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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF A DROWSINESS WARNING SYSTEM WITH AN ALCOHOL DETECTOR USING RASPBERRY PI.

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Bachelor of Computer Engineering Technology (Computer System) with Honours

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DEDICATION

Every difficult task requires both self-effort and the wisdom of elders,especially those who were extremely dear to us

My humble effort I dedicated to my loving

Father,Mother & Family,

who's care, love, support, and day and night prayers give me courage and motivation to be able to achieve such achievement and honour,

Along with all hardworking and respected

Lectures

ACKNOWLEDGEMENTS

ABSTRACT

In this era of globalization, technology has become part of our daily life. With technology's help, many problems able to be solved and makes human life easier. Globally, there are many deaths are increasing day by day due to road accidents and the factor causing this death are drivers drunk or sleepy during driving. When the driver drives while sleepy or in a drunk state, it is very dangerous and able to lead other vehicle crashes and affect other people's safety. These are the problem that will occur when the driver actually does not alert due to, they are sleepy or in a drunk state. Due to this situation and it needs an alerting system to remind the driver of the safety of the driver. Therefore, the purpose of the project is to develop a drowsiness warning system with an alcohol detector in the vehicle. The objective of this project is to develop a warning system for sleepy driver or alcohol presence from the driver and use the raspberry pi as the main component, to give alerting sound to drivers using a buzzer and USB camera that is able to observe the driver's eye. This drowsiness and alcohol alerting system used Raspberry Pi as the main component to control the input and output of the system which consists of image processing to detect the driver's eye. An alcohol sensor is used to detect the driver's alcohol presence from the driver and the buzzer will produces a sound to alert the driver if the alcohol is presence. This project is user-friendly as it is able to improve the safety of the driver before they drive their vehicle.

ABSTRAK

Dalam era globalisasi ini, teknologi telah menjadi sebahagian daripada kehidupan seharian kita. Dengan bantuan teknologi, banyak masalah dapat diselesaikan dan memudahkan kehidupan manusia. Secara global, terdapat banyak kematian semakin meningkat dari hari ke hari akibat kemalangan jalan raya dan faktor penyebab kematian ini ialah pemandu mabuk atau mengantuk semasa memandu. Apabila pemandu memandu dalam keadaan mengantuk atau dalam keadaan mabuk, ia amat berbahaya dan boleh menyebabkan kenderaan lain merempuh dan menjejaskan keselamatan orang lain. Inilah masalah yang akan berlaku apabila pemandu sebenarnya tidak berjaga-jaga disebabkan pemandu tersebut mengantuk atau dalam keadaan mabuk. Disebabkan keadaan ini dan ia memerlukan sistem amaran untuk mengingatkan pemandu tentang keselamatan pemandu. Oleh itu, tujuan projek ini adalah untuk membangunkan sistem amaran mengantuk dengan pengesan alkohol di dalam kenderaan. Objektif projek ini adalah untuk membangunkan sistem amaran untuk pemandu yang mengantuk atau kehadiran alcohol dari pemandu dan menggunakan raspberry pi sebagai komponen utama, untuk memberikan bunyi peringatan kepada pemandu menggunakan buzzer dan kamera USB yang mampu memerhati mata pemandu. Sistem amaran mengantuk dan alkohol ini menggunakan Raspberry Pi sebagai komponen utama untuk mengawal input dan output sistem yang terdiri daripada pemprosesan imej untuk mengesan mata pemandu. Sensor alkohol digunakan untuk mengesan kehadiran alkohol pemandu di dalam kereta dan buzzer akan mengeluarkan bunyi untuk memberi amaran kepada pemandu jika terdapat kehadiran alkohol. Projek ini mesra pengguna kerana ia mampu meningkatkan keselamatan pemandu sebelum mereka memandu kenderaan mereka.

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CHAPTER 1

INTRODUCTION

This chapter demonstrates the background of the project, problem statement, objectives, scope of the project, and the project outline.

