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FACE RECOGNITION FOR DRUNK DRIVER

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FACE RECOGNITION FOR DRUNK DRIVER

Face Recognition For Drunk Driver

MUHAMMAD FAKHRUL ALIF BIN HEIRMAN

A dissertation submitted in partial fulfilment
of the requirement for the degree of
Bachelor of Engineering
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ABSTRACT

This project's objective is to determine whether there is a discernible difference between the face behaviours of persons who are drunk and those of people who are sober. There is a significant amount of face recognition that occurs in situations involving intoxicated persons. It is imperative that intoxicated drivers be identified as soon as possible, preferably before they get behind the wheel, to reduce the likelihood that an accident will take place. At the outset, a comparison is made between the facial behaviour of a drunk person and that of a sober person. This is followed by the collection of comprehensive data regarding the distinction between the two face behaviours through the utilisation of the data that is produced following the training of the digital images through Image Processing. This procedure has the potential to demonstrate that the distinction between intoxicated and sober people can be identified based on facial behaviour, and that the distinction can be spotted using computer vision. The first approach for achieving the project's objectives is to run the face detection method, which detects the red colour on the eyes, nose, and cheeks by utilising Haar Cascade to identify just the face and obtain the confidence rate value. The project proceeds by completing the training and testing processes for all digital photographs, which are classified into three cases. A total of 100 digital images of sober face and 100 digital images of drunk face from single individuals for case 1. For case 2, 150 digital images of drunk face and 150 digital images of sober face from multiple individuals. As for case 3, a total of 50 digital images of sober faces and 50 digital images of drunk faces from multiple individuals. To meet the project's goals, a probability comparison from the testing procedure between drunk and sober is performed. The confidence rate of red colour detection for eyes, nose and cheek is between 75% until 98% for drunk face and 35% until 74% for sober face. Meanwhile, the probability of drunk face is approximately between 0.94 until 0.99 and probability of sober face is between 0.62 until 0.84 for case 1. Next, the probability of drunk face is between 0.79 until 0.95 and the probability for sober face is between 0.78 until 1.00 for case 2. For case 3, the probability of drunk face is between 0.62 until 0.99 and the probability of between 0.91 until 0.99 was for sober face.

ABSTRAK

Objektif projek ini adalah untuk menentukan sama ada terdapat perbezaan yang boleh dilihat antara tingkah laku muka orang yang mabuk dan orang yang sedar diri. Terdapat sejumlah besar pengecaman muka yang berlaku dalam situasi yang melibatkan orang yang mabuk. Pemandu yang mabuk adalah penting untuk dikenal pasti secepat mungkin, sebaik-baiknya sebelum mereka berada di belakang roda, untuk mengurangkan kemungkinan kemalangan akan berlaku. Pada permulaannya, perbandingan dibuat antara gelagat muka orang yang mabuk dan orang yang sedar diri. Ini diikuti dengan pengumpulan data komprehensif mengenai perbezaan antara dua tingkah laku muka melalui penggunaan data yang dihasilkan berikutan latihan imej digital melalui Pemprosesan Imej. Prosedur ini berpotensi untuk menunjukkan bahawa perbezaan antara orang mabuk dan orang yang sedar boleh dikenal pasti berdasarkan tingkah laku muka, dan perbezaan itu boleh dikesan menggunakan penglihatan komputer. Pendekatan pertama untuk mencapai objektif projek ialah menjalankan kaedah pengesanan muka, yang mengesan warna merah pada mata, hidung dan pipi dengan menggunakan Haar Cascade untuk mengenal pasti hanya muka dan mendapatkan nilai kadar keyakinan. Projek ini diteruskan dengan melengkapkan proses latihan dan ujian untuk semua gambar digital, yang dikelaskan kepada tiga kes. Sejumlah 100 imej digital muka sedar dan 100 imej digital muka mabuk daripada satu individu untuk kes 1. Bagi kes 2, 150 imej digital muka mabuk dan 150 imej digital muka sedar daripada pelbagai individu. Bagi kes 3, sejumlah 50 imej digital muka sedar dan 50 imej digital muka mabuk daripada pelbagai individu. Untuk memenuhi matlamat projek, perbandingan kebarangkalian daripada prosedur ujian antara mabuk dan sedar dilakukan. Kadar keyakinan pengesanan warna merah untuk mata, hidung dan pipi adalah di antara 75% hingga 98% untuk muka mabuk dan 35% hingga 74% untuk muka sedar. Manakala kebarangkalian muka mabuk adalah lebih kurang antara 0.94 hingga 0.99 dan kebarangkalian muka sedar adalah antara 0.62 hingga 0.84 bagi kes 1. Seterusnya kebarangkalian muka mabuk adalah antara 0.79 hingga 0.95 dan kebarangkalian muka sedar adalah antara 0.78 hingga 1.00. untuk kes 2. Bagi kes 3, kebarangkalian muka mabuk adalah di antara 0.62 hingga 0.99 dan kebarangkalian antara 0.91 hingga 0.99 adalah untuk muka sedar.

