Sign Language Detection using Computer Vision

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ABSTRACT: Sign Language is a critical tool to aid the hearing-impaired population and allow them to meet the ends with the normal people. For the purpose of translating sign language, the camera is the primary element used in Sign Language Recognition (SLR). Mostly existing SLR through image processing uses high quality cameras whereas to reach larger audience, we need a better approachability, hence this paper proposes using of normal cameras like of smartphones and webcams. This paper depicts the significance of encompassing intelligent solution into the SLR systems and meets the requirement of a SLR web portal that is universally and easily available for every needful person. Altogether, it is anticipated that this study will promote the production of intelligent-based SLR, the accumulation of knowledge, and will give readers, researchers and practitioners a roadmap for future direction.

KEYWORDS: Computer Vision, Machine Learning, CNN, Sign Language, Gesture Detection;

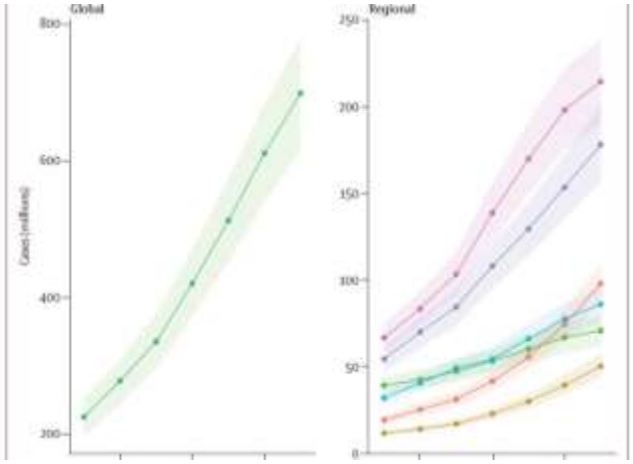
1 INTRODUCTION

Sign language is a kind of conversing dialect that conveys meaning visually using facial expressions, hand gestures, and body language. For those who have trouble hearing or speaking, sign language is quite helpful. The gesture translation into the alphabets or words of formal spoken languages that already exist is called sign language recognition (SLR). Therefore, utilizing an algorithm or model to translate sign language into words can help close the communication gap between persons who have hearing or speech impairments and the rest of society.

Researchers working in the fields of computer vision and machine learning are now focusing intensively on image-based hand gesture awareness. Many researchers are working in this field since it is a natural method of human connection, having the aim of creating the interaction of human and computer, simple and natural by cutting off the need of additional gadgets. Therefore, the primary intent of research in gesture identification is to develop systems that are able to recognize and utilize particular human gestures. For example, to deliver information. For the same, interfaces that are vision based, need quick, extremely authentic hand detection as well as real-time sign identification for this.

Sign Language is a popular & effective way to facilitate the deaf and dumb community, but the primary limitation of lack of sign language interpreters results in non-availability and non-reachability of the interpreters. The expected achievement is to contribute towards research and development towards solutions for deaf and dumb community. The aim of this paper is to model a Sign Language Recognition System accessible via a web portal, which takes video input and predicts hand actions into signs, achieving higher accuracy than existing solutions.

Within this frame of reference, we have sign language recognition (SLR), the mode of communication utilised by the deaf and the silent. Hand gestures constitute a potent human communication method that has many possible uses.



[1]Figure 1. Hearing impairment ubiquity of 35 dB or more, 1990-2019 by WHO, including predictions to 2050.95%. UI is rendered as shading. UI= uncertainty interval.

Figure 1 depicts the estimate ubiquity account in the interval of 1990 and 2019, resulting in rise of the rate by 27·8% (95% UI 26·6–29·0), from 15·9% (15·3–16·6) in 1990 to 20·3% (19·5–21·1) in 2019. The prevalence rate of age-standardized hearing impairment stays steady globally, on comparison. In conclusion, the noted pattern signifies that growth of prevalent instances, when there is rise in cases of hearing loss but stability in age standardized rates, are causes of ageing and growth in population.

2 METHODOLOGY

The architectural diagram in Figure 2 describes working infrastructure of the plan. It depicts a user logging in to the web portal provided for the user interaction and after accepting requests for required permissions, it briefly introduces to the functioning of camera as the primary means of interplay between detection system and user. Fleeting operations including pre-processing, key points extraction and database accessing takes place. Data from database is used for training and testing, where testing data is also the feeded input data that is converted from gestures to signs and finally the user experience is received as feedback.