1.1 RESEARCH BACKGROUND

This technology was created to detect the presence of alcohol from the driver before that person drives their vehicle. The technology helps to prevent accidents caused by intoxicated driving. The proposed system is going to identify whether the person is in a drunken state or not and it will give a warning sound to the driver. This can be done using the Raspberry PI board. "Alcohol and sleepiness detection" is the major goal of this study. Several accidents are occurring in the present environment as a result of alcohol intake or the person feeling sleepy while steering the vehicle.

The attitude of the driver is very important to ensure the safety of the road. Feeling sleepy and alcohol an emotional state will affect the driver's performance [4]. All these distractions will make them lose control of their vehicle which will lead to traffic accidents. Drowsiness is a significant factor in traffic crashes. Driving in a drunk state will increase the road traffic crash and caused death or serious injury to themselves or the surrounding people.

As a result, intoxication and drowsiness may be a major cause of accidents all over the world. We are proposing this alcohol detection system and drowsiness in vehicles to prevent vehicle accidents due to sleepy and drunk. The MQ5 Alcohol Detection sensor can be applied in all vehicles to detect whether the driver has consumed alcohol, and an alert sound will be triggered to warn the driver itself if the person is in a drunken state or the person feeling sleepy before they can drive their vehicle. This is a good way to detect alcohol consumers and sleepy people to minimize vehicle accidents occur.

1.2 PROBLEM STATEMENT

Nowadays, drowsiness and drunken driving are factors that cause car accidents globally and are always highlighted news. The percentage of these accident cases continues to increase from year to year. Driving in a drunken drowsy state is a major transportation safety concern and is responsible for thousands of accidents [3]. Drowsy and drunk driving accidents will usually result in the driver's loss of control, often leading to unpredictable vehicle trajectories and no braking response [4]. The main problem is the driver needs to be aware and conscious before they need to drive. So, this product will help the driver to make the driver alert and ensure safety of the driver before they can drive their vehicle. With this drunk and drowsiness warning system, the driver is able to be more cautious when they had drunk some alcohol or if they are feeling sleepy before they are driving. Predicting the driver's behavior and their next move is the crucial part [4]. The systems will help to increase the alert and safety of drivers and they're conscious when in the vehicle bad driving behavior will lead to road accidents occur and a warning system to alert the driver's attention to make the driver realize of driving their vehicle is an evolving area of research.

1.3 OBJECTIVE

In order to complete this project, there are several objectives that needed to be achieved in order to determine the success of the project. The main objective of this project is to design a drowsiness warning system with an alcohol detector. The objectives are as stated as follows:

a) To identify the optimal settings on the Raspberry Pi that involve sensor connections.
b) To analyse the effectiveness of the warning system to warn the driver.
c) To develop a prototype drowsiness warning system based on eye and alcohol detection.

1.4 SCOPE OF RESEARCH

This project focuses on designing a product that is able to conduct an analysis of vehicle accidents and the efficiency of this warning system to warn the driver.

The scope of this project is as follows:

a) Construct a circuit consisting of Raspberry PI that involves image processing and sensors that able to sense alcohol presence.

b) The alcohol presence and counts of eyes open from each frame will be recorded in a table.

c) The open eye's algorithm will be used in OpenCV which is using Python as a programming language.

