Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF VEHICLES NUMBER PLATE RECOGNITION USING OPTICAL CHARACTER RECOGNITION TECHNIQUE

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF VEHICLES NUMBER PLATE RECOGNITION USING OPTICAL CHARACTER RECOGNITION TECHNIQUE

MUHAMMAD FARIS BIN MD NAZARI

A project report submitted
in partial fulfillment of the requirements for the degree of
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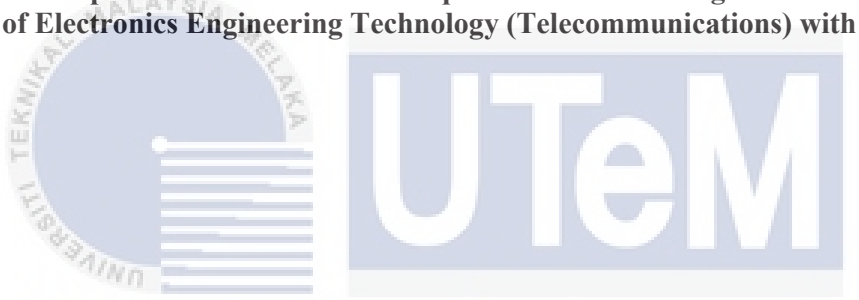

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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I hereby declare that the project report titled "Development of Vehicle Number Plate Recognition Using Optical Character Recognition Technique" is the product of my own study, except as noted in the references. The project report is not presently being considered for any degree and has not been approved for any degree.

Signature	:	
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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

Signature : 

Supervisor Name : Ts. Zahariah binti Manap

Date : 30/1/2023

DEDICATION

Alhamdulillah, praise to the Almighty Allah S.W.T

This thesis is dedicated to:

My beloved Parents,

Mr Md Nazari and Mrs Sazura

My supportive friends,

MUHAMMAD HARITH BIN BADZLI

And

DANIAL AFIF BIN MOHD ZAKI

My lovely and kindhearted Supervisor,

Ts. ZAHARIAH BINTI MANAP

ABSTRACT

This abstract describes a project aimed at developing a system for recognizing vehicle license plates using optical character recognition (OCR) techniques. The system is intended to automatically detect and recognize the characters on a license plate, and it could have a variety of applications such as traffic management, parking management, security monitoring, and crime prevention. OCR is a technology that can recognize and extract text from an image, it is a process that consist of several stages including pre-processing, segmentation, recognition, and post-processing. The challenges of this project include achieving high accuracy in recognizing license plate numbers, handling variations in license plate styles and environmental conditions, and dealing with moving vehicles. The proposed solution is to use OCR in conjunction with other computer vision techniques such as image processing, pattern recognition, and machine learning. The system is expected to improve the process of recognizing license plates, making it faster and more accurate. Using OpenCV and optical character recognition, this system detects and reads number plates automatically. When a key(s) is pushed on the keyboard, the Pi camera module saves the most recent frame as a new picture while continuing to take frames. Then, it finds the number plate using OpenCV's contour function. Finally, the number plate numbers are read using optical character recognition, which Raspberry Pi does by cropping off that specific region. After collecting the data for the development of a vehicle number plate recognition system using OCR technique, there are some of the key considerations for analysing the data. To evaluate the performance of the developed system, two key considerations are analysed. The first parameter is the accuracy of character recognition which reflects the quality of the images in terms of image clarity and legibility. Out of the 30 sample images tested, 22 samples were properly identified, yielding an accuracy rate of 73.33%. The second parameter is the image classification which reflects the ability of the system to handle different scenarios in terms of the type of vehicles, license plate formats, and backgrounds. Out of the 30 sample images tested, 10 samples were properly identified, yielding a classification accuracy rate of 33.33%. As a result, the goals of this vehicle number plate identification system were fulfilled satisfactorily.