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LIST OF ABBREVIATIONS

BAC	Blood Alcohol Content
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EBA	Evidential Breath Analyzer
NHLC	New Hampshire Liquor Commission
MIROS	Malaysian Institute of Road Safety Research
PCA	Principal Component Analysis
SVM	Support Vector Machine
CNN	Convolutional Neural Network
ReLU	Rectified Linear Units
RGB	Red, Green, Blue
HMM	Hidden Markov Model
IoT	Internet of Things
LCD	Liquid Crystal Display
GPRS	Global Packet Radio Service
DUI	Driving Under the Influence
HOG	Histogram of Oriented Gradients
GUI	Graphical User Interface

CHAPTER 1

INTRODUCTION

1.1 Background

The origins of alcoholism can also be understood via the lens of behaviourism. For some adolescents, alcohol may serve to an end—the attainment of a sense of emotional fulfilment. Therefore, increased night-time activity correlates with increased alcohol consumption. Anxiety increases with inappropriate drinking, and drinking significantly reduces anxiety, showing evidence again for negative reinforcement route relating sleep/circadian variables to alcohol participation [1].

The effects of drinking, both short- and long-term, as well as binge drinking, are substantial. To begin, there is the universal intoxication. This occurs because alcohol causes the blood arteries of the face to dilate and constrict, forcing blood to flow beneath the thinner skin of the face. That's why she looks so flushed and red. After being repeatedly stretched open and reopened, blood vessels can break, causing spider veins to appear on the face. Bloodshot eyes are a common symptom of spider veins in the eyes [2].

Facial edoema and swelling are both symptoms of alcoholism. Skin maintains as much water as it can because of alcohol dehydration. Facial puffiness and redness can also be caused by drinking alcohol. Rhinophyma of the nose is another possible side effect of chronic alcohol abuse. An alcoholic nose is characterised by enlargement, redness, and swelling [2].

Drunk is a word used to describe anyone who has a high level of alcohol in their body. A drunk person is unable to control themselves to such an extent that they are unable to stand up straight, speak slurred and show marked reactions of a person who is not normal. A drunk driver is someone who's behind the wheel when tipsy and indirectly become someone who is very confident to drive. Drunk drivers are also very dangerous to let because they can disturb the order of other road users.

In today's age of advanced technology, the action taken by the authorities is to take alcohol readings in the body by doing a breath test from every road user when conducting roadblocks in certain areas. Action will be taken if someone finds the alcohol content in their body exceeds the Blood Alcohol Level (BAC) that has been set by law. There are a few types of technologies and algorithm to detect a drunk person by the face behaviour.

Drinking alcohol causes the blood arteries to loosen and dilate, making it easier for blood to flow through the body. Because the blood vessels are becoming closer to the surface of the skin because of the enlargement, the face will get heated and red. If you lack alcohol-metabolizing enzyme aldehyde dehydrogenase, may cause cheek blush to become more pronounced.