d) This warning system can only operate when the person is feeling sleepy, or the alcohol is presence when the sensor is activated.
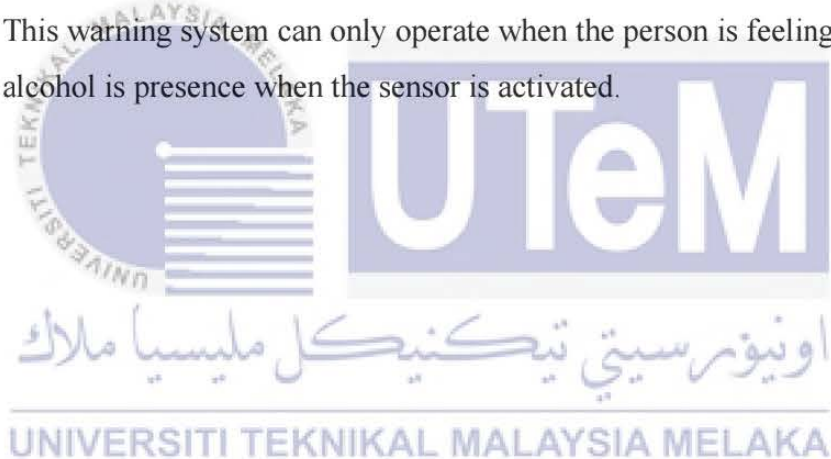
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discusses the important details from previous research and several studies. Thus, the discussion begins with the study of drunk and drowsiness detector concepts. The research of these concepts is important as it is the main objective of this project. This project involves the Raspberry Pi technology, so it is crucial to study the concept of how using it and how it is work. For the summary, the chapter ends with a comparison of the related existing projects and the implementation that fits this project.

2.2 Concept of drowsiness and drunk warning system.

In general, the warning system is a system deployed by a person or a group of people to give information about a future danger [6]. The main purpose of the warning system is to make preparation and give responses so that able to avoid it. The warning system will be effective if people react to it. This warning system is applied to drowsiness and drunk in the vehicle, which will be alerting the driver to avoid driving the car if they are in a drunk and sleepy state [8]. It will be a useful device for the driver to remind them not to drive if they feel sleepy or drunk. It is much easier if we create a flexible device to detect these symptoms and are able to perform alerting system to the driver. Figure 2.1 illustrate a system consists image processing which will act as input to observe whether a person is sleepy before the drive, and give a warning to the driver rapidly and effectively.
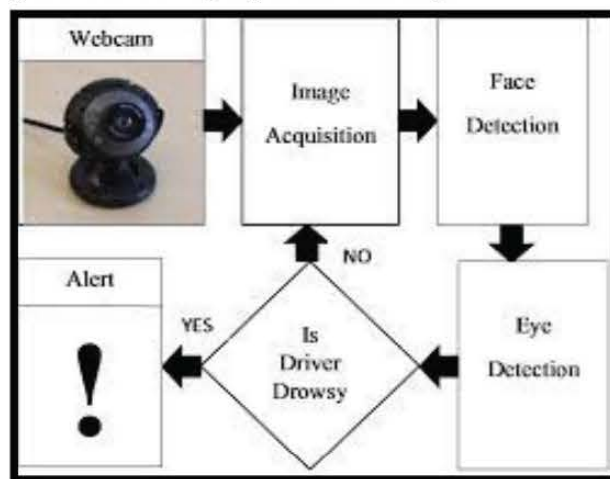

Figure 2.1: Example of Drowsiness
Warning System

2.3 Concept of Alcohol Detector

One of the famous alcohol sensors that is commonly used is MQ5. This sensor is a type of Metal Oxide Semiconductor (MOS). It is also called Metal oxide sensors also known as Chemiresistors. It is able to sense the changes of resistance of the sensing material when it is exposed to alcohol [13]. Placing MQ5 in a simple voltage divider network, it is able to detect alcohol concentrations.MQ5 is a heater-driven sensor so it is why it needs to be enclosed in two layers of fine stainless-steel mesh which is known as an Anti-explosion network [13]. It is because the heater element in the sensor will not cause an explosion since the alcohol is a flammable gas [3]. It has protection for the sensor and filters out unwanted particles so it only allows gaseous elements to go through inside the chamber.

Figure 2.2: Example of Alcohol Sensor

Figure 2.2 shows the example of alcohol sensor which has a SnO_2 (Tin Oxide) semiconductor layer. As a result, oxygen is adsorbed on the surface of the SnO_2 semiconductor layer when it is heated to a high temperature. In clean air, electrons from tin dioxide's conduction band are drawn to oxygen molecules [13]. This produces a potential barrier by forming an electron depletion layer just below the surface of SnO_2 particles. As a result, the SnO_2 layer becomes highly resistive, preventing the flow of electric current [13]. Figure 2.3 shows the specification for MQ5 sensor and its behavior. MQ5 sensor used voltage between 4.9V and 5.1V which able to detect alcohol presence between 200 ppm until 10000 (Part Per Million).

