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A Survey on Indian Sign Language Detection Using Gesture Recognition

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ABSTRACT: Convolutional Neural Network is used in pattern recognition . Sign Language Recognition, which is a part of language technology, involves evaluating Human Hand Signs and Gestures through Machine Learning Algorithms .Vision oriented hardware like cameras are used to convert these sign languages into meaningful form like text or sound. With the massive and quick development of computer technologies and its growth of applications, the demand for communication between humans and machines is becoming more extensive. The main aim of this paper is to study CNN and various machine learning algorithms , and their applications in Sign language recognition .It will help to understand various techniques and feature extraction concepts and various approaches carried out . This research will surely help to develop a system for the people with vocal and hearing disability . This paper gives a broad overview of work done related to sign language or gesture recognition .

KEYWORDS: CNN, Convolutional Neural Network , Sign Language Recognition , Gesture Recognition , Machine Learning.

I. INTRODUCTION

The World Health Organization (WHO) report states that, at least 466 million people around the world have disability in hearing (more than 5% of the world's population), of which 34 million are children. Studies expect that the number will rise to 900 million by 2050 . Communication provide interaction among the people to exchange the feelings and ideas.This project will help to reduce the communication gap between the vocally disabled and other communities .This model will capture the gesture for the user and convert them into equivalent text or speech This project will mainly focus on Indian sign language recognition and will help people to understand vocally disabled people without actually learning the sign language .

Sign language is the way through which the people communicate with each other . It is a non-verbal means of communication used by the vocally disabled to communicate amongst each other and with others . Hand Gesture recognition is a type of computing using a user interface that allows the computers to capture and translate human gestures into commands .Along with sign language this project will also have a potential to add new gestures and increase the overall scope of gesture recognition . The aim of this work is to provide a real-time system translator which can convert Indian Sign Language (ISL) to the text.

The development of new products in sign language recognition can surely help the differently abled community by reducing the communication gap between people.People communicate with each other using Sign language which is one of the ways for non verbal communication. It is one of the non-verbal means of communication used by the vocally disabled to communicate amongst each other and with others and other communities . It helps in communication for people to express themselves and understand each other using gestures or signs. Hand gesture recognition is a type of computing which has a user interface that allows computers to capture the user's signs and interpret human gestures into its equivalent meaning.

Professionals in India believe that there is an acute shortage of special institutions for deaf community .The institutions that provide such facilities for vocal or hearing disability are limited to few people . Also there is a lack of proper and effective use of modern technology to train such children or people.

II. LITERATURE REVIEW

2.1 A systematic review on hand gesture recognition techniques,challenges and applications Mais Yasen, Shaidah Jusoh[1]

This paper tells us about the importance of HCI in gesture recognition. Hand gesture recognition is considered an important aspect in Human Computer Recognition(HCI).

They researched 560 papers available on IEEE from 2016-2018 out of which 465 were excluded and only well organised papers were studied. We learnt from studying the paper that the surface electromyography (sEMG) sensor with wearable hand gesture devices were most used and Artificial Neural Network was the widely used classifier, the most dominant factor that affects the accuracy of recognition is the background color and finally overfitting was a major issue faced by many.

2.2 Hand Gesture Recognition Based On Computer Vision: A REVIEW OF TECHNIQUES.[2]

The gesture recognition conveys a defect in the interaction systems. Doing things by hand is easier, feasible, and cheaper, also there is no need to fix the issues caused by hardware devices, they are not required.

We know from the experiments conducted that there is a need to work into developing reliable and robust algorithms with the help of a camera sensor that has a certain characteristic to encounter common issues and achieve a reliable result. The author has studied different approaches some are vision-based and some are sensor based and some vision based techniques .In vision based techniques we can use single camera or stereo camera or Kinet and Leap motion controller .For sensor based techniques we can use Inertial measurement unit (IMU) , Electromyography , wifi and radar or any other mechanical or electromagnetic technology . All the methods mentioned however, have its pros and cons and may perform well in some challenges while may not work in some conditions depending on various factors.

2.3 A review of hand gesture and sign language recognition technique [3]

They have proposed various ways by which we can detect the hand signs. There are various ways and different types of cameras used in gesture recognition like single camera setup , stereo camera, LMC etc.. Various steps involved in gesture recognition are image preprocessing , segmentation, classification ,feature extraction .They had a recognition accuracy of 87.5% in their model.

Standard references for future research are available for sign language recognition research and benchmark data set . SIFT, SURF, PCA, DWT and LDA are included in appearances based approaches for common feature extraction .By referring to this paper, we came to know about the various ways we can use machine learning techniques to make our model.