ABSTRAK

Abstrak ini menerangkan projek yang bertujuan membangunkan sistem untuk mengecam plat lesen kenderaan menggunakan teknik pengecaman aksara optik (OCR). Sistem ini bertujuan untuk mengesan dan mengenali secara automatik aksara pada plat lesen, dan ia boleh mempunyai pelbagai aplikasi seperti pengurusan trafik, pengurusan tempat letak kereta, pemantauan keselamatan dan pencegahan jenayah. OCR ialah teknologi yang boleh mengecam dan mengekstrak teks daripada imej, ia merupakan satu proses yang terdiri daripada beberapa peringkat termasuk pra-pemprosesan, segmentasi, pengecaman, dan pasca-pemprosesan. Cabaran projek ini termasuk mencapai ketepatan yang tinggi dalam mengenali nombor plat lesen, mengendalikan variasi dalam gaya plat lesen dan keadaan persekitaran, dan menangani kenderaan yang bergerak. Penyelesaian yang dicadangkan ialah menggunakan OCR bersama-sama dengan teknik penglihatan komputer lain seperti pemprosesan imej,pengecaman corak dan pembelajaran mesin. Sistem ini dijangka menambah baik proses pengecaman plat lesen, menjadikannya lebih pantas dan tepat. Menggunakan OpenCV dan pengecaman aksara optik, sistem ini mengesan dan membaca plat nombor secara automatik. Apabila kekunci ditolak pada papan kekunci, modul kamera Pi menyimpan bingkai terbaharu sebagai gambar baharu sambil terus mengambil bingkai. Kemudian, ia mencari plat nombor menggunakan fungsi kontur OpenCV. Akhir sekali, nombor plat nombor dibaca menggunakan pengecaman aksara optik, yang Raspberry Pi lakukan dengan memotong kawasan tertentu itu. Selepas mengumpul data untuk pembangunan sistem pengecaman nombor plat kenderaan menggunakan teknik OCR, terdapat beberapa pertimbangan utama untuk menganalisis data. Untuk menilai prestasi sistem yang dibangunkan, dua pertimbangan utama dianalisis. Parameter pertama ialah ketepatan pengecaman aksara yang mencerminkan kualiti imej dari segi kejelasan dan kebolehbacaan imej. Daripada 30 sampel imej yang diuji, 22 sampel telah dikenal pasti dengan betul, menghasilkan kadar ketepatan 73.33%. Parameter kedua ialah klasifikasi imej yang mencerminkan keupayaan sistem untuk mengendalikan senario berbeza dari segi jenis kenderaan, format plat lesen dan latar belakang. Daripada 30 sampel imej yang diuji, 10 sampel telah dikenal pasti dengan betul, menghasilkan kadar ketepatan klasifikasi 33.33%. Hasilnya, matlamat sistem pengenalan nombor plat kenderaan ini tercapai dengan memuaskan.

ACKNOWLEDGEMENTS

Alhamdulillah, thank you Allah, I finally completed and finished my final year project successfully.

During the process to complete my project objective, I do a lot of research either by using the internet, reading past year thesis, reference books and journal. With the guidance and support from people around me, I finally completed the project due to the time given. Here, I want to give credit to those who helped me to achieve what I had achieved in my final year project.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

This chapter been explaining about the introduction of this project, which includes the project background ideas and the problem statements. The aims and objectives of this project discussed too as well as the research scopes and limitations of this project.

1.1 Project background

The background of this project likely pertains to the need for automated systems for recognizing vehicle license plates. Automatic number plate recognition (ANPR) systems have a variety of applications, such as traffic management, parking management, security monitoring, and crime prevention. However, recognizing license plates can be a challenging task, due to factors such as variations in license plate styles, environmental conditions, and motion blur from moving vehicles.

Manual recognition of license plates can be time-consuming and prone to errors, making automated systems more desirable. OCR is a technology that can recognize and extract text from an image, which makes it a suitable technology for recognizing license plate numbers. However, OCR systems alone may not be sufficient for this task, and other computer vision techniques such as image processing, pattern recognition, and machine learning may also need to be used.

The development of machine learning is capable to analysis of massive volume of data according to how the purpose and algorithm embedded in the program system. There are several key technique in machine learning for solving problem in big data area such as computational finance (trading), the computational biology (drug analysis, detection of tumor), the energy production (price forecasting), the automotive , manufacturing and aerospace (maintenance prediction), the natural language processing (applications of voice recognition) and last but not least is the image processing toward computer vision

(motion detection, face recognition, object detection, character and word recognition system).

This project aims to develop a system that can automatically detect and recognize license plates using OCR and other computer vision techniques. This could improve the process of recognizing license plates, making it faster and more accurate, as well as it can also reduce the human error, boost the security, and enhance the traffic monitoring.

