Sign Language Recognition Application Systems for Deaf-Mute People: A Review Based on Input-Process-Output

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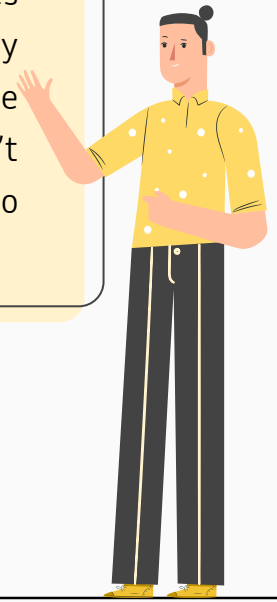
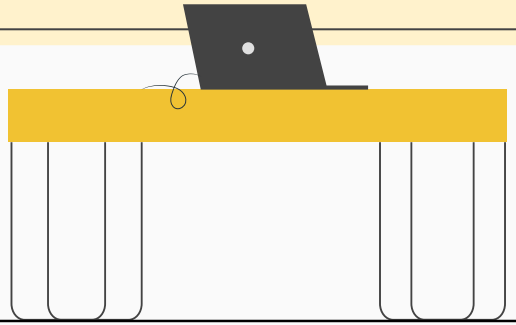
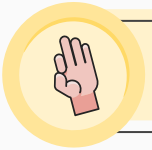
INTRODUCTION

Deaf-mute people are only disabled in both hearing and/or speaking, therefore they can still do normal things. The only thing that separates them from normal people is communication. Even if sign language is very important to deaf-mute people, it still gets little to no attention. If there is a way for deaf-mute people to communicate with others that don't understand sign language, then it will be easier for deaf-mute people to live normally.





