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Sign Language Detection and Recognition using Machine Learning

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Abstract: Communication is a crucial factor of human interaction. Due to our hearing ability, we can understand thoughts of each other. But what if one absolutely cannot hear anything and eventually cannot speak? So Sign Language is the main communicating tool for hearing impaired and mute people, and also to ensure an independent life for them.

This paper proposes a system to recognize the hand gestures using a Deep Learning Algorithm, Convolution Neural Network (CNN) to process the image and predict the gestures. This paper shows the sign language recognition of 26 alphabets and 0-9 digits hand gestures of American Sign Language as well as some other general words. The proposed system contains modules such as image pre-processing and feature extraction, training and testing of model and sign to text and audio conversion. Different CNN architecture and pre-processing techniques such as greyscale, thresholding, skin masking, and Canny Edge Detection were designed and tested with our dataset to obtain better accuracy.

Keywords: Convolutional Neural Network(CNN), Image Processing (IP), Machine Learning(ML), Data Science(DS), Deep Learning (DL)

I. INTRODUCTION

People whose hearing aids are completely or partially damaged are termed as deaf. They face difficulty to interact with others**.** They are not able to express themselves properly nor they are able to present their talent in-front of normal people. They always face that communication gap between them and normal people like all of us. Hence, to overcome that communication barrier sign language proves to be a beneficial concept. Sign language is a language used largely by deaf persons that consists of hand gestures, other movements, face expressions, and body postures. There are numerous distinct sign languages, including British, American and Indian Sign languages. When attempting to communicate.
with someone who does not share their language, humans will occasionally create new hand gestures. People with normal hearing are sometimes unable to communicate with deaf people because they are unaware of sign language. One of the most effective ways we may express our thoughts to others is through hand gestures.

Sign Language is the most basic and natural form of communication for hearing-impaired people. These physically disabled people are neglected and isolated by society. Individuals who know sign language can bridge the gap between normal people and hearing-impaired people. We intend to create an efficient system to assist in breaking down this communication barrier. A working sign language interpreter can allow a muted person to communicate with a non-signing person without the assistance of an interpreter.

The goal of this project is to encourage the development of algorithms and to create a system for the hearing impaired or deaf people so that the society can grow. American Sign Language's 26 hand movements were used to create the system. Each alphabet had between 250 and 300 images, and each number had about 200 images.

Preprocessing the photos acquired for this project was the simple step. The following algorithms were used to pre-process the obtained raw pictures for this paper: grey scaling, Skin Masking, Threshold, Canny Edge Detection. For training and testing purposes, the images from the post-processing stage were fed into the convolution neural network model. Architectures were run and tested to determine the best architecture for the recognition of hand gesture.

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II. EXISTING SYSTEM

[1] Sandrine Tornay Marzieh, Razavi Mathew Magimai.-Doss has proposed system for Towards Multilingual Sign Language Recognition. They develop a multilingual sign language approach, where hand movement modeling is also done with target sign language independent data by derivation of hand movement subunits using CNN.[2]Dhivyasri S, Krishnaa Hari K B, Akash M, Sona M has proposed system for An Efficient Approach for Interpretation of Indian Sign

Language using Machine Learning. To enable people with special disabilities to communicate effectively with those around them, a system that translates hand gestures from Indian Sign Language (ISL) numbers (1-9), English letters (A- Z) and some English words in words that can understand the text on the other hand are proposed in this article. This is done using image processing techniques and machine learning algorithms. [3]Dardina Tasmere, Boshir Ahmed has proposed system for Hand Gesture Recognition for Bangla Sign Language Using Deep Convolution Neural Network. In their study paper, the authors suggest a brand-new framework for hand gesture identification in Bangla sign language to close the communication gap between sign language users and deaf people. The hand was seen experimenting with the YCbCr and HSV colour spaces. Deep convolution neural networks can identify 37 characters in total (8 vowels and 29 consonants).[4] Yue Sun, Tiantian Yuan, Junfen Chen, Rui Feng has proposed system for Chinese Sign Language Key Action Recognition Based on Extenics Immune Neural Network. Using Kinect technology, a sizable continuous sign language data set is created in order to address the issue of low accuracy in key action capture and feature detection in Chinese sign language human-computer interaction. Extension immune detector is made to accurately locate the main sign language acts by fusing immune neural network (INN) and extension analysis theory.

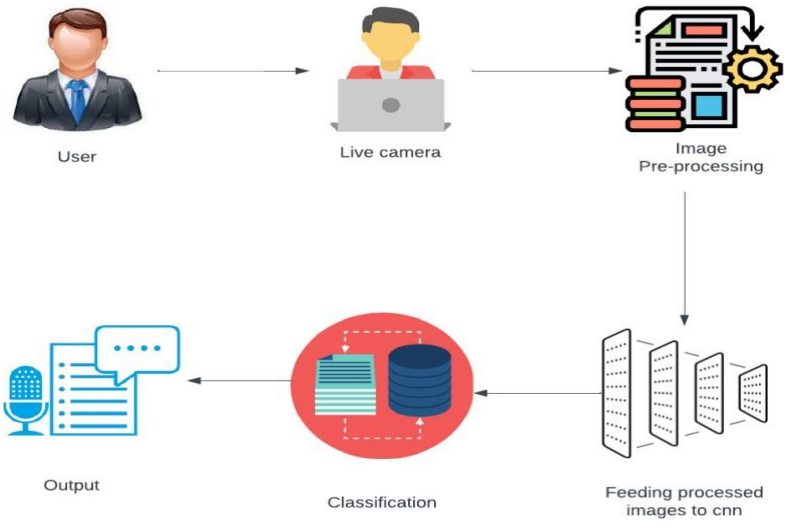
III. PROPOSED SYSTEM

The module below receives an image as input and returns the alphabet/number corresponding to the sign visible in the image captured through live camera.