1.2 Problem Statement

Drunk driving is still a major concern in Malaysia. Every year, many people were killed because of drunk drivers. Despite the Malaysian administration's promise to pass new regulations with stiffer punishments, the problem has spiraled into calls from parliamentarians for fewer sites permitted to serve alcohol, halting of distribution, as well as the collapse of Malaysia's alcohol sector. However, simply passing laws and imposing punishments on drunk drivers is ineffective in dealing with traffic accidents caused by drunk drivers. Early efforts should be made to prevent drinkers from driving before the incident occurs.

According to the Transport Ministry's written Parliamentary reply to Tumpat MP Datuk Che Abdullah Mat Nawi on November 13, 2018, the number of people killed in drunk driving accidents was 49 persons in 2010, 33 persons in 2011, before growing rapidly to 136 persons in 2012 and continuing a general upward trend of 207 persons in 2013, 193 persons in 2014, 229 persons in 2015, and 237 persons in 2016. According to a Transport Ministry document posted on the website of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the number of deaths has dropped from 237 in 2016 to 58 in 2017 and 54 in 2018. According to these numbers 1,147 individuals were murdered in Malaysian alcohol - impaired driving accidents between 2011 and 2018 [3].

There was a time when 3 cases of drunk driving occurred within a week in 2020 in different areas, namely in Rawang, Kajang and Kuantan. It's distressing that all three casualties were in the incorrect location at the wrong moment. An inebriated Kuantan man hit the victim on May 25, 2020. The accident occurred on the perpetrator's commute to work. 29 May 2020 was the next case. After a 22-year-old student failed of his automobile and slammed into their bike, a freight company worker died, and his colleague was seriously injured. Three days previously, the decedent came on board. A youngster intoxicated motorist hit a Food Panda courier on his return trip after distributing his wife's homecooked food to clients in the third case [4].

The enforcement of the law and the implementation of additional roadblocks with breath tests conducted by the government to prevent alcohol drinkers from driving is a good and effective action. A roadblock on April 9 at Jalan Simpang Tiga resulted in the arrest of three individuals after an Evidential Breath Analyzer (EBA) test revealed that

all three had blood alcohol concentrations above the legal limit. Police acting chief, Superintendent Merbin Lisa of Kuching district reported 111mg/100ml, 86mg/100ml, and 104mg/100ml for the three suspects aged 35, 37, and 50 respectively. The present limit in Malaysia is 35 micrograms per 100 millilitres of breath. There was one officer and ten other members of the Kuching district police's Traffic Investigation and Enforcement team at the checkpoint [5].

By only doing the roadblocks that the government is currently doing, the data taken is only stored and only if the same perpetrator is caught will big action be taken. However, there is a deficiency that has not yet been resolved, which is that there is no data record of alcohol users that is stored and can be identified directly by taking the face of an intoxicated person before driving.

There is an image processing approach for recognising intoxicated persons that considers drunk-status variables such as the concentration of alcohol in the automobile surroundings, the driver's face temperature, and pupil width. For data collecting, the suggested system includes a gas sensor, a temperature sensor, and a digital camera. Data is collected and analysed in a two-stage machine learning system that includes feature selection and supervised classification methods. This clearly demonstrates the lack of the requirement for a large amount of intoxicated people data and challenging algorithm processes to obtain drunk people face recognition.

1.3 Objectives

Based on the problem statement, there are three main project objectives that have been identified as follows:

1. To analyse the differences of face features between drunk and sober individuals
2. To integrate image processing into the early detection of the drunk driver
3. To design a drunk detection algorithm for drunk driver using face recognition

1.4 Project Scope

The scope of this project is to create the system that using the face features of alcohol drinkers who are already in the drunken phase in Malaysia before starting to drive. This involves several sets of digital pictures of drunks and before being drunk.

Taking face features is done only in the vehicle because the purpose is to prevent drunks from driving on the road. All angles of the face features are taken as input to the system.

Next, this project only involves data processing and no real time image or video capturing work is carried out. It only involves a lot of static digital images before intoxication and after intoxication which are necessary to get the desired results.