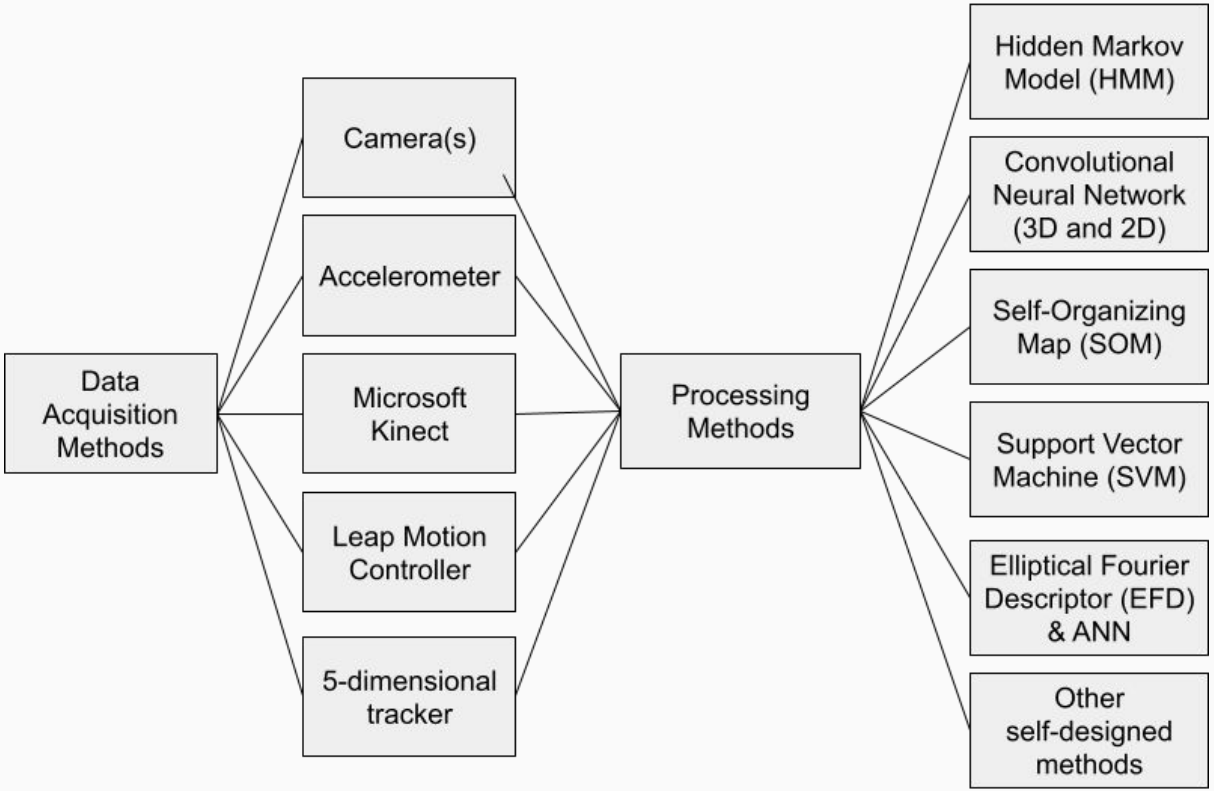


INTRODUCTION

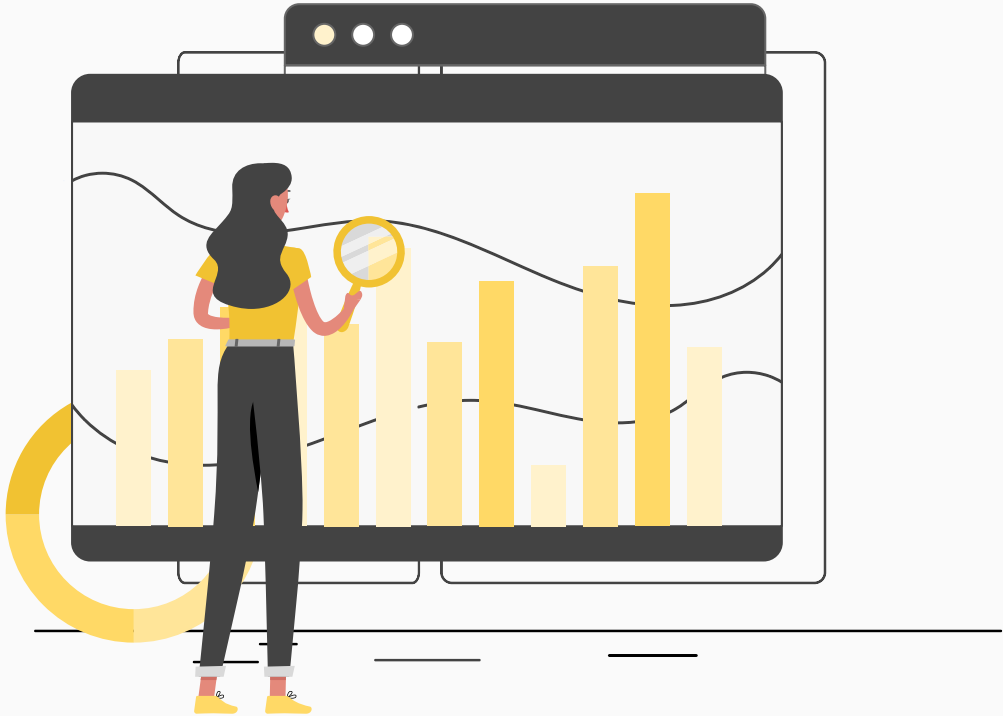
- **Significance:** While sign language is very important to deaf-mute people, to communicate both with other people and themselves, it is still getting little attention. People tend to ignore the importance of sign language, unless they have loved-ones who are deaf or mute.
- **Hypothesis:** Finding the best method for Sign Language Recognition that can be commercialized will make it easier for deaf-mute people to communicate with others.
- **Objectives:** The aim of this paper is to review the sign language recognition approaches and find the best method that has been used by researchers. Hence other researchers can get more information about the methods used and develop better Sign Language Application Systems in the future.
- **Scope:** The researchers will discuss the Sign Language Recognition (SLR) form application point of view as well as the devices used in getting the data, data acquisition, such as data from early researches or self-made data, the recognition method that are recently used by researchers, and the output of previous researches.

METHODOLOGY

- The two main parts of developing a SLR System are the data acquisition and the classification process.
- The main device used to get data in SLR is a camera as gesture images can be captured by one. Microsoft Kinect is also another device that is used to capture images. A Leap Motion Controller is a system that can detect hand gestures. Other methods such as an accelerometer and 5-dimensional trackers can also be used in acquiring data.
- The most used processing method in SLR is the HMM, especially combined with other methods. The other popular processing method is by using neural networks such as the CNN. Some also use ANN with the EFD for the recognition method. Others even use self-made methods. An example is the Wavelet family method.



RESULTS AND DISCUSSION



RESULTS & DISCUSSION

Authors	Data Acquisition Method(s)	Classification Method(s)	Accuracy Result
Wang H, Chai X, Zhou Y, Chen X	Kinect	Light-HMM	83.6%
Li Y, Chen X, Zhang X, Wang K, Wang ZJ.	Accelerometer and Surface Electromyography	Multi Stream HMM	86.7%
Huang J, Zhou W, Li H, Li W	Kinect	3D-CNN	94.2%
Pigou L, Dieleman S, Kindermans PJ, Schrauwen B.	Kinect	3D-CNN	78.8%
Kishore PVV, Prasad MVD, Prasad CR, Rahul	4 Cameras	EFD and ANN	91.5%
Krizhevsky A, Skutskever I, Hinton GE.	Accelerometer and Surface Electromyography	Convolutional Neural Network	83%
Tewari D, Srivastava S.	High Specification Camera	Kohonen SOM	80%
Thang PQ, Dung ND, Thuy NT.	5-dimensional tracker	SimpSVM	98.9%
Singha J, Das K.	Web Camera	Eigen Value	97%
Kalsh EA, Garewal NS.	Web Camera	Wavelet Family	100%

RESULTS & DISCUSSION

Authors	Data Acquisition Method(s)	Classification Method(s)	Accuracy Result
Zhang LG, Chen Y, Fang G, Chen X, Gao W.	Camera and Color Gloves	Tied-Density HMM	91.3%
Gao W, Fang G, Zhao D, Chen Y.	Two Cybergloves and 3SPACE-position tracker	SOFM, SRN, HMM	91.3%
Greg C. Lee & Fu-Hao Yeh & Yi-Han Hsiao.	Kinect	SVM and HMM	85.14%
Raheja JL, Mishra A, Chaudary A.	Web Camera	SVM	97.5%

CONCLUSIONS AND RECOMMENDATIONS

Sign Language Recognition System has been developed from classifying only static signs and alphabets to a system that could successfully recognize dynamic movements that come in continuous sequences of images. Researchers nowadays are paying more attention in making a large vocabulary for sign language recognition systems. Many researchers are developing their Sign Language Recognition System by using small vocabulary and self-made databases. Large database built for Sign Language Recognition System is still not available for some of the countries that are involved in developing Sign Language Recognition System. Especially the Kinect-based data, which provides the color stream and depth stream video. The classification method of identifying the sign language is also varied from researchers. Using their own ideas and limitations for the Sign Language Recognition System, the comparison of one method to another method is still subjective. Fair and direct comparison between approaches are limited because of the variation of sign language in different countries and the difference in limitations set by each researcher. Variation of sign language in most of the country is based on their grammar and their way to present each word, such as presenting the language by word or by sentence.

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