Specifications of MQ-5 Gas Sensor :

Item	Parameter	Min	Typical	Max	Unit
VCC	Working Voltage	4.9	5	5.1	V
PH	Heating consumption	0.5	-	800	mW
RL	Load resistance		adjustable		
RH	Heater resistance	-	31±10%	-	Ω
Rs	Sensing Resistance	10	-	60	kΩ
Scope	Detecting Concentration	200	-	10000	ppm

Figure 2.3: MQ5 Specifications

2.4 Concept of Image Processing

Image processing is the process of converting a physical image to a digital representation and then conducting operations on it to extract valuable information [8]. When implementing specific specified signal processing algorithms, the image processing system normally treats all images as 2D signals. There are various techniques of digital image processing which commonly used nowadays such as medical imaging, videophone, satellite imagery, and others [8]. The aim of this early image processing was created was to increase the quality of the image and to improve the visual effect of the people. Figure 2.4 is the example of showing the vision of camera on to detect the driver's eye whether they are sleepy of not.
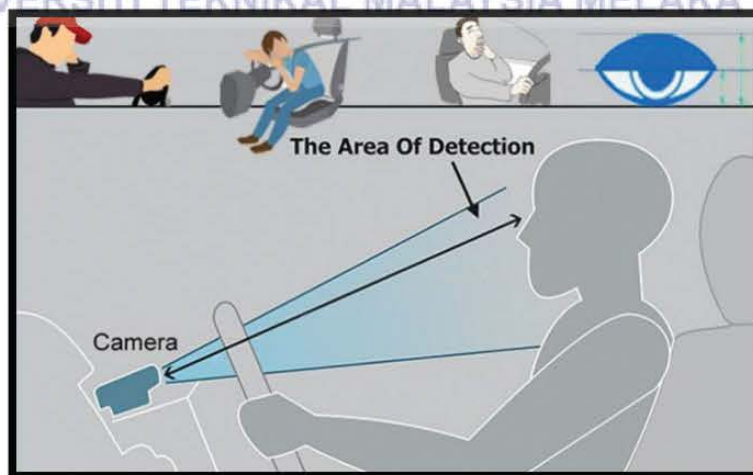

Figure 2.4: Image Processing example in a car

OpenCV which is also called as Open Source Computer Vision Library is a common tool for image processing technology. OpenCV is a cross-platform library that allows us to create real-time computer vision apps. It primarily focuses on image processing, video recording, and analysis, which includes characteristics like face and object detection. Computer vision is a discipline that discusses how to reconstruct, interrupt, and interpret a 3D scene from its 2D images in terms of the structure inherent in the scene. It is concerned with employing computer software and hardware to model and replicate human vision.

Although OpenCV is designed in C++ and has a C++ interface as its primary interface, it also has a less comprehensive but still significant older C interface. The C++ interface displays all of the recent breakthroughs and algorithms. Python, Java, and MATLAB/OCTAVE all have bindings. The online documentation contains the API for these interfaces. Wrappers for a variety of programming languages have been created to encourage greater use.

2.5 Concept of Raspberry Pi Technology

People use the Raspberry Pi all across the world to learn to program, develop hardware projects, automate their homes, and even employ them in industrial applications [12]. The Raspberry Pi project was created with the goal of encouraging the teaching of basic computer science in schools and disadvantaged countries. Figure 2.5 shows an example Raspberry Pi model which is low cost, versatility, and open design, it is frequently employed in various sectors, including weather monitoring. Due to its embrace of HDMI and USB devices, it is mostly utilized by computer and electronic experts.

