

REAL-TIME VIDEO ROAD SIGN DETECTION AND TRACKING USING
IMAGE PROCESSING AND AUTONOMOUS CAR

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**REAL-TIME VIDEO ROAD SIGN DETECTION AND TRACKING USING
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**A report submitted in partial fulfilment of the requirements for the degree
Of Bachelor of Mechatronics Engineering**

Faculty of Electrical Engineering

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2018

“I declare that this report entitle” **Real-Time Video Road Sign Detection and Tracking Using Image Processing and Autonomous Car** “is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree”

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ABSTRACT

Road Sign Detection and Tracking (RSDT) system becomes one of today's research in autonomous car industries. A safe driving becomes a priority for all drivers and passengers. The rate of cars user increased by each year and it's also increasing the rate of accidents in Malaysia. Neglecting road signs contributing to high rate of accidents. Drivers get confused because there are many types of road signs with different types of shapes and colours. Besides, drivers missed the road signs because of not giving full attention while driving. The research aiming to improve the safety in driving among the driver in road. The system is design to classify 5 types of road signs. Real-time video RSDT is a system that will detect and classify a road sign on a video's motion by using image processing. RSDT will help the drivers to recognise the road signs while driving image alert description. The detection of road signs on the motion video is done by using Video and Image Processing technique control in Python by applying deep learning process to detect an object in video's motion. The features such as road sign that is successfully extracted from the video frame will be proceed to template matching on recognition process based on the template in the database. The experiment for the fixed distance shows an accuracy of 99.9943% while the experiment with various distance the accuracy decreased as the distance increasing. For the distance of 4 metre from the road sign to camera the accuracy is 99.9842%, accuracy for 5 metre is 99.9780% and for 6 metre is 99.97114%. For the light intensity on morning the accuracy is 99.9934% and on afternoon the accuracy is 99.9966%. The result showing, the system able to detect and recognise the road sign accurately and reliable. In a nutshell, RSDT will be a smart system in future for drivers to use while driving on road.

ABSTRAK

Pengesanan dan Penjejakan Tanda Jalan Raya (PPJR) menjadi salah satu kajian pada masa ini dalam industri autonomi. Pemanduan yang selamat menjadi keutamaan bagi semua pemandu dan penumpang. Kadar pengguna kereta meningkat setiap tahun dan ia juga meningkatkan kadar kemalangan jalan raya di Malaysia. Pengabaian tanda jalan raya menyumbang kepada peningkatan kadar kemalangan jalan raya Pemandu keliru kerana terdapat banyak jenis tanda jalan dengan pelbagai jenis bentuk dan warna. Selain itu, pemandu-pemandu terlepas tanda jalan kerana tidak memberi perhatian sepenuh masa semasa memandu. Penyelidikan ini bertujuan untuk meningkatkan keselamatan dalam memandu di kalangan pemandu di jalan raya. Sistem ini mampu mengiktirafkan 5 jenis papan tanda. PPJR pada masa sebenar adalah sistem yang akan mengesan dan jejak papan tanda jalan raya dengan gerakan video menggunakan kaedah memproses gambar. PPJR akan membantu para pemandu mengenali papan tanda jalan raya semasa memandu dan ia akan memberi amaran dalam bentuk penerangan. Pengesanan papan tanda jalan raya menggunakan pergerakan video dilakukan dengan menggunakan teknik kawalan pemprosesan video dan imej dalam Python dengan menggunakan proses pembelajaran mendalam untuk mengesan objek dalam gerakan video. Ciri-ciri papan tanda jalan raya yang berjaya diekstrak dari bingkai video akan diteruskan ke padanan templat dalam proses pengiktirafan berdasarkan templat dalam pangkalan data. Eksperimen dengan jarak yang tetap menunjukkan ketepatan 99.9943% manakala eksperimen dengan jarak yang berbeza menunjukkan ketepatannya menurun jika jarak meningkat. Untuk jarak 4 meter dari tanda jalan raya ke kamera, ketepatan adalah 99.9842%, ketepatan untuk 5 meter adalah 99.9780% dan untuk 6 meter adalah 99.9914%. Untuk intensiti cahaya pada waktu pagi ketepatan adalah 99.9934% dan pada waktu petang ketepatan adalah 99.9966%. Keputusannya menunjukkan, system dapat mengesan dan mengenali tanda jalan dengan tepat dan muktamad. Kesimpulannya, PPJR akan menjadi sistem pintar pada masa akan datang untuk pemandu yang menggunakannya semasa memandu di jalan raya

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LIST OF ABBREVIATIONS

RSDT	= Road Sign Detection and Tracking
MIROC	= Malaysian Institute of Road Safety
SVM	= Support Vector Machine
RGB	= Red, Green and Blue
HSI	= Hue, Saturation and Intensity
HSV	= Hue, Saturation and Value
CAM	= Colour Appearance Model
CIE	= International Commission on Illumination
ANN	= Artificial Neural Network
MLP	= Multilayer Perceptron
RBF	= Radial Basis Function
MSER	= Maximally Stable External Region
SURF	= Speeded Up Robust Features
OPC	= Optical Character Recognition
HOG	= Histogram of Oriented Gradient
FYP	= Final Year Project
CNN	= Convolutional Neural Network
FPS	= Frame per Second

