, a sound feedback will be produce to wake up the drive. Drowsiness is dangerous because it can lead to an accident. Therefore, a solution have been proposed with the use of IoT. The concept of this proposed system is to detect driver’s drowsiness by doing facial landmark where if face is found, facial landmark detect and extract eye region then compute the eye aspect ratio and the eyes closure patterns will be studied. Besides, this system will alert the driver with the sound feedback if drowsy is detected and will allow the third party to keep the record of driver’s behaviour while driving by using Pushbullet application and can get notified by Pushbullet application if the driver is detected with drowsiness. In addition, this project helps to reduce the chance of accident by giving alert to the driver and help the associated person to do an employee evaluation based on the record of driver’s behaviour while driving

ABSTRAK

Selepas berjam-jam memandu atau dalam ketiadaan kecerdasan mental, kelopak mata pemandu akan menjadi berat kerana keletihan. Pemandu mula hilang fokus dan apabila ini berlaku, penggera akan dipasang secara automatik untuk membangunkan pemandu. Mengantuk adalah berbahaya kerana ia boleh mendatangkan kemalangan. Oleh itu, penyelesaian yang telah dicadangkan dengan penggunaan IoT. Konsep sistem yang dicadangkan ini adalah untuk mengesan pemandu yang mengantuk. Di samping itu, sistem ini akan memberi amaran kepada pemandu dengan bunyi jika mengantuk dikesan dan akan membolehkan pihak ketiga untuk menyimpan rekod tingkah laku pemandu semasa memandu dengan menggunakan aplikasi Pushbullet. Di samping itu, projek ini dapat membantu untuk mengurangkan kemalangan dengan memberi amaran kepada pemandu dan projek ini juga boleh membantu orang yang berkaitan untuk membuat penilaian pekerja berdasarkan rekod tingkah laku pemandu semasa memandu.

CHAPTER 1: INTRODUCTION

1.1 Background

Technology has a huge impact on our society. It has become an important part of our lives by providing so many benefits to us. Technology improves productivity in healthcare, transportation, entertainment and more. One of the example of technology is Internet of Things. Nowadays, the demand for internet application development is very high. The Internet of Things (IoT), also known as the Internet of Everything (IoE), is bringing about massive evolutionary changes in information and communication technology (ICT) by integrating wireless communications, sensors and data collection and processing techniques. In almost all segments of society and business, IoT will establish new ICT dimensions. IoT technologies are expected to improve quality of life, create new business opportunities and improve the productivity of factories, buildings, public infrastructure and services (Jamil Y. Khan, 2019).

The used of IoT can help to reduce the chance of an accident happen. As an example an alert system can help to monitor and alert the driver if drowsiness happen. An accident that caused by a sleepy driving has become one of the major issues of a traffic collision. According to reports, a significant number of road accidents occur due to sleepy driving, resulting in severe injuries and fatalities (Preidt, 2018). For this reason, various studies have been carried out in the design of systems that can examine the driver's fatigue and alert the drive in advance, preventing the driver from falling asleep behind the wheel and causing an accident.

1.2 Problem statement

Normally, after long hours of driving or in the absence of mental alertness, the driver's eyelids will become heavy due to fatigue. The driver's concentration begins to lose focus and this can creates the event of accidents. These are the common fatigue reactions, which are very dangerous. Mostly, tired drivers are not aware that even for a moment (micro sleep) they fall asleep. Unfortunately, the accident can happen at any time, less than a second (Peters, 2019).

Nowadays, safe driving is a major concern for societies around the world. The numbers of car accidents are also rising year on year. Malaysia also has the highest risk of road fatality among ASEAN countries caused by car accidents (Ruxyn, 2017). The statistics of the accidents increasing from 1998 to 2017 which are 211,037 to 533,875 (Hishamudin, 2018). There are some factors that contribute to the car accident caused by the condition of the vehicle and human's behaviour. Many traditional approaches have used vehicle-based metrics to model their method, but such indicators are highly influenced by the configuration of the road, the type of vehicle and the driving skills. Other approaches used psychological measures for their system, which tend to improve the accuracy of the driver's sleepiness monitoring. Nevertheless, these procedures are typically invasive, since electrodes must be placed on the head and body. Furthermore, there are few existing studies in which subjective measurements are used as inputs for the system, but these methods can distract the driver and lead to an ambiguous result (Md. Yousuf Hossain, 2019).