Figure 2.5: Raspberry PI 1 Model
1

Some individuals purchase a Raspberry Pi to learn to code, while others use it to learn how to code electronics for physical projects. The Raspberry Pi may let you construct your own home automation projects, which is popular among open-source enthusiasts since it puts you in charge rather than relying on a proprietary closed system [13]. Thus, the Raspberry Pi is ideal for adaptive technology since it can show visuals or play films in high-definition resolution, which is ideal for prototyping embedded systems. This product allows you to create complicated and effective structures at a lower cost.

2.6 Related Previous Projects

The study of previous related projects that are largely focused on monitoring drowsiness and drunk is essential to have a good consideration of the project so that fundamental bits of knowledge are gathered able to achieve the objectives of this project. As a result, this part will analyze five past projects that use a similar strategy and have a similar goal to fulfill the main goal of this project.

2.6.1 Drunk and Drive using IoT

This paper introduces Drunk and Drive Detection Using IoT by which is this project basically mixing the use of programming and gear to run it by using an Arduino board. The MQ3 sensor will distinguish the liquor and bring the information from the sensor to the ThingSpeak stage This platform was used to send messages to people in the area [16]. If the alcohol concentration is discovered, the car will not move any further and will be stopped.

2.6.2 Drowsiness Detection and Alert System

The purpose of this study is to propose drowsiness and alert system by using Arduino Uno SMD as the main component. For this research, it alerts the truck driver as well as the owner of the company [11]. Whenever the driver sleepy and closes his eyes for more than a second, the buzzer will be triggered [11]. After that, it will send the driver text messages as warning.

2.6.3 Identification of Driver Drowsiness Using Image Processing

The research used MATLAB software through image processing to implement a driver's drowsiness detection. This project consists of a small camera pointing to the driver's face and eye. The first yawn is detected along with a closed eye which will be recorded regularly. Then, a buzzer will be used to alert the driver if drowsiness is detected [1]. Figure 2.6 is about driver drowsiness using image processing where a video camera installed beneath the front mirror records the driver's face on a regular basis and process on how it executed. To detect the yawn in the first place, the camera's sequence of frame images must be used to recognize and monitor the face. From the identified face, the position of the eyes and mouth is determined. Along with closed eyes, closed eye movement is sensed for yawning detection. It improves the robustness of the false detection method's segmentation [1]. The mouth and eye geometrical traits are then used to identify the yawn. The device alerts the driver to his fatigue with a beep or buzzer, as well as the potentially dangerous driving state if yawning is detected.
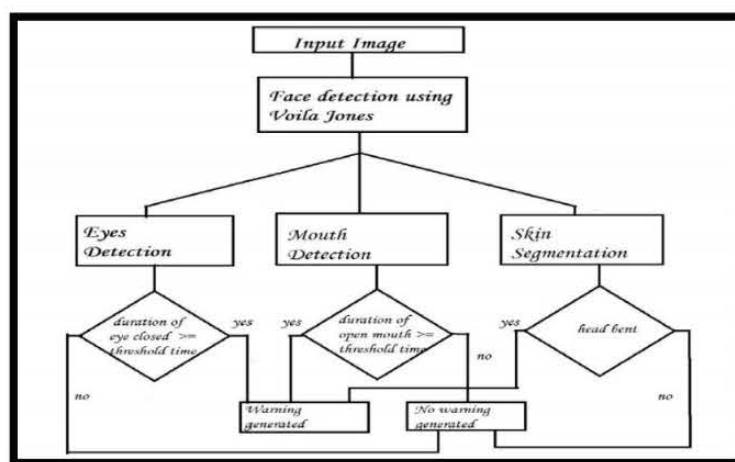
Figure 2.6: Driver Drowsiness using Image Processing