1.2 Problem Statement

Tracking automobiles going at a slow pace is a problem. The development of a system that can properly recognise a vehicle's number plate is still in progress. Many of the articles we looked at used an ANPR (Automatic Number Plate Recognition) technology. The ANPR is a system that reads licence plates. Scanners or cameras gather this data, which is subsequently cross-referenced for a variety of traffic and law enforcement applications. Optical character recognition is the process of converting a picture of a number plate into machine-encoded text using ANPR technology. CCTV, traffic enforcement cameras, and ANPR-specific cameras can all benefit from the technology. Infrared light can aid in the acquisition of a crisper picture by cameras. Plate differences must be considered when using ANPR technology. Concerns concerning ANPR include government tracking of residents' movements, misidentification, high mistake rates, and increased government expense due to privacy concerns. It has been characterised by critics as a type of mass surveillance. The problem with ANPR systems is that they don't always account for human mistake and behaviour.

1.3 Objectives

The aim of this project is to develop an ANPR for slow moving vehicles. There are objectives as listed below:

1) To build a number plate reference database based on existing dataset.
2) Using Python, create and implement a recognition system for identifying and detecting car number plates.
3) To verify that data can be accessed in the event of inadequate illumination.
4) To ensure the output data been sent automatically at Gmail.

1.4 Scope

Number plate identification is accomplished by using cameras to capture photos of the backs of automobiles, which are then processed to identify number plates. This project is scope as follows:

1) Takes 40 data (10 training and 30 testing). Only takes Malaysian number plate with JPJ specification,
2) Identification and localization of number plates with image processing, the visual of the scene is improved in this part.
3) Character Segmentation, in which characters are segregated from the detected number plate focus for Malaysian number plates solely using JPJ specifications.
4) OCR which converts text into encoded text data.
5) We only focus on cars at slow speeds near to stopped car in residential areas and guarded gate,
6) The system can detect at range lower than 1m,

1.5 Project significance

In terms of commercialization, it is intended that this project would give recognition number plates for universities, hospitals, retail malls, airports, and residential facilities that are in high demand in the market, as well as closed areas such as parking, industries, and cafeterias. The commercial potential is enticing since this system has minimal equipment costs, low maintenance costs, and a simple infrastructure. Users profit greatly from the initiative in terms of detecting or tracking the whereabouts of their intended number plate. As a result, instead of searching manually, the number plate been detected automatically. This can help you save time and simplify your life.

1.6 Thesis outline

To help readers better grasp the overall project, this report is divided into five chapters. Additionally, it outlines the actions necessary to comprehend and acquire the approach utilized to create the project's model.

Chapter 1:

The project's concept is briefly introduced in the first chapter. The project's overview has been discussed. This chapter explained the project's summary in terms of the history behind the title chosen for the project, its primary goals, its scope, and the relevant issue statement.

Chapter 2:

All sources of information, including books, journals, and articles pertaining to this subject, be addressed in this chapter. The data and information from the research have been used to build the project. For better and easier overviewing, the entire information has been literally summarized.

Chapter 3:

The process of implementing a process and the methods utilized to accomplish the intended objectives and goals have been covered in this chapter. The third chapter also provides an explanation of the technical aspects of the programmed or application in use.

Chapter 4:

This chapter demonstrated and described all the outcomes of the software simulation study. In addition, outcomes from machine learning software may include a variety of data and associated images. The specifics of the outcomes then be discussed.

Chapter 5:

The project's last chapter discusses the results and offers suggestions for further research. The outcomes attained and the reported targets were summarized immediately.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A system that takes a vehicle's number plate and recognises the characters is known as automatic number-plate recognition (ANPR). Traffic control, parking management, parking charge collecting, vehicle localisation, security monitoring, and crime prevention are all common uses for the systems. The accuracy of recognising the number plate for moving cars is one of the most difficult difficulties in ANPR. The goal of this project is to create an automated number plate recognition system for moving vehicles. The characters on number plates have been captured using a camera and saved as photographs. To train the characters and conduct the character matching procedure, a machine learning approach have been used. The device is anticipated to accurately detect the number plate of a moving car. The vehicle licence plate picture is captured by the ANPR system camera, which is then processed by numerous algorithms to give alpha digit conversion of the image into text format. Because each vehicle has a number plate as part of its identification, vehicle number plate detection becomes a part of the Intelligent Transportation System (ITS). Weather variations, vehicle shadows, non-uniform licence plate kinds, a diversity of styles, and environmental colour effects have all made recognition of car number plates a difficult process. Petrol pumps, retail malls, airports, motorways, toll booths, hotels, hospitals, vehicle parks, and other locations all use the ANPR system.