In addition, some initiative have been done to develop a real-time safety system to detect the drowsiness driver by a system called, drowsiness detection with OpenCV which able to monitor the driver's blinking eyes pattern by using a detection of facial landmark where if face is found, facial landmark detect and extract eye region then compute the eye aspect ratio (Rosebrock, 2017).

This system alert the driver using sound feedback if drowsiness is detected. This existing system is lack in few aspect such as, it does not have functionality to send the notification to the third party which the family members or employee's supervisor. This notification is to notify the third party if drowsiness is detected and can help the employee's supervisor to do employee evaluation. Fast action could be taken to save lives of the accidents victims, even for a few second.

1.3 Aim and Objective

The objectives of this project is:

i. To design and develop system that can detect drowsy eyes by eye detection using facial landmark.

ii. To alert the driver and to notify the third party if the drowsiness is detected.

1.4 Scope

This project will be using IoT based and will focus on the stimulation environment of drivers. A confined space will be set up with the table and chair and with the help of 2 or 3 people to test the system. The prototype of the system will be put on the table. A stand stick will be used to put the camera in front of the user. This method may slightly different with the condition of driver in the car as the angle of camera might be different from the inside of car. This system will not be tested on the real situation as it is dangerous to pretend drowsy on the road and it can cause an accident. Therefore, with all the consequences this system will only focus on the stimulation environment.

1.5 Brief Methodology

Rapid Application Development was built as a solution to the waterfall model, as the engineering background of the waterfall model was not well tailored to the fast paced and ever-

changing world of software development (Pelk, 2017). As this project required a fast development, Rapid Application Development (RAD) is the most appropriate methodology that can be used for this project. The implementation phase of this project is not necessary because it is not being introduced to public users for general use. The maintenance phase is not part of this methodology because there is no need for hardware and software upgrades after the final model has been deployed. In contrast, RAD systems are more reliable and faster. There are four phases in this model. The reasons for choosing rapid application development (RAD) in Alert System for Drowsy Driver on the Road using IoT are as follows:

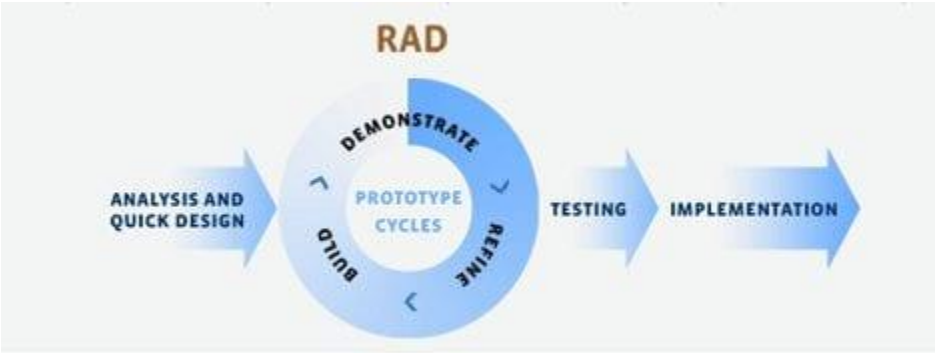

Figure 1.5: Rapid Application Development (RAD) Model

1.5.1 Analysis and Quick Design

The starting point of the stage is an analysis and quick design phase. This stage will be undertaken through meeting and discussion between student and supervisor to decide the requirement of this project and how to design and develop the system. At this stage, student needs to identify the problem, objective and the outcome of the project. Students need to gather all hardware and software requirements through brainstorming and similar literature reviews found online. Next, analyse those requirements to achieve the objectives of this project.