2.4 Indian Sign Language Numeral Recognition Using Region of Interest Convolutional Neural Network .[4]

In this they have proposed a system which can be used on Indian sign languages with the help of CNN. The model works in the following way, Input the image (video frame), Find the hand object, Extract the feature, Classification and prediction .In their architecture different layers are included such as Convolutional layers, Pooling layers, RELU(Rectified Linear Unit), Fully connected layer, Softmax layer. Nodes of the next layer will be formed after pooling operation and all convolution systems will flatten all the processed images to a linear array . Fully connected layer or dense layer is the connection of one layer to the next layer using corresponding weights .The classification layer is given with scores which is the output of the dense layer . Their system has attained an accuracy of 99.56% for the same subject while testing and the accuracy reduced to 97.26% in the low light condition. In future they can include more symbols from alphabets of static symbols of Indian sign language which include double hand notation. The low light problems have to be solved by increasing the dataset.

2.5 Fast and Robust Dynamic Hand Gesture Recognition via Key Frames Extraction and Feature Fusion [5]

In this paper they have proposed hand gesture recognition using Key Frame extraction.Key frames extraction is the key technology for video abstraction, which can remove the redundant information in the video greatly. .In this paper, a method of key frames extraction based on image entropy and density clustering is proposed. Key frames extraction methods are mainly divided into three steps, namely

- calculating image entropy
- finding local extreme points
- executing density cluster.

In order to build a fast and robust gesture recognition system, in this paper, they presented a novel key frames extraction method and feature fusion strategy. Considering the speed of recognition, they propose a new key frames

extraction method based on image entropy and density clustering, which can greatly reduce the redundant information of original video.

2.6 An improved hand gesture recognition with two-stage convolution neural networks using a hand color image and its pseudo-depth image.[6]

They proposed an RGB hand gesture recognition model by using a two-stage CNN architecture. In order to improve the color image recognition performance, they focused on generating pseudo depth as an effective step in our methods. They also designed a two-stream CNN for the second stage of the network which extracts the useful feature from the raw color and generates pseudo-depth image to obtain high classification accuracy. We have evaluated the proposed method on the MaHG-RGB D database, and the experimental results show that the pseudo depth image, as an important part, can improve the accuracy of gesture recognition. In the future work, we intend to find better ways to exploit advantages of pseudo-depth generation by adding a gesture preserved loss.

2.7 HAND GESTURE RECOGNITION: A LITERATURE REVIEW[7]

In this paper various methods are discussed for gesture recognition, these methods include from Neural Network, HMM, fuzzy c-means clustering, besides using orientation histogram for features representation. For dynamic gestures HMM tools are perfect and have shown its efficiency especially for robot control . NNs are used as classifiers and for capturing hand shape. For features extraction, some methods and algorithms are required even to capture the shape of the hand as in ,applied Gaussian bivariate function for fitting the segmented hand which used to minimize the rotation affection . The selection of specific algorithms for recognition depends on the application needed. In this work application areas for the gestures system are presented. Explanation of gesture recognition issues, detailed discussion of recent recognition systems are given as well. Summary of some selected systems are listed as well.

2.8 MIE324 Final Report: Sign Language Recognition[8]

In this paper Anna Deza and Danial Hassan have made a model using neural networks to recognize American Sign Language. This project works as a translator for the deaf community. For data processing they have used numpy arrays applied to various filters and ZCA whitening. The training model is contained in train-model.py. It is trained with various hyperparameters. The model is validated with every epoch. The data they used was taken from kaggle. The data set contained 87,000 images which were 200*200 pixels each. The data preprocessing was done using the PILLOW library. A CNN machine was used to train the model. It has 7 layers. The model was trained using Adam Optimizer and cross entropy loss. The validation accuracy of the model was 77%.

2.9 The Sign Language Recognition, Translation & Production Workshop[9]

The workshop brought together researchers who work on various aspects of sign language understanding spanning techniques from linguistics to computer vision. With the addition of providing a platform for a range of technical contributions, there was several important information from the workshop. First, it is crucial that deaf communities and researchers are present at every stage of research projects and workshop/conference organizations about sign languages. Second, the focus of applied sign language research should be realistic applications that people will want to use, rather than those with no practical need. Third, proper efforts are necessary in data set collection if the research community is to benefit from recent advances in neural machine translation

2.10 SIGN LANGUAGE RECOGNITION: STATE OF THE ART[10]

This paper focuses on Indian Sign Language recognition. They have used the CAS-PEAL database for the training and testing of the model. After studying the paper we can conclude that current systems are mainly focused on static signs/ manual signs/ alphabets/ numerals. The Standard dataset is not available for all countries/sub continents / languages. There is a need for a large vocabulary database in the current scenario to carry out more research. The focus should be on continuous or dynamic signs and nonverbal type of communication. Hand gesture recognition systems should adopt data acquisition in any situation. Systems should be able to distinguish face, hand (right/left) and other parts of the body simultaneously. These systems should perform recognition tasks in a convenient and faster manner.



