

Malaysian Sign Language Recognition Using 3D Hand Pose Estimation

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Abstract—Sign languages are one of those mediums for hearing-impaired people. These languages transmit meaning by visual-manual treatment, or more simply, hand movement. Currently, there are only 95 sign language interpreters registered with the Malaysian Federation of the Deaf as of 2020, compared to 40,389 hearing-impaired individuals with disabilities registered with the welfare department which is a problem. Therefore, with the use of deep-learning technology, this paper proposes to alleviate the scarcity of Malaysian Sign Language interpreters for the benefit of hearing-impaired persons. The paper aims to test and report a sequenced 3D keypoint hand pose estimation model for Malaysian Sign Language Recognition and evaluate the implementation of action model in decoding basic poses of Malaysian Sign Language. According to the findings, the detecting of 3D keypoints and incorporating into LSTM models using deep learning machine learning platform and framework like TensorFlow and MediaPipe enables the detection of Malaysian sign language 3D hand posture estimation. The results demonstrated that 3D hand posture estimation may be utilised to estimate sign language in real time, providing for a better interpretation approach for the deaf community.

Keywords—Deep learning, Sign Language, 3D hand pose estimation

I. INTRODUCTION

Communication is undeniably essential because it is believed to be the key to transferring information. It is known that communication necessitates the use of a medium for both the sender and the receiver to get access to any type of information. Sign languages (also known as signed languages) are one of those mediums for those with hearing-impairment. These languages transmit meaning by visual-manual treatment, or more simply, hand movement. However, sign languages were never considered legitimate until William Stokoe found in 1960, while observing deaf students chatting at Gallaudet College, that the American Sign Language (ASL) had its own grammatical structure [1]. As a result of continual social interactions, sign languages develop into sophisticated languages.

Malaysia contains three sign languages, according to the Ethnologue, a comprehensive inventory of the world's languages: Bahasa Isyarat Malaysia (BIM) or Kod Tangan Bahasa Malaysia (KTBM), Penang Sign Language, and Kuala Lumpur Sign Language (KLSL). Mr. Tan Yap, known as the "Father of the Deaf" began studying sign language interpreting in 1964 at Gallaudet College in Washington, D.C., USA [1] and established KLSL from ASL. He taught KLSL to deaf individuals in Johor who had not finished secondary school. In 1968, he founded a deaf school in Kuala Lumpur to educate deaf children [2]. BIM is a sign language that combines ASL with certain local signs [3] and has been used as the primary communication method among Malaysia's deaf community with the establishment of Malaysian

Federation of the Deaf in 1998. Based on Malay basic words, BIM sign words were created for educational purposes [3]. Deaf youngsters learn sign language for Malay root words and affixes, which they utilize to express themselves in phrases according to Bahasa Malaysia grammar. In terms of syntax and lexicon, Bahasa Malaysia influenced BIM development [1]. Even though ASL has had a substantial influence on BIM, the two are unique enough to be considered independent languages.

It is apparent that sign language users have adapted regular lifestyles by reading lips and comprehending people. However, the opposite is not applicable. There are only 95 sign language interpreters registered with the Malaysian Federation of the Deaf as of 2020, compared to 40,389 hearing-impaired individuals with disabilities registered with the welfare department [4]. This makes it much more difficult for those with hearing impairment to interact with others as it is heavily dependent on whether an interpreter can be available to interpret.

II. RELATED WORKS

This section examined and discussed works related to recent methods in sign language recognition.

A. Sign Language Recognition Methods

Convolutional Neural Network (CNN) is a type of deep, feed-forward artificial neural network in machine learning. CNN typically includes of an input and output layer, as well as numerous hidden layers such as convolutional, pooling, fully connected, and normalising layers [5]. According to [6], the YOLO system uses CNN to recognise objects in real-time. The project focuses on the translation of Malaysian Sign Language hand gesture movements, which include the alphabet and fingerspelling. 2D CNN is utilised in the study by [7] to extract features from gestured alphabets and classify them into 24 alphabets.

When it comes to dealing with data sequences where the temporal dynamics connecting them are critical, recurrent neural networks (RNN) are the networks of choice [8]. RNN generates and recognises characters based on their past interactions [5]. There are two primary techniques to using RNN in sign language recognition: the Hidden Markov Model (HMM) and the Long Short-Term Memory (LSTM) architecture. [9] developed a method for extracting features and classifying the Vietnamese Sign Language's continuous dynamic motions (VSL). The data was collected using a Microsoft Kinect depth sensor. In another study, [5] introduce a modified four gated LSTM cell with 2D CNN for sign sentence recognition in another study.

Sensor modules are designed to record information about hand movement in the form of an electric signal (analogue voltage) [10]. [11] explored which algorithm combinations,