1.5.2 Prototype Cycles

The prototype will be created in this phase where it consists of building, demonstrating and refining the project. The build phase is to setting up hardware modules of microcontroller and sensors. Camera is used to capture the driver's face and the sound feedback will be produced if drowsiness is detected. Raspberry Pi is used to receive data from each sensor. All sensors can be buy at the online shop such as Shopee and Lazada.

1.5.3 Testing

In this phase, a continual testing will be performed to achieve the best outcome. It is also necessary to check the reliability of the system. This phase is therefore intended to test the system function and make the system accepted.

1.5.4 Implementation

Implement and integrate all units together as a completed module and keep on testing as a completed module to make sure the whole system works efficiently. Students will gather all the feedback from target user. In this phase, the final prototype will be finished completely to be used in daily life, but it is not been deployed in mass production of public use.

1.6 Significant of Project

This project will alert the driver with the sound feedback if drowsiness is detected and will allow the third party to keep the record of driver's behaviour while driving by using Pushbullet application and can get notified by Pushbullet application if the driver is detected with drowsiness. This project used Raspberry Pi as the microprocessor, pi camera to capture the image of driver, Wi-Fi module is not being used as the Raspberry Pi can connect to Wi-Fi and Bluetooth directly and Pushbullet application as the platform to keep record of driver and as a medium to be notified

by the system. This project helps to reduce the chance of accident by giving alert to the driver and help the associated person to do employee evaluation based on the record of driver's behaviour while driving.

1.7 Project Schedule

This project is divided into two parts which are Final Year Project 1 and Final Year Project 2. The FYP 1 consists of submission of chapter 1 (introduction), chapter 2 (background study or literature review) and chapter 3 (methodology). While the FYP 2 consists of chapter 4 (implementation) and chapter 5 (testing). The Gantt chart for the project schedule can referred in appendix section.

1.8 Expected Outcome

The proposed system is expected to detect driver's drowsiness by eye closure detection using facial landmark. If the face is found, facial landmark detect and extract eye region then compute the eye aspect ratio and the eyes closure patterns will be studied. Apart from that, a sound feedback will be produce once drowsiness is detected. This system also will allow the third party to keep the record of driver's behaviour while driving by using Pushbullet application and that third party will be notified if the driver is detected with drowsiness. This system will give the advantages to the drivers by giving them alert and warning that they are in drowsiness and make them realize that they have to take a rest before they continue their journey. Other than that, this system will make sure that the driver is still awake while driving on the road and this system also provide another ways to keep the driver's record of behaviour by Pushbullet application and this can help the associated person to do employee evaluation. By using this system an accident can be avoided and can save many lives.

1.9 Conclusion

In conclusion, this chapter has discussed the proposed project in details and the overview of alert system by IoT. The proposed project will be developed to make a solution to the simulation environment of driver. All the problems that they faced have been explained in the problem statement. Furthermore, this chapter briefly explained the process and schedule of the project in Gantt chart and overview how the project this project will be developed.

CHAPTER 2: LITERATURE REVIEW

2.1 Overview

A project using internet called IoT is addressed in this chapter. As the literature review is important in the project to improve the understanding about the proposed system. This also explain the reasons of choosing IoT technology. Besides, in this chapter also included with the discussion of the existing systems that consists of related and similar function or processes to the proposed system.

2.2 Background Study

Nowadays the demand for internet application development is very high. IoT is bringing an evolutionary changes in information and communication technology (ICT) by integrating wireless communications, sensors, data collection and processing techniques (Jamil Y. Khan, 2019). This revolution can help to reduce the accident happen because of drowsiness by providing detection of drowsiness and alarm to alert the drivers. There were some existing alert system or equipment for drowsy driver that have been developed from time to time to improve the function of systems.

2.3 Reviews on existing systems

For review the different existing system that have similar properties to the system that have been proposed which is Alert System for Drowsy Driver by Study the Eyes Closure Using IoT and will be compared to discover the similarities and differences of existing system. The features used in the existing system also will be discussed in this section.

