HAND GESTURES RECOGNITION USING DEEP NEURAL NETWORK

LIM BOON CHEONG

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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FAKULTI KEJUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

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DEDICATION

Dedicated to my beloved family and friends who supported and encouraged me to finish this project.

ABSTRACT

Gestures are another type of communication tool which can be used to express idea, thought and feeling. It is usually used by those who have hearing and speech disability as mother language. This project was about implementation of a deep learning-based recognitions system for 30 MSL static hand gestures and evaluation of the performance of the system designed in term of recognition accuracy. This project was designed for those users who using the recognition system in front of an USB camera and the system designed was capable to recognize 30 MSL hand gesture sonly. The recognition system designed was made up by two hierarchical CNN architectures, in which YOLOV2 model was used for hand detection while MobileNet pretrained model was used for gestures classification of this project. Throughout this project, the hand gestures recognition system designed achieved 98% average testing accuracy on self-generated testing dataset. Given the limitations of the datasets and the encouraging results achieved, a fully generalizable translator for all 30 MSL static hand gestures can be produced with further research and inclusion of more dataset for MobileNet classification training.

ABSTRAK

Gerak isyarat adalah satu alat komunikasi yang boleh digunakan untuk menyatakan idea, pemikiran dan perasaan. Ia biasanya digunakan oleh mereka yang mempunyai kecacatan pendengaran dan pertuturan sebagai bahasa ibu. Projek ini adalah mengenai pelaksanaan sistem pengiktirafan berasaskan pembelajaran mendalam untuk 30 tangan gerak isyarat statik MSL dan penilaian prestasi sistem yang direka dari segi ketepatan pengiktirafan. Projek ini direka untuk pengguna yang menggunakan sistem pengiktirafan di hadapan kamera USB dan sistem yang direka mampu mengiktiraf 30 tanda tangan MSL sahaja. Sistem pengiktirafan yang direka dalam project ini terdiri daripada dua seni bina CNY hierarki, di mana model YOLOV2 digunakan untuk pengesanan tangan manakala model MobileNet digunakan untuk pengkelasan gerak isyarat. Melalui projek ini, sistem pengenalan gerak isyarat tangan direka mencapai 98% ketepatan ujian purata atas data yang dikumpulkan sendiri. Memandangkan batasan data yang ada dan hasil dicapai yang menggalakkan, penterjemah yang sempurna dan umum untuk semua 30 gerak isyarat tangan statik MSL dapat dihasilkan dengan penyelidikan lanjut dan memasukkan lebih banyak data untuk latihan klasifikasi MobileNet.

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Last but not least, I would like to express my deeply appreciation to all participants who taking part in my dataset collection. Without their involvement, I am not able to complete this project.

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LIST OF SYMBOLS AND ABBREVIATION

CNN	:	Convolutional Neural Network
ANN	:	Artificial Neural Network
DNN	:	Deep Neural Network
RELU	:	Rectified Linear Unit
TP	:	True positive
TN	:	True Negative
FP	:	False positive
FN	:	False negative
MSL	:	Malaysia Sign Language
ASL	:	American Sign Language
PCA	:	Principal Component Analysis
LDA	:	Linear Discriminant Analysis
KNN	:	k-nearest neighbors
SVM	:	Support Vector Machine
IoU	:	Intersection over Union
mAP	:	Mean Average Precision
AP	:	Average Precision

LIST OF APPENDICES

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CHAPTER 1:

INTRODUCTION

This chapter consists of five sections. The overview of the project is firstly introduced in this chapter. The problem statement regarding to the study are described in section 1.2. The objectives for this study are stated in section 1.3. Section 1.4 discusses the scope and limitations of work while section 1.5 describes the project significant. The thesis outline is presented in the final section of this chapter.

1.1 Project Overview

Gestures are another type of communication tool which can be used to express idea, thought, feeling and even for devices controlling. Meanwhile, hand gestures or gestures performed by one or two hands is the largest category of gestures due to large number of signs can be performed by varying the fingers or hands orientation or position.

From the past, the researches on hand gestures recognition for both static and hand gestures had been applied in many fields for example entertainment, automotive device controlling, communication and etc. Hand gestures recognition system can be implemented using various approaches in which deep learning approach is currently the most popular. Authors in studies [1] and [2] were conducted their researches on hand gestures recognition using different deep learning approaches.

Although there are lot of research had been conducted on hand gestures recognition for sign language users, there is still difficult to construct a robust sign language recognition system due to the numerous sign languages that are used in the world and for a sign language, there are a lot of different hand gestures. Communication between those who have speech or hearing disability and normal people is still becoming an issue.

In light of this, a deep learning-based hand gestures recognition system had been proposed to solve the communication issue between disabled and normal people to certain level.

1.2 Problem Statement

According to World Federation of the Deaf, 70 million deaf people are using sign language as their first language or mother tongue. Sign language is one of the effective communication tools for the people who are not able to speak and hear anything. It is also useful for the person who are able to speak but not able to hear or vice versa[3]. However, due to the disabilities, deaf and dumb people are having difficulty to communicate with the normal people. This cause a communication gap or ideas sharing obstacle and collaboration problem for the deaf -mute community and people who can speak and hear since not everyone learns sign language.

In addition, from previous studies, most of Malaysian Sign Language (MSL) static hand gestures recognition systems were implemented using conventional approach. Deep learning is a trending technology in image recognition which had been proven its successful in several studies. Thus, this project is aims to implement a hand gestures recognition system based on deep neural network (DNN) to recognize 30 Malaysian Sign Language (MSL) static hand gestures.

1.3 Objectives

The objectives of this project are:

1) To construct a deep learning-based recognition system for 30 static hand gestures.
2) To evaluate and analyze the performance of system designed in term of accuracy.

1.4 Scope of Project

In this project, a hand gesture recognition system is designed to recognize 30 static hand gestures only. This is due to dynamic hand gestures recognition system requires longer period of time, more complex network architecture and higher computation power to train. Static hand gestures are considered less useful than dynamic hand gestures in daily communication since most of static hand gestures are alphabets and numbers. However, static hand gestures are effective in expressing certain word such as a person's name, place name and others. In addition, this system is designed for those users who sat in front of a camera. The hand gestures look different when a user shows the gestures in front of a camera in sitting or standing pose. The angle and orientation of hand gestures shown in front of camera will influence the recognition result of the system designed.

Besides, the system is designed to recognize Malaysia Sign language (MSL) hand gestures only since this is the most commonly used in Malaysia. In addition, the software for the system will be developed by using KERAS in Python language. KERAS is a high-level interface for deep learning and Python is a high-level programming language that easily to understand. The syntax in python helps the programmers to design coding in fewer steps as compared to Java and C++. Moreover, an USB camera is used to capture raw images for hand gestures due to it is cheap and within the budget of project.

1.5 Project Significant

This system can be used during communication between deaf dumb and normal people. With this system, the translation of gestures or sign language to text form will be carried out immediately after the system detected a hand gesture. This can help in reducing the communication gap between these disabled people and normal people. Through this system, these disabled people can adapt to normal people lifestyle and not just live in their small group.

Apart from that, hand gestures or sign language not only used by people who are unable to speak. It is also used by deaf, people who have trouble with spoken language due to disability, people who have problem in hearing and those with deaf family