MALAYSIAN SIGN LANGUAGE & ALPHABETS RECOGNITION USING DEEP LEARNING ALGORITHM AND IMAGE PROCESSING TECHNIQUE

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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This report is submitted in partial fulfillment of the requirements for the degree of Bachelor of Electronic Engineering with Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

2023

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : Malaysian Sign Language & Alphabets Recognition Using Deep Learning Algorithm And Image Processing Technique

Sesi Pengajian : 2022/2023

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Supervisor Name : Assoc. Prof. Dr. Masrullizam Bin Mat Ibrahim

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DEDICATION

To my beloved family.

ABSTRACT

People who suffer from hearing difficulties use sign language as a way of communication and sign language translators quickly become inadequate to serve the entire deaf community, especially in Malaysia. To address the problem, this project aims to develop a Malaysian Sign Language recognition algorithm and translate it into text form. To achieve the objective, a dataset of Malaysian Sign Language and alphabets are constructed. Furthermore, image processing techniques to extract specific landmarks were used. The developed algorithm is trained using CNN architecture and PyCharm software is used to perform real-time gesture translation into text form. The algorithm shows a promising result with an accuracy of 96.16%. In addition, the result of precision, recall, and F1-Score for every predicted class is as high as 100%.

ABSTRAK

Orang yang mengalami masalah pendengaran menggunakan bahasa isyarat sebagai cara komunikasi dan penterjemah bahasa isyarat dengan cepat menjadi tidak mencukupi untuk berkhidmat kepada seluruh masyarakat pekak, terutamanya di Malaysia. Untuk menangani masalah tersebut, projek ini bertujuan untuk membangunkan algoritma pengecaman Bahasa Isyarat Malaysia dan menterjemahkannya ke dalam bentuk teks. Untuk mencapai objektif tersebut, set data Bahasa Isyarat Malaysia dan abjad dibina. Tambahan pula, teknik pemprosesan imej untuk mengekstrak tanda tempat tertentu telah digunakan. Algoritma yang dibangunkan dilatih menggunakan seni bina CNN dan perisian PyCharm digunakan untuk melakukan terjemahan gerak isyarat masa nyata ke dalam bentuk teks. Algoritma menunjukkan hasil yang menjanjikan dengan ketepatan 96.16%. Di samping itu, hasil ketepatan, ingat semula dan F1-Score untuk setiap kelas yang diramalkan adalah setinggi 100%.

ACKNOWLEDGEMENTS

Alhamdulillah, all praise be to Allah S.W.T. the Provider of Guidance, for lending me the strength and wisdom to complete this thesis.

I express my deepest appreciation to my supervisor, Associate Professor Dr. Masrullizam Bin Mat Ibrahim for his countless efforts and patience in helping me to complete this project. I am very grateful to my family, especially my parents, Abdul Hakim Bin Abdul Hamid and Marziana Es, Binti Abdul Manaf for their continuous support and encouragement throughout my studies. My special thanks go to the lecturers, friends, and all those involved in my project directly or indirectly. Last but not least, great appreciation must go to the Universiti Teknikal Malaysia Melaka (UTeM) for providing great facilities, amazing educators, and meaningful memories for me throughout my studies.

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LIST OF SYMBOLS AND ABBREVIATIONS

ANN	:	Artificial Neural Network
CNN	:	Convolutional Neural Network
CSV	:	Comma-Seperated Values
GUI	:	Graphical User Interface
IDE	:	Integrated Development Environment
LSTM	:	Long Short-Term Memory
MB	:	MegaByte
MSL	:	Malaysian Sign Language
OS	:	Operating System
PC	:	Personal Computer
ReLu	:	Rectified Linear Unit
RGB	:	Red Green Blue
RNN	:	Recurrent Neural Network
RoI	:	Region of Interest
SDG	:	Sustainable Development Goal
SLR	:	Sign Language Recognition

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CHAPTER 1

INTRODUCTION

1.1 Overview

The deaf community cannot communicate with others through verbal communication. Since they do not possess the ability to hear, they lose the sense to control their voice. Hence, they have been using sign language to convey their intention, statement, feeling, and others. In Malaysia, the deaf community uses Malaysian Sign Language as the official sign language. However, sign language itself is typically learned by the deaf community only. The lack of awareness and effort from other communities to learn sign language causes the number of individuals who are not deaf that understand sign language still low. Communications between the deaf and others are inevitable since the deaf community still needs to attend court, counsel, or handle official matters. Hence, this complication raises the demand for sign language translators.

The sign language translator in Malaysia is trained to translate the Malaysian Sign Language into Bahasa Melayu. They provide the service of translation when the deaf community needed them. However, in Malaysia, the number of sign language translators is too low compared to the number of deaf people. Hence the process of acquiring a sign language translator becomes difficult. The service is typically needed to be booked and sometimes consumes a lot of time. Therefore the efficiency of the service is low since it cannot fulfill the service on demand. As a result, researchers have comes up with a better solution to automate the translation of sign language using artificial intelligence (A.I.) to reduce the need for a human sign language translator.

1.2 Problem Statement

The deaf community cannot communicate with people who do not understand Malaysian Sign Language. Typically, the Malaysian deaf community will learn Malaysian Sign Language from school. It enables them to communicate with each other and anyone who understands the language. However, the number of non-deaf people who understand this language is really low. This creates a communication gap between the deaf community and the non-deaf community. Since there are a lot of people who are reluctant to learn Malaysian Sign Language, there is a need to develop a device that can quickly translate Malaysian Sign Language without learning it.