2.3.1 IoT Eye Drowsiness Detection System by Using Intel Edison with GPS Navigation (Auni Syahirah Abu Bakar, 2019)**.**

This system detects drowsiness with the notification of the accident and the location by using Global Positioning System (GPS) navigation. In this system, the image processing analysing through open source Computer Vision (OpenCV) is used to monitor eye condition. This system focused on the time taken of the closed eyes. If the driver is detected with closed eyes for about more than 4 seconds, the driver is consider as drowsy and alarm system will be activated to warn the driver and notify the status and location to relative for further action via message (SMS). Smartphone camera is attached in front the driver and used as sensor to capture video. The video are sent to cloud for analyse eye condition either sleep or awake. At the same time, the GPS navigation module is activated to trace the current location data of the driver. All the captured data will be send to the cloud storage. The information that being stored in cloud will be sent to Intel Edison for communicating with hardware. Intel Edison will trigger the output by LCD, LED, buzzer and Global System for Mobile (GSM) notification. This system is connecting by network wireless connection (WiFi) (Auni Syahirah Abu Bakar, 2019) . Figure 2.3.1.1 and 2.3.1.2 below shows the circuit diagram of the system and the result of the system.

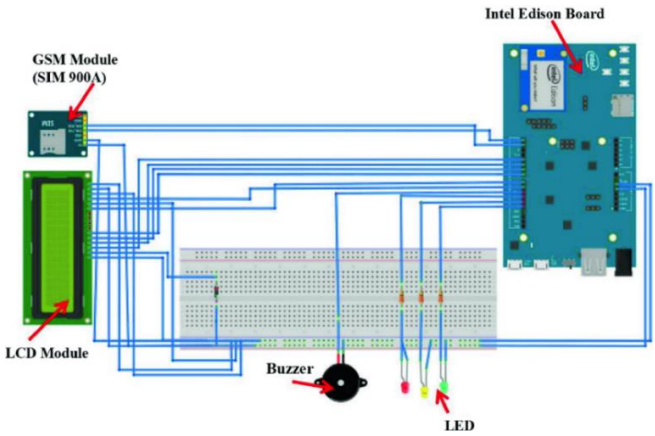

Figure 2.3.1.1: The circuit diagram of the system

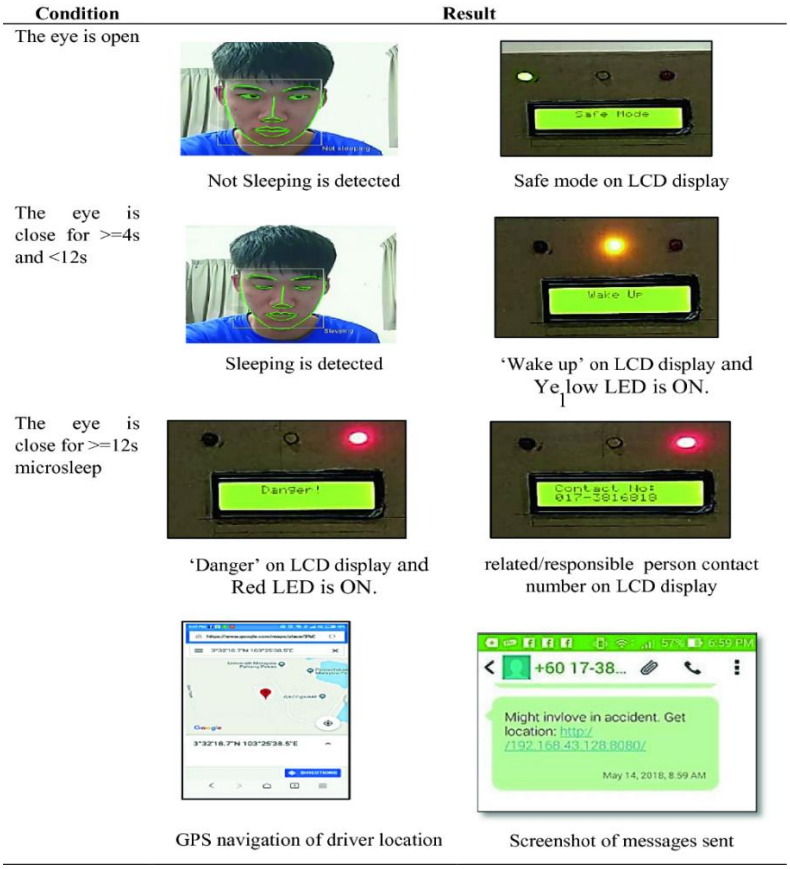

Figure 2.3.1.2: The result of the system

In this system hardware used are Smartphone Camera, Intel Edison board, GSM module, buzzer, LEDs, GPS and LCD. The detail of the hardware and its function were shown in the Table 2.3.1 below.