2.6.4 Alcohol Detection based Engine Locking System Using MQ-3 Sensor

The goal of this research is to make a safe driving experience by using an ATmega8 microcontroller and MQ-3 alcohol. Figure 2.7 shows engine locking system where alcohol is able to be detected by using an alcohol sensor that is connected to a microcontroller that already set a permissible limit for alcohol concentration. When this occurs, the vehicle engine system will turn off and the GPS module will detect the present location of the vehicle.
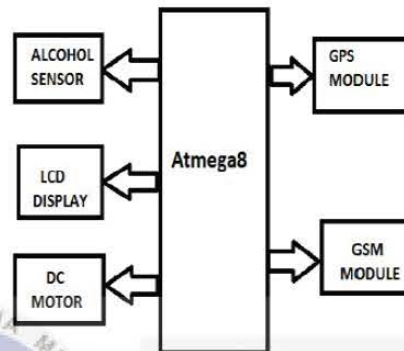
Figure 2.7: Engine Locking System
Block Diagram

2.6.5 AI-Based Drowsiness Driver Alert System

The AI-Based Drowsiness Driver Alert System is involved eye-blinking, yawn detection, opening and closing of the eye. When the drowsiness of the driver is detected, this system will alert the driver through the speaker, and the relay will slow down the vehicle [6]. This system also involves some sensors which are temperature sensors, vibration sensors, and alcohol sensors with GPS devices to locate the accident that took place.

2.7 Comparison Between Previous Projects

Table 2.1: Comparison previous related projects

No	Reference	Method	Advantages	Disadvantages
1	[16]	This project is about drunk and drive by using IOT which mix the use of Arduino and programming.	This project able to get accurate level of liquor whether the person is intoxicated state or else ordinary state.	The changes in breathing example will affect the final breath results.
2	[11]	Arduino Uno SMD is the main component for this research which involve buzzer as the alerting system.	When the driver's eye blinking more than 1s, it able immediately to react and give the warning sound through buzzer.	The driver need to use spectacles which it quite disturbing and not really comfortable for the driver.
3	[1]	This research used MATLAB for implementation of driver's drowsiness by with image processing which involve Viola-Jones and Hough Transform.	The research can scan the whole specific part for facial such as eyes, mouth and skin as input for image processing.	Learning MATLAB algorithm is quite challenging and costly if not for educational purpose.
4	[13]	This paper describes about the use of ATmega8 microcontroller and MQ-3 sensor to detect alcohol and sending data through GPS module and GSM module.	Able to giving info and warning to the family members if their driver is having alcohol content.	The GPS module will not able to function if the driver is drunk at the area have bad connection.
5	[6]	The research is about alcohol sensor and Raspberry pi 3 and able to update GPS location to the nearest location if the driver is drunk.	It is good when able to update and give information the location of the driver.	Raspberry pi 3 had slow processing time compare to Raspberry PI 4 and costly.

2.8 Summary

Overall, all related previous research and projects has their own benefits and their own weakness. Some of the projects that use Raspberry Pi 3 is a bit old which mean the processing time is quite slow. Due to project's requirement, using Raspberry Pi 4 is quite reasonable and understandable to implement. The research about eye detection and alcohol detection is crucial in order to understand the concept of the project.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter explains the methods used to achieve the goals of the project and able to create the project. It is a strategy and approach for developing, collecting, and analyzing data to create evidence to support a research study known as methodology. The study design and elaboration of the process flow, as well as the hardware specification, are the three primary aspects of this chapter. To ensure that the project's flow remains steady, detailed research on the employed hardware was conducted in order to gain a clearer picture and a better understanding of how to handle it and the best model to use for this project. This chapter is also important for gaining a broad understanding of the project flowchart. The process flow is described in great detail, and the hardware specs will be detailed after that. The methodology is essential to implement any new project or an improvement to a current project in the market.

3.2 Study Design

The purpose of this project is to develop a drowsiness warning system with an alcohol detector using Raspberry Pi for all drivers in Malaysia. Basically, Raspberry Pi is the brain of this project. Then, an alcohol sensor is used to detect the presence of alcohol and a USB camera has also included in the project to detect the eye of the driver. A buzzer is used in this project to enable the warning system by producing an alert sound to the driver. The software that is used in this project is Raspberry Pi imager which is used to write operating system images to the microSD card. Open CV is also used for processing images which to detect the driver's eye movement and Proteus software to construct the circuit virtually.