Sign Language Recognition (SLR) system using a sensor-based system provide inconvenience restraint to the user and is expensive. There have been numerous efforts to develop a device that can translate sign language. Among them is the use of a sensor-based system. These sensors are attached to the signer to extract information during the signing process. However, the study shows that the implementation of the system makes the signer feel inconvenienced and restrains their movement. This discourages the deaf community from fully committing to using the system. In addition, the number of sensors used can increase significantly when a higher accuracy of information from the signers is needed. Hence, it will increase the cost of the system. Therefore, an alternative to the sensor-based system, such as a vision-based system can be a solution to the problem.

There is a lack of research and system development focused on Malaysian Sign Language recognition. As for 2021, the number of research focused on Malaysian Sign Language Recognition made up less than 1% of the accumulated research for sign language recognition across the world [1]. The highest number of research is held by the American Sign Language Recognition system which is 32% as in Figure 1.1. This indirectly shows that the number of collected data to be used in Malaysian Sign Language Recognition is significantly lower compared to the rest of the world. Therefore, there is a need to support the lack of advancement in the area of the Malaysian Sign Language Recognition System. One of the solutions is to construct the Malaysian Sign Language dataset.

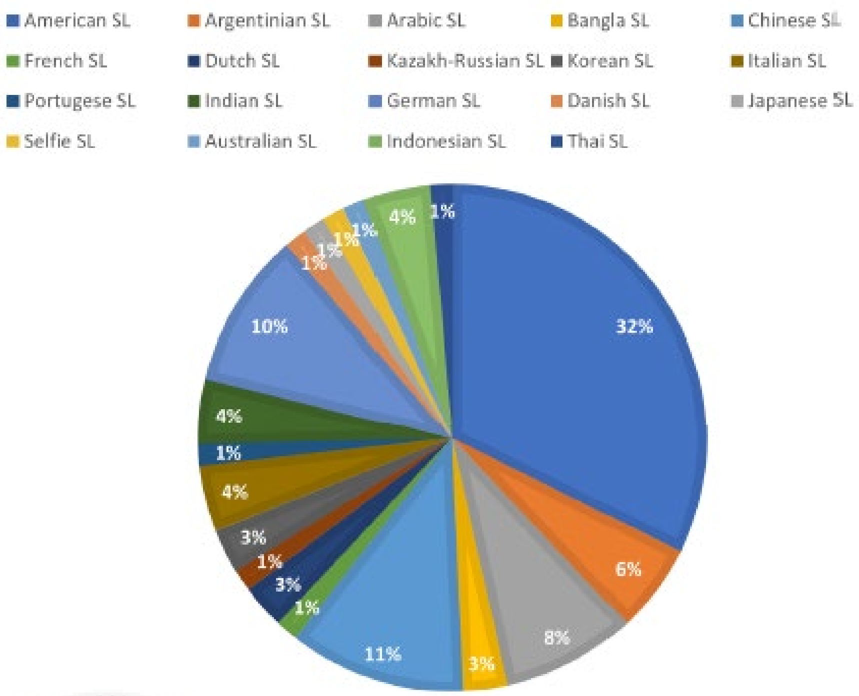

Figure 1.1: Number of publications based on sign language recognition by language [1].

1.3 Objectives and Scopes of Project

1.3.1 Project Objectives

The objectives of the project are as follows:

i. To construct Malaysian Sign Language datasets with the label.

ii. To develop a Malaysian Sign Language Recognition and alphabets algorithm using deep learning models and image processing techniques.

iii. To convert the Malaysian Sign Language and alphabets into text form.

iv. To analyze the performance of the Malaysian Sign Language Recognition algorithm.

1.3.2 Scopes of Project

To develop an artificial intelligence that can recognize Malaysian Sign Language and the alphabet, a set of data is collected. The data is a static image of people that perform a specific Malaysian Sign Language and alphabet gesture. Hence, the device to capture the image is determined. To improve the effectiveness of the algorithm to be applied on a personal computer (PC), the camera of the PC itself is used to capture all of the images. Although the built-in PC camera has a lower quality compared to other types of cameras, this approach is used to ensure that the neural network is trained for the worst-case scenario.

Even though the initial data is accumulated in image format, the image then is processed to extract the hands and face landmarks. These landmarks then are used as the input data for the neural network. Instead of training the neural network based on the original image, the neural network is trained based on specific finger joints and facial features that are traced on an empty canvas. This approach is taken because the focus of this project is to classify a gesture according to Malaysian Sign Language and alphabet, hence the finger position and the facial features extraction are cleared before feeding to the neural network.

The neural network was trained based on a deep learning model. The deep learning model eliminates some of the pre-processing problems. Furthermore, the deep learning model can recognize features from its dataset without human interference. This project has used the Convolutional Neural Network (CNN) architecture in the neural network. This is because CNN architecture is excellent at finding strong features in image recognition.

Another scope of the project is that the algorithm can recognize 24 alphabets and 5 words in Malaysian Sign Language. Malaysian Sign Language can be divided into two categories which are the static sign and the dynamic sign. The static sign does not involve a moving gesture while the dynamic sign does. The static sign can be captured