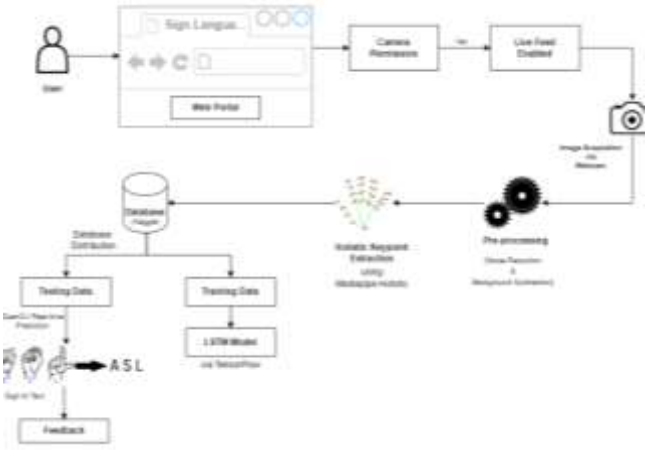


Figure 2. Architectural Diagram for Sign Language Detection.

3 LITERATURE SURVEY

The procedures followed in our work focuses on use of different methods mentioned below. Following observations were made after having a detailed study of previously acquired results in image processing.

3.1 *Image Acquisition*

[2, 3]Camera/Webcam eliminates the requirement of equipping other devices and is easy to use, making it comparatively the best image acquisition method. [4]Data glove is a feasible and easy feature extraction device as it prevents influence from outside environment. They are highly expensive with low convenience and fails to maintain originality of interaction. Kinetic is another image acquisition device which has high usage in various applications involving human computer interaction with limited range depth detection. Leap motion controller has elevated speed processing with high accuracy in recognition, that facilitates in detecting hand and fingers.

3.2 *Image Enhancement*

[5]Using Histogram Equalization (HE) for images in grayscale gets best result and it has simple implementation. The downside is that image brightness gets modified due to which featured and noise become hard to distinguish. [6]Adaptive Histogram Equalization (AHE) has better performance than histogram equalization and is best suited to amplify edges and local contrast of image. [7]Original brightness is retained in Contrast Limited Adaptive Histogram Equalization, and reduced noise can be noticed when comparing to HE and AHE. [8]Logarithmic Transformation is useful when high intensity pixel values are to be reduced into lower intensities pixel values.

3.3 *Image Filtering*

[9]Mean filter implementation is easy, but shows significant impact in incorrect pixel value representation. [10]Median filter counters problem of mean filter by retaining image sharpness and thin edges. [11]Gaussian type of noise is best removed using Gaussian filter.[12] Adaptive filer is better at preserving high frequency parts like edges than linear filter. [13]Wiener filter is a well-liked picture repair filter. Noise has no effect on it, so it is suitable for utilizing the image's statistical features.

3.4 *Image Segmentation*

[14]Thresholding method as segmentation technique is an efficient and simple strategy. It can be used without any prior knowledge and requires less computation power. [15]Edge based method is suitable for pictures with better object contrast. [16]Region based method is more useful and less sensitive to noise when the similarity criteria are simple to define. [17]Because of the usage of the fuzzy partial membership, Clustering method is more applicable to real-world problems. [18]Artificial Neural-Network based method can function without a complicated program, and it is less noisy in nature.

4 WORKING STEPS

MP Holistic- Media Pipe Holistic combines distinct model of hands, poses and face.
Keypoints- Landmarks for object detection.
LSTM- Long Short-Term Memory Model processes sequence of data like video input

i. Install and import dependencies.
ii. Detect keypoints and extract their values using MP Holistic.
iii. Collect keypoint values in folders.

iv. Create labels and features.
v. Build and Train LSTM Neural Network.
vi. Initiate predictions and save weights.
vii. Evaluate and test in real time.

5 RESULTS

Table 1. Sensitivity (Se) results of the ASL letters

Letters	LSTM Se(%)
A	92.35
B	87.89
C	100.00
D	89.87
E	87.87
F	100.00
G	98.97
H	56.76
I	100.0
J	79.09
K	86.65
L	100.00
M	97.23
N	97.67
O	97.72
P	88.23
Q	78.93
R	99.78
S	68.38
T	86.67
U	56.78
V	100.0
W	100.0
X	81.80
Y	100.0
Z	87.98

6 CONCLUSION

Sign Language Recognition is a subject of in-progress research which still has no extensive deployed system. This paper provides computer vision-based solution with better accuracy and accords to the associated knowledge domain. Literature Survey of this paper focuses on use of distinct methods for the solutions of gesture recognition and provides various perspectives on use of dissimilar methods and techniques.

Future research will include relative analysis of this study with other existing and newly gleaned solutions incorporated with ever-evolving technologies.

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