CHAPTER 1

INTRODUCTION

1.1 Introduction

Real-Time Video Road Sign Detection and Tracking is still growing rapidly in the researches of Malaysian autonomous car industries. Real-time stands for the present time when something happening. When real-time is combined with road sign detection and tracking system, the system will detect and recognise the road signs while the car is moving on and at the same time it will alert the drivers if the system detected any road signs. The road sign detection and tracking (RSDT) is a computerized system which will detect and recognise the road sign from a video.

Most of the existing system is using image processing method to detect and track the road sign. The input image like video's frame being used in the form of signal processing by image processing. The image processing outputs will be an image or any parameters that related to image. Video is an electronic technology that capture, record, process, store and transmit scenes in motion. Video is used in this system to obtain a better visual appearance of road sign and to get ready the image to be measured for the features present.

The information source for this project is the road signs which been utilized on the road side. Road signs will provide important information regarding the conditions or circumstances of the road to drivers. Different types of road signs been utilized on road and the road sign is different in shapes and colours which provide information like warning, direction, prohibition, mandatory and obligation of the roads. The system will detect road sign which stating the upcoming conditions of the road and provide with display and description about the signs. The RSDT system will assist drivers to have a safe and convenient journey.

1.2 Motivation

The population of people increasing rapidly. Consequently, the number of people using car increased and it also increasing the probability of accidents to occur. According to Malaysian Institute of Road Safety road, accidents increasing by each year. The main contribute for the accidents is caused by the failure of drivers to notice the road signs. By implementing RSDT system, the rate of car accidents is able to reduce. Table 1.1 shows the accident and death rates in Malaysia, Figure 1.1 and 1.2 shows the accident and death rates for the year 2014, 2015 and 2016 in Malaysia based on the details obtained from MIROS [1].

Table 1.1: Accident and death rates in Malaysia

Year	Accident Rates	Death Rates
2014	476196	6674
2015	489606	6706
2016	521466	7152



Figure 1.1 Rate of accidents for year 2014, 2015 and 2016 in Malaysia

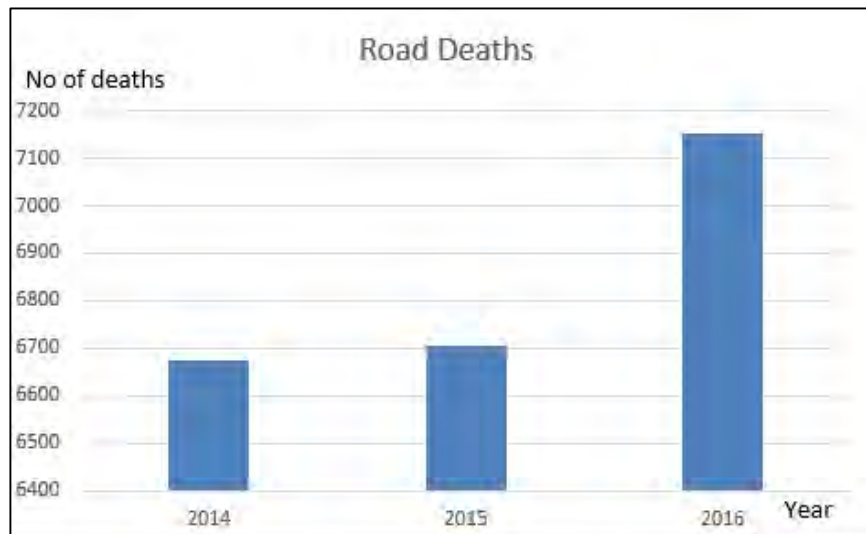


Figure 1.2 Rate of death for year 2014, 2015 and 2016 in Malaysia

Besides that, this system also act as driving assistance for tourist who depend on the road sign while travelling to other country. RSDT system will interpret the road sign for the drivers and drivers won't get confused. Since RSDT still under growing in Malaysia and other countries. A lot of researcher developing road sign detection system with different methods and its high in demand among the autonomous car industries. In future there is chances for this system to develop with traffic light system to enhance traffic flow, SK Subramanian et al [2].

1.3 Problem Statement

The number of cars user increased by each year and this also increasing the rate of accidents in Malaysia. Based on the research done by Department of Transportation, a total of 6706 people died in road accidents in Malaysia on the year of 2015 and the death rate increased to 7152 on the year 2017. Malaysian Institute Road Safety Research (MIROS) found that the major cause for accident was because of the drivers that neglecting the traffic rules.

Neglecting road sign is contributing to high rates of accidents in Malaysia. Drivers ignored the important road signs such as warning, prohibition, stop and mandatory signs while driving on road. The main reason for the ignorance of road sign is the driver missed the road sign because of not giving fully attention while driving. This eventually leads to accident in Malaysia.