CHAPTER 2

LITERATURE REVIEW

2.1 Alcohol

Alcohol is a chemical substance contained in drinks such as beer, wine, and liquor. Alcohol is also found in some medicines, household products and some essential oils. A little history about the existence of alcohol is in ancient times, they didn't call it alcohol yet. It is simply called as fermented drinks or fermented beverages because the process of making the material uses the fermentation process. Ancient Egypt had pickled beverages, while 7000 B.C. China had a glass of wine. India enjoyed rice-distilled sura around 3000 to 2000 B.C.

Meanwhile, the municipality "Alcohol" is an Arabic origin ward derived from the ward "Al-Kohol," which means "a fine ineffable powder with which Eastern ladies colour their eyebrows, and recently used to refer to a variety of largest brilliance" in Arabic. Victories over enemies, birth, wedding, and successful hunting are just a few of the numerous social events that people use alcohol to commemorate. Alcohol was widely used for fun and excitement. People used to get drunk as a part of a contest just to have fun, irrespectively of the link between excessive alcohol consumption and aggressive behaviour. Alcoholism is unique. First, it normally occurs and can occur at any age. Second, it's caused by inheritance, geography, economy, and the atmosphere, and each drinker has a unique drinking background. Third, alcoholics and accompanying infirmities can recover [6].

The availability of the ingredients used to prepare the drink aided the excessive use of wine or mead. The allocation of grapes, dates, cereals, and many other types of fruit, in addition to honey, in ancient Egypt, Greece, and other Mediterranean nations made the drinks accessible to all levels of the regions. This was not the case for the early Romanians, who faced high wine costs. Pliny's advice to Romulus to drink milk instead of wine reflects the reality that wine was limited and expensive, which is why the vineyard was the first thing regarded when assessing and pricing a plantation [7].

Alcoholic drinks have been consumed in human communities from the dawn of written history. Prior European colonial expansion, most countries of the world manufactured and sipped fermented beverages, which transformed the traditional standing of alcohol practically universally. Because alcohol is a depressant, it decreases the functioning of the central nervous system, including the brain. As a result, it is not recommended that anybody drive after consuming alcohol, because alcohol can impair the driving by producing impaired eyesight, slower response times, decreased attention and attentiveness, feeling more relaxed and drowsier, and complacency. Furthermore, alcohol might still influence the following morning [8].

2.2 Effects of Alcohol

A hangover from a night of drinking can make it difficult to focus and drive safely, and it can even cause to fall asleep while driving. And, because alcohol alters the perceptions and experiences of reality, it may be ignorant of how much your driving abilities have been harmed. A person who has used alcohol may believe that if they are extra cautious, they would be capable of driving safely, but this is frequently warped by the effects of alcohol [9].

Our ability to focus on a subject or thing while driven. At least 0.03 Blood Alcohol Content (BAC) impairs alertness, according to research. Visual functions encompass image quality, eye motions, visual acuity, and eye impulse control. Loss of vision started at BACs of 0.03 for several functions.



Figure 1 : Eyes of drunk and sober [10]

When someone is inebriated, they will plainly appear drunk because their face expression will display the characteristics of an individual who has a high amount of alcohol in their body. Furthermore, psychological facial expressions are an important supplement to verbal communication because they accurately represent the subject's emotional state and so convey the emotional content of a message [11].

Simulated emotional facial expressions can be recognised from those of emotional due to small changes in facial circadian rhythms. Furthermore, both the encoding and decoding of emotional facial expressions are generally instantaneous and automated processes. Among the prominent indicators of intoxication on the face are bleary, glassy, or watery eyes, a heated face, drooping eyelids, and a blank gaze or bewildered expression.

Results from experiments show that the nose and forehead accurately represent the behavioural development of the heat flux when consuming alcoholic beverages. It is reasonable to assume that the brightness spectra representing the cooler temperature of the nose will decrease as alcohol consumption increases. When a counter example, as one's tolerance to alcohol increases, the forehead's image values reflect a greater warmth [12].

Research on the cognitive consequences of alcohol suggests that it limits facial encoding. Extracting comprehensive signals about the interdependence of elements, such as the space between the eyes and their location respect to the nose and mouth, which are estimated from the duration of face-scanning motion parallax, is crucial to normal face learning. However, it is well-documented that alcohol impairs scene vision, machine vision, and face encoding by slowing motion parallax motion and limiting eye movements. Furthermore, it hinders one's ability to recognise facial asymmetrical on both sides, which leads to exaggerated assessments of others' beauty [13].