Table 2.1: Comparison between the technologies used in system

Technology	Strength	Weakness
Optical Character Recognition (OCR) [7], [8], [10], [11], [13], [15]	Higher Productivity High Accuracy	Quality image can be lost during process. System is expensive
Convolutional Neural Network (CNN) [1], [3], [10], [11], [13]	Little dependence on preprocessing	Significantly slower due to an operation
Automatic License Plate Recognition (ALPR) [1]–[4], [6], [9], [12]–[15]	Human behaviour Privacy concerns	Rarely consider human error and behaviour
Generative Adversarial Network (GAN) [5]	Generate the sharpest images	Density Estimation, cannot predict the accuracy of the density of the evaluated model
Bidirectional Recurrent Neural Network (BRNN) [5]	Trained without the limitation of using input information just up to a preset future frame	Gradient vanishing and exploding problems
Long Short-Term Memory (LSTM) [13], [14]	Relative insensitivity to gap length	fails to store information for a longer period
Morphological Operation (MO) [10], [12], [14], [15]	ability to give valuable results in relation to the original purpose of the search	poor access to support software
Digital Image Processing (DIP) [6], [7], [10], [11], [14], [15]	faster and more cost-effective	very costly depending on the system used, the number of detectors purchased
Artificial Neural Network (ANN) [1], [4], [6], [7]	Store information on entire network	Hardware Dependence

2.2 Digital Image Processing

Different edge detection techniques, such as Sobel, Prewitt, Laplacian, and Canny edge band detectors, can be used in image processing from article [2] to distinguish the picture's edges. In a horizontal and vertical direction, the Sobel edge detector successfully changes a small, detachable, and numerical valued filter to the picture. In frames, Prewitt is used to identify vertical and horizontal edges. As a result, Sobel and Prewitt have a lot in common. The most successful approach for complicated edge detection is undoubtedly the Canny edge detector. The prior literature on vehicle number plate detection approaches based on edge detection is addressed here. They used a variety of image processing approaches and showed some of their vehicle number plate detection.

development tactics. This article discusses how much research has been done so far on car number plate detection and identification, as well as the effectiveness of their suggested technique and exactly what caused their recommended method to fail. Pre-processing techniques for images include converting the input picture to grayscale and using a filtering technique to remove noise. Apply the clever edge detection algorithm to extract the licence plate area next. After that, use the suitable detection method to efficiently identify the car registration plate, and then use the segmentation approach to segment the registration plate's characters. Finally, each of the characters is recognised using the proper character recognition method.

2.2.1 Digital Image Reading

Use the imread function to import an image from any supported graphics image file format in any of the available bit depths. The RGB variable in the MATLAB workspace is read from a TrueColor picture in this example.

2.2.2 Image Binarization

Binary pictures have pixel values of 0 or 1 in Boolean logic. Pixels with a value of 0 seem black, whereas pixels with a value of 1 appear white. Pixel values in intensity photos range from the least to the highest supported by their data format. Binary pictures can only contain 0s and 1s, but they aren't binary unless they have a Boolean data type.

2.3 Generative Adversarial Networks

Generative adversarial networks use an adversarial approach to simultaneously train a generative and discriminative model. DCGANs (deep convolutional generative adversarial networks) are a robust architecture for GAN training. By conditioning both the generator and the discriminator, conditional GAN generates pictures with predefined class labels. GANs may be conditioned on text descriptions and pictures in addition to class labels, allowing the CycleGAN to propose a text-to-image or image-to-image translation. Our model is built on the learning of mapping between two domains with no matched pictures. CycleGAN uses the cycle consistency loss to allow unpaired pictures to be used for training, fulfilling the concept that "if we translate from one domain to another and back again, we must reach where we started." Wasserstein GAN (WGAN)