Chapter 27
A Comprehensive Study on Gesture Detection:
An Approach for Sign Language Interpretation Analysis

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ABSTRACT

The advent of technologies made our lives more comfortable with their rapid spread in various sectors like business, education, productive industry, marketing, health sector, and many more. Computer vision being an interdisciplinary field has a large scope of applications, and among them, object detection carries a vital role and has wide spread in various fields of study. Object detection exhibits a potentiality in numerous applications like image and video annotation, gesture detection, etc. In this regard, a preliminary research is carried out on sign language gesture recognition to review and facilitate the road map of earlier research findings. The work is carried with a focus on the recent developments and the enormous techniques and tools that were introduced to handle gesture recognition varying from mathematical models to deep learning models with its advantages and limitations. Issues like computational complexity and accuracy with respect to the various verticals of the sign language interpretation are explored and are listed with their remarkable outcomes.

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INTRODUCTION

Computer Vision is a branch of Artificial Intelligence that is used to extend the visual ability of the machines so that they can interpret the input data and recognize them. Generally, one can think about how easily a human eye can capture the scene and interpret its essence. For a machine to interpret the same, it should learn to mimic the human brain. Though it turns out to be easy in the case of human learning, there are years of evolutionary context that assists the human to visualize and understand the captured data. To replicate the same in computers the researchers have come out with plenty of techniques. To some extent the traditional image processing techniques like classification, segmentation, filtering etc would help to understand or interpret the images. However the image processing techniques alone cannot make machines learn as humans. An extension of visual capability and evolutionary context setup is required to do so, which can be achieved through Computer Vision (CV) and Machine learning techniques.

The big challenge for computer vision techniques lies in training the machines to truly mimic the human brain which needs an incredibly large amount of data, millions of objects in thousands of angles. In order to attain this, CV techniques supply a suite of algorithms to the machine where they can take advantage of visualizing the data just as a big array of integers that represents intensity levels of the image. With the use of these algorithms the machines are trained to understand effectively what that specific arrangement of numbers will represent. Sometimes there are situations where the human eye cannot differentiate the similar images properly. But whereas machine learning provided with enough data and training is eventually capable of identifying and differentiating them easily. Computer Vision handles more complex challenges by incorporating image processing techniques extended with deep learning. The main idea behind is instead of working on raw images captured from a sensor, it operates on processed images to attain high accuracy. Various fields expanded their automation with the rapid application of Computer Vision techniques. Most popular applications are Manufacturing, Medical Science, Recognition, Surveillance, Agriculture, Retail etc. In the manufacturing industry the fault detection of the machinery can be done with the robots which are equipped with the CV techniques. In a similar way, a lot of medical history is available these days and can be properly inferred and interpreted using CV techniques. This interpretation would help the medical community to better assist the society by means of early and accurate detection of disease level, prediction of future diseases etc. Another field of application is surveillance, in which live footage of the public can be processed to identify harmful objects and thus helps the society to control crime, theft and to maintain law and order etc. To meet all such requirements, sub disciplines such as Object Recognition, Image Colorization, 3D Reconstruction, Image Synthesis etc are built on the top of the computer vision techniques. As the scope of this work mainly relies on object detection and sign language interpretations, the earlier research findings and their future scope is presented in detail below.

Object Detection

Object detection is one of the challenging problems built on the top of the Computer Vision techniques, which aims to find object locations or instances from predefined image categories. In order to do so, the spatial and boundary coordinates of the objects are located to determine their extent and instances of various categories like human, animals or things. So understanding the image from object detection and computer vision serves the purpose of solving various simple to complex vision based problems (Rastgoo, Kiani, and Escalera, 2020). However, for building such a system, it needs an information exchange and