Table 2.3.1: Detail of the hardware and its function

Hardware	Function
Intel Edison Board	Intel Edison acts as a microcontroller. It is used to perform various function and operations throughout the system.
GSM module (SIM 900A)	GSM is used in this system for alerting and messaging system to notify the family members or emergency agency by sending message (current location) when the driver is suspected to involve in accident.

LCD module	The 12C 1602 LCD module is a 2 line by 16 characters display interfaced to a 12C daughter board. LCD module is used to display the eye condition of the driver.
Buzzer	Acts as alarm to wake up the driver up, three different led light (Green, Yellow and Red) which is the indicator to show the fatigue of the driver where green led indicates safe mode, yellow led means alarm is ringing due to eyes is closed more than 4seconds and red led represents danger mode and message is ready to be sent.
Smartphone Camera	A smartphone camera is a video camera that feeds its image in the real time by install an IP camera which id uses a direct connection using Ethernet or Wi-Fi. This camera will use to capture the eyes condition of the driver.
GPS	To detect the actual location of the driver.

2.3.2 Drowsiness Detection with OpenCV (Rosebrock, 2017).

In this system if the face is detected, facial landmark will be applied and extract the eye regions. If the eyes aspect ratio indicates that the eyes have been closed for a sufficiently long enough amount of time, an alarm will be triggered to wake up the driver. This system applied computing a metric called eye aspect ratio (EAR) unlike the traditional image processing method for computing blinks. Eye aspect ratio is instead much easier solution involved simple calculation based on the ratio of distances between facial landmarks of the eyes. This system detects eyes blink with OpenCV, Python and dlib (Rosebrock, 2017). As it is a simple system of detecting the drowsiness with the alarm, the only hardware used in this systems are USB webcam (Logitech 920) and standard laptop. Figure 2.3.2.1 until 2.3.2.4 below shows the flow of the system.

Figure 2.3.2.1: The setup of webcam

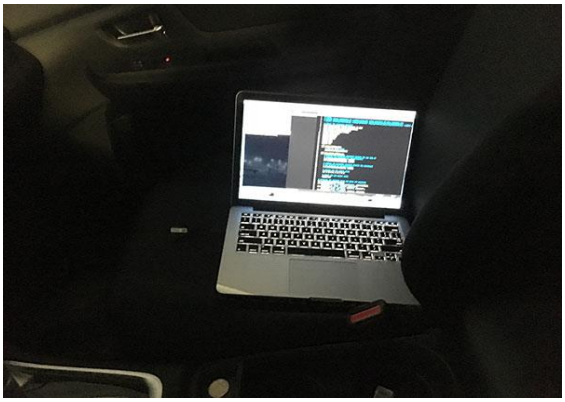

Figure 2.3.2.2: The computer is connected with webcam

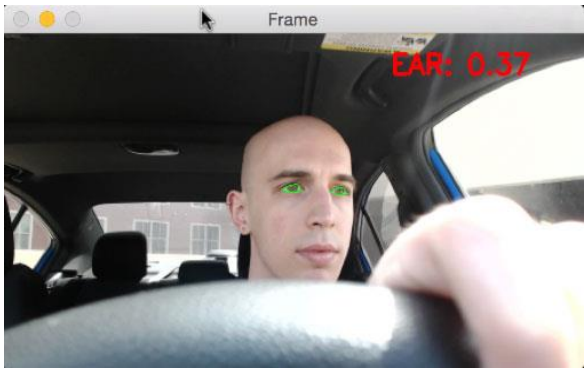

Figure 2.3.2.3: Face landmark is applied