2.11 Bengali Sign Language Recognition Using Deep Convolutional Neural Network[11]

This paper is based on bengali sign language recognition which CNN. They are performing this on 37 static signs with a total of 1147 images. The overall accuracy of the model is 96.33%. The Bengali language has 51 letters out of which 38 can be used in sign language. CNN is used for the classification of the data. The network consists of the following: Convolution Layer, Max-Pooling Layer , ReLU Layer, Dropout layer, Fully Connected Layer, SoftMax Layer .With their proposed recognition system, the they have achieved following results - validation loss of 0.3523 (categorical cross-entropy) and validation accuracy of 84.68%. This accuracy is very high considering the small size of the dataset.

2.12 Sign Language Recognition Using Convolutional Neural Networks[12]

The architecture of the model consists of two CNNs, one for extracting hand features and one for extracting upper body features. For the pooling method, we use max-pooling: only the maximum value during a local neighborhood of the feature map remains. To accommodate video data, the max-pooling is performed in three dimensions. Still , using 2D convolutions gives a better validation accuracy than 3D convolutions. The architecture of the model consists of two CNNs, one for extracting hand features and one for extracting upper body features. The accuracy on the test set is 95.68% and we observe a 4.13% false positive rate, caused by the noise movements. The survey shows that CNNs can be used to accurately recognize different signs of a sign language, with users and surroundings not included in the training set. This generalization capacity of CNNs can contribute to the broader research field on automatic sign language recognition.

Table: Summary of Literature Review

SN	TITLE	YEAR	FEATURES
1	A systematic review on hand gesture recognition techniques,challenges and applications Mais Yasen, Shaidah Jusoh	2016	Methods used: Research of 560 papers to have more knowledge.
2	Hand Gesture Recognition Based On Computer Vision: A REVIEW OF TECHNIQUES	2018	Methods used: This paper reviews hand gesture recognition techniques. It explains us Human Computer Interaction.



3	A review of hand gesture and sign language recognition technique	2012	Methods used: camera setup , stereo camera, LMC,CNN Accuracy: 87.5%
4	Indian Sign Language Numeral Recognition Using Region of Interest Convolutional Neural Network .	2018	Methods used: CNN,ReLU,pooling layers Accuracy: 99.56%
5	Fast and Robust Dynamic Hand Gesture Recognition via Key Frames Extraction and Feature Fusion	2020	Methods used: hand gesture recognition using Key Frame extraction Accuracy: 97%
6	An improved hand gesture recognition with two-stage convolution neural networks using a hand color image and its pseudo-depth image.	2019	Methods used: CNN architecture,MaHG- RGB D database Accuracy: 84.5%
7	HAND GESTURE RECOGNITION: A LITERATURE REVIEW	2017	Methods used: Neural Network, HMM, fuzzy c-means clustering



8	MIE324 Final Report: Sign Language Recognition	2013	Methods used: Numpy,CNN Accuracy: 77%
9	The Sign Language Recognition, Translation & Production Workshop	2016	Methods used: It is a workshop which showed the importance of sign language recognition and the techniques to overcome it.
10	SIGN LANGUAGE RECOGNITION: STATE OF THE ART	2019	Methods used: CAS-PEAL database is used with CNN
11	Bengali Sign Language Recognition Using Deep Convolutional Neural Network	2017	Methods used: Accuracy: 84.68%
12	Sign Language Recognition Using Convolutional Neural Networks	2018	Methods used: Accuracy: 95.68%

III. ADVANTAGES

- The output of the sign language will be displayed in the text or speech form in real time. This will help in reducing communication between the physically challenged.
- As the traditional approach is using sensors or gloves, the implemented system suggests the direct use of images from a web camera for recognition which reduces the cost.
- As no specific hardware is required here, and the project is just software, there is no degradation in performance with respect to time. The performance will rather increase if the processor is of higher specification.

IV. DISADVANTAGES

- The proposed system uses only cameras for input purpose, so illumination of the room shadows and background can result in the efficiency and accuracy of the output.
- The performance of the system also depends on the type of hardware used. Higher end systems can yield higher accuracy as well as high frames per second.

V. CONCLUSION

This paper focuses on convolutional neural networks and how it can be used to identify images and classify various images into different signs for Indian Sign Language . It also reviews existing techniques used for sign language recognition along with the data set used to train the model for identification of Indian Sign Language or Indian Sign gesture .

This paper also has a broader overview of different uses of convolutional neural networks along with machine learning algorithms for sign language recognition . So we can conclude that CNN has a wide application for classification of images and has limitless potential to solve day to day life problems .

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