The process involves three major steps, which are as follows:

1. Capture image from live camera
1. Image pre-processing
2. Input the image into the CNN model
3. Displaying the output in text and audio format.

The input is first obtained as an image which is captured from a live camera in the first step. The captured image is then pre-processed using the various methods before being sent to the CNN model. The CNN model compares the loaded image to the trained images and predicts the sign using the most likely labels from the previously trained model. The output is then given through the audio and text form for the passed image in input phase.



Fig

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IV. IMPLEMENTATION

When unprocessed images are fed directly to the CNN model, it cannot predict labels accurately. The main issue with CNN processing is its inability to properly cancel out the background. As a result, the images must be processed separately using various image processing techniques. Before processing, the images were resized to 45x45. The various techniques used on the images in our dataset are described further below.

Greyscale

The first method we used to process our images was to simply convert the RGB image to greyscale and resize it to pass through the CNN model that was used to train the images.Grayscale is a set of monochrome shades ranging from black to white. Digital images can be saved in black and white or colour, and even colour images contain grayscale information. Regardless of colour, each pixel has a luminance value. Image luminance can be defined as brightness or intensity, which can be measured on a scale ranging from black to white.

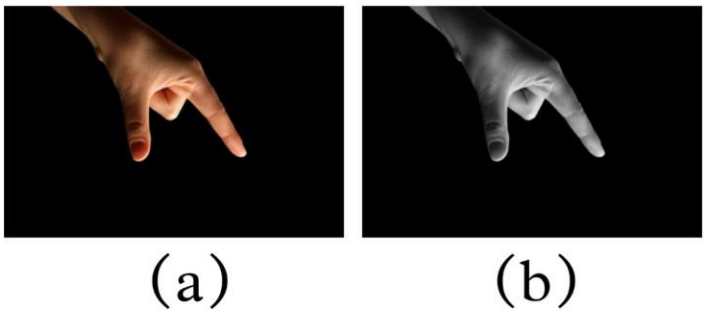
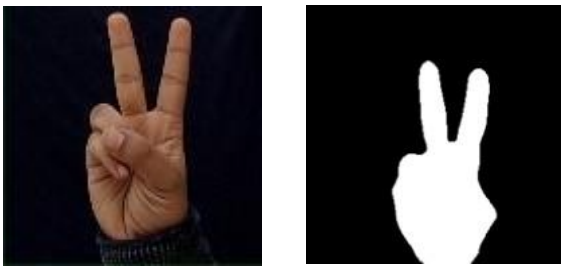


Fig - 1: Gray Scale Conversion of Image Threshold

Image thresholding is a simple method of separating an image into foreground and background. This image analysis technique is a type of image segmentation in which objects are divided by converting grayscale images into binary images. Image thresholding is useful for processing images with high contrast levels.



INPUT OUTPUT

Fig 4.2: Threshold Output

CNN

Convolutional Neural Networks (CNNs) are Deep Learning architectures that are commonly used for image classification and recognition. It has several layers, including Convolutional layers, Pooling layers, and fully connected layers. The Convolutional layer extracts features from the input image using filters, the Pooling layer reduces computation by down sampling the image, and the fully connected layer makes the final prediction. Backpropagation and gradient descent are used by the network to learn the best filters.

To classify the images, the CNN model is fed the processed images. The image processing techniques described above and are carried out using the American Sign Language alphabet dataset. Convolution Neural Network was used to train the images. To classify the images, we feed the processed images into the CNN model. After fitting the model, we use it to predict random images from the computer in order to predict the text and audio and display it on the screen.

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V. FUTURE SCOPE

Given the ongoing study into the creation of a sign language system, the project's future scope may be extremely broad. The model presently only supports American sign language, so it is anticipated that it will be sufficiently improved to support Indian sign language and other sign languages also. The model needs to be improved in the areas of capturing dynamic gestures as well, as it can only currently predict or interpret for static finger spellings. Additionally, the databases need to be improved with more precise and high-quality images. By including photos with different illumination densities, the images can be changed.

More model training is required for accurate recognition of two hand gestures. Words can also be found in sign language, which goes beyond just alphabets and numbers.

CONCLUSIONS

Our objective of making this project is to bridge communication gap between the deaf people and normal healthy people. It is very important in today's life to express our views, most of the people are not able to understand the sign language so we tried to make it possible to build a system to make it easier. In this project image will be captured live from the user after that it is be analyzed, processed, and transformed to both signal or textual show at the display for the advantage of the listening to impaired. We have learned and demonstrated that how CNN can learn, analyze, predict the output. We have created a model and trained it to get the best output based on the given inputs. We have attempted distinct images processing strategies to discover the fine one we want for our use. Here we learned how to get the output in the form of audio and text as well.

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