Besides that, drivers often get confused because there are many types of road signs in Malaysia's road. Driver often get confused with the shape of road sign such as circular, triangular, diamond and rectangular. When shape of road sign is the factor that confusing the drivers they even get confused with the colours of road sign which have few variations like red, blue, yellow and green.

The change in light source distribution also causing a significant change in the appearance of the road sign image. High light source distribution on road signs makes the road sign to be not clear. This may cause the drivers to unable to understand what's mean by the road signs. The real-time road sign detection and tracking system could assist the driver by giving an alert on important road signs.

1.4 Objective

The objectives of the project are:

1. To design a real-time video road sign detection system by using image processing and autonomous car.
2. To classify five different types of road signs such as (Stop, No right turn, Direction, T-junction and Speed bump).
3. To analyse and improve the classifications accuracy of road sign detection by using convolutional neural network.

1.5 Scope

The first scope will be focusing the road sign being used in Malaysia. The road sign detection and tracking is based on colours and shapes. The colours that will be detected is red, yellow, and blue while the shapes which will be detected is circle, diamond and triangle. The distance of the camera capturing the road sign which is fixed in the middle of dashboard is taken from a distance of 3 to 6 metres between the camera and a car. The video is recorded with the driving speeds below 60 km/h because it is standard driving speed in urban area. Haar cascade and Convolutional Neural Network is the method used for road sign detection and classification. Besides that, it only will recognise the video frames that's has been recorded in good weather and lighting condition in day time.

1.6 Project Overview

This reports consist of five chapters. First of all, chapter one begin with introduction of real-time video road sign detection and tracking using image processing and autonomous car. Next is motivation of this project, followed by problem statement objective, and scope.

Next it continued with chapter 2, Literature review. This chapter will discuss about the previous related project or researches done by other researchers based on journal, books and articles. There is explanation about methods been used for road sign detection, existing extraction features and recognition using deep learning method.

Chapter 3 will explain about the methodology. This chapter consists of experiment setup that been use to get results of road sign detection and recognition process.

Chapter 4 of this report will discuss on the result based on the analysis done. Lastly, the chapter 5 about the conclusion about the research that have been done and will discuss about the future works for further development method.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Latterly, road sign detection and tracking system become the famous research in computer vision, Baro X et al [3]. There is a lot of methods been used by researchers on developing the road sign detection and tracking system by using image processing in autonomous car. This chapter will discuss on the review of existing method that been used for road sign detection and tracking. Besides that the methods of image labelling, feature extraction and artificial neural networks been discussed. In the end of the literature review, conclusion is made based on the highlighted methods.

2.1.1 Detection and Tracking Using Image Processing

An Image can be described as a physical similarity or representation of someone, animals, objects, things, photographed, sculpted, painting or otherwise visibly made described by the saurus's dictionary. An image also described as a symbol, description of something or an illusion which give exact meaning of the objects. Image processing defined similar as an image. Detection is an act of discovering or extraction an information. Tracking can be described as following a movements or something in order to find it.

2.1.2 Software

Software is a program consist of computer instruction used to run computers. Matlab or the real name Matrix Laboratory is used as high performance language in image processing. Matlab is the best tool for programming because it has data structure which is built in editing and also debugging appliances with object oriented programming. Matlab has a lots of functions in its toolbox. Another high level programming software is Python. Python enable to create as many as functions needed. It have extensive library which have modules of database and networking. Table 2.1 shows the comparison between Matlab and Python.

Table 2.1: Comparison between Matlab and Python.

Matlab	Python
Huge standard library	Standard library
Easier for beginners	Difficult for beginners
Easy to find documentation	Hard to find documentation
Average community	Big community
Expensive	Free

2.2 Detection of the Road Sign

Road sign detection has pull in the attention of researchers in machine vision field in current years. Road sign classification systems is developed in autonomous car, so it will inform or alert the drivers with the existence of road signs like stop, direction, no entry and many more. It helps the driver to notice the road sign when they pass by.






Road signs are able to detect by using few features such as shape, colour and pictogram, Pazhoumad et al [4]. The road sign detection and tracking is turn to be an important for autonomous car because it will regulate the traffic and alert to aware the

driver to have a safe driving. Table 2.2 shows the road signs characteristic in Malaysia based on colour shape and Table 2.3 shows the examples of road sign in Malaysia and descriptions.

Table 2.2: The road signs characteristic in Malaysia based on colour and shape.

Colour Shape	Red	Yellow	Blue	Green
Circular	Prohibition		Mandatory	
Rectangular		Warning	Information	Information
Inverted Triangular	Give way			
Diamond		Warning		
Octagonal	Stop			

Table 2.3: Examples of road sign in Malaysia and descriptions

Road sign	Description
	Stop sign
	Yield sign
	Warning sign
	Prohibitory or mandatory sign
	Direction or information sign