Table 1 : Common symptoms at each level of alcohol intoxication [14]

Intoxication Stage	BAC	Symptoms
Mild	0.00% to 0.05%	<ul style="list-style-type: none"> • minor difficulties with communication and recall • minor disturbances in equilibrium and motor control • moderate concentration deficits • preliminary drowsiness • characteristics seen to be good, such as calming down
Moderate	0.06% to 0.15%	<ul style="list-style-type: none"> • deteriorating language and cognitive abilities. • worsening of harmony and coordination issues. • mild to intermediate memory loss. • threat of aggressiveness, in certain cases. • the potential for harm to oneself etc is amplified. • substantial deficits in driving ability. • improvement in evaluating the positive benefits of alcohol, like as calming affects, has increased.
Severe	0.16% to 0.30%	<ul style="list-style-type: none"> • severe difficulties in communicating and remembering. • severe problems with movement and equilibrium. • severe delays in thinking and acting. • hazardous deficits in driving ability. • vomiting. • awareness lapse.
Life threatening	0.31% to 0.45%	<ul style="list-style-type: none"> • attention collapse. • potential for a fatal alcohol intoxication. • mortality risk due to inhibition of essential processes.

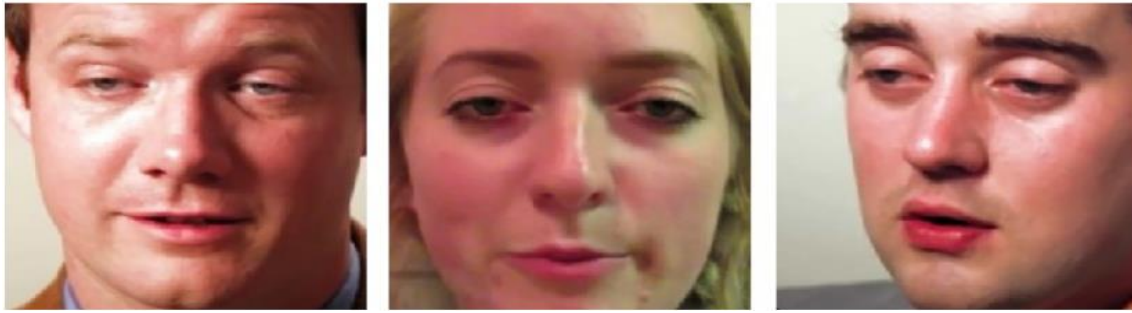


Figure 2 : Face behaviour of drunk person [15]

2.3 Acts and Laws Regarding Alcohol

The government passes legislation and significant laws to prevent the occurrence of certain actions and situations that can be disastrous to the lives of individuals and to the community. Unfortunately, the widespread normalisation and consumption of alcoholic beverages has led to negative consequences. Therefore, there is a pressing need to lower the demand for alcohol in all its forms because of the potential negative health, familial, and social implications that might result from excessive use. The leverage ratio and disease symptoms of alcohol dependency are often seen to be distinct from those of other legally regulated substances, such as opium [16].

The National Minimum Drinking Age Act (Public Law 98-363) mandated in 1984 that states raise the legal drinking age to 21. While the legislation has helped reduce public drunkenness and alcohol-related car accidents, a large percentage of young drinkers are still able to legally acquire alcohol from stores and bars in the United States. People between the ages of 17 and 19 are frequently used by the New Hampshire Liquor Commission (NHLC) to seek to purchase alcohol around the state as part of routine conformance inspections. Customers should tell the truth about their identification and provide identification like a driver's licence if they are requested to prove it [17].

The police have stepped up administration of the legislation by enhancing the number of patrols and barricades in Malaysia where conjunction with the decreased alcohol recommended restrictions and obligatory incarceration for drunken driving under Section 45A of the Road Transport Act 1987. The legal limit for intoxication was already lowered as shown in Table 2 below, in accordance with Section 45G of the Road Transport Act of 1987.