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Sign Language Recognition Application using Python and OpenCV

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Abstract: *Deep learning (DL) is a machine learning method that allows computers to mimic the human brain, usually to complete classification tasks on images or non-visual data sets. Deep learning has recently become an Industry-defining tool for it's to advances in GPU technology. Deep learning is now used in self-driving cars, fraud detection, artificial intelligence programs, and beyond. These technologies are in high demand, so deep learning data scientists and ML engineers are being hired every day. Sign language recognition has gained focus over the last few years, it is a difficult task for normal human beings to interpret sign language. The project deals with the real time input which is given by the user , recognition of gesture is done by application of support vector machine(SVM), Convolutional neural network (CNN) and other required algorithms, after this step the hand gesture is recognized and its meaning is predicted and message.*

Keywords: CNN, Sign Language, Gesture Recognition, OpenCV, ROI, Relu, Silhouette, Pooling, Histogram

I. INTRODUCTION

Deep learning (DL) is a machine learning method that allows computers to mimic the human brain, usually to complete classification tasks on images or non-visual data sets. Deep learning has recently become an industry defining tool for its advances in GPU technology. Deep learning is now used in self-driving cars, fraud detection, artificial intelligence programs, and beyond. These technologies are in high demand, so deep learning data scientists and ML engineers are being hired every day. Today, we'll help you take the first step toward those exciting careers. You'll learn how deep learning works, why it's become so popular, and teach you to implement your first deep learning model. Deep learning and other ANN methods allow computers to learn by example in a similar way to the human brain. This is accomplished through passing input data through multiple levels of Neural Net processing to transform data and narrow the possible predictions each step along the way. Types of Learnings Machine Learning Algorithms can be classified into 3 types as follows:

1. Supervised learning
2. Unsupervised Learning
3. Reinforcement Learning

There are various models in deep learning, Supervised Models are Classic Neural Networks (Multilayer Perceptron), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and for Unsupervised Models Self-Organizing Maps (SOMs), Boltzmann Machines, Auto Encoders.The proposed recognition model have used Convolutional Neural Networks (CNN) for detecting gesture from real time input. Deep learning algorithms have powerful advantages over other models like:

- **Unstructured data handling:** Once trained with structured data, deep learning models can automatically make sense of unstructured data. This means businesses can plug all available data they have without formatting or standardizing it first.
- **Recognize unexpected patterns:** Most models require engineers to select what pattern the ML algorithm will look for. Any correlations beyond those directly selected go undetected. Deep learning algorithms can track all correlations, even those not requested by engineers.
- **Unmatched accuracy:** Deep learning delivers more accurate results and scales better with large data pools than other methods.

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II. Related Work

In [1],A Saudi Sign Language Recognition System based on Convolutional Neural Networks, Alaa H Al-Obodi, Ameerh M Al-Hanine, Khalda N Al-Harbi, Maryam S Al-Dawas, and Amal A. Al-Shargabi, International Journal of Engineering Research and Technology,2020, The system is based on the Saudi Sign language dictionary, which was published recently in 2018. In this study, we constructed a dataset of 40 Saudi signs with about 700 images for each sign. We then developed a deep convolutional neural network and trained it on the constructed dataset.

In [2], Real-time Vernacular Sign Language Recognition using MediaPipe and Machine Learning Arpita Halder a , Akshit Tayade, International Journal of Research Publication and Reviews Vol (2) Issue (5) (2021), The main purpose of this paper is to demonstrate a methodology that simplified Sign Language Recognition using MediaPipe's open- source framework and machine learning algorithm. The predictive model is lightweight and adaptable to smart devices. Multiple sign language datasets such as American, Indian, Italian and Turkey are used for training purposes to analyze the capability of the framework. With an average accuracy of 99%, the proposed model is efficient, precise and robust.

In [3],.Towards Continuous Sign Language Recognition with Deep Learning,Boris Mocialov, Graham Turner, Katrin Lohan , Helen Hastie ,2017, paper focuses on natural language and in particular on sign language recognition. The approach described here combines heuristics for segmentation of the video stream by identifying the epenthesis with stacked LSTMs for automatic classification of the derived segments. This approach segments continuous stream of video data with the accuracy of over 80% and reaches accuracies of over 95% on segmented sign recognition

In [4], An Efficient Indian Sign Language Recognition System using Sift Descriptor, em using Sift Descriptor Jasmine Kaur, C. Rama Krishna, International Journal of Engineering and Advanced Technology (IJEAT),Aug 2019, In this paper to address these issues, Scale-Invariant Feature Transform (SIFT) as a descriptor is used. It extracts the features that train the Feed Forward Back Propagation Neural Network (FFBPNN) and optimizes it using Artificial Bee Colony (ABC) according to the fitness function. The dataset has been collected for alphabet from the video by extracting frames and for numbers it has been created manually from deaf and dumb students of NGO "Sarthak"

In [5], A Review Paper on Sign Language Recognition System For Deaf And Dumb People using Image Processing, Manisha U. Kakde , Mahender G. Nakrani , Amit M. Rawate,IJERT ,March 2016, This paper reviews a different methods adopted to reduce barrier of communication by developing an assistive device for deaf-mute persons. The advancement in embedded systems, provides a space to design and develop a sign language translator system to assist the dumb people, there exist a number of assistant tools. The main objective is to develop a real time embedded device for physically challenged to aid their communication in effective means.

In [6], A Comprehensive Analysis on Sign Language Recognition System Rajesh George Rajan, M Judith Leo, International Journal of Recent Technology and Engineering (IJRTE), March 2019, Thriving efforts in the area of Sign Language Recognition (SLR) research within the last few decades makes a good interaction between human and computer system. SignLanguage is basically a means for dissemination through signing which, utilizes specific sign patterns performed to deliver the meaning with the use of hands, lips and facial expressions to conveniently be able to express the signer's thoughts

In [7], Sign Language Recognition using Convolutional Neural Networks, Lionel Pigou, Sander Dieleman, Pieter-Jan Kindermans, Benjamin Schrauwen,2018, There is an undeniable communication problem between the Deaf community and the hearing majority. Innovations in automatic sign language recognition try to tear down this communication barrier. Our contribution considers a recognition system using the Microsoft Kinect, convolutional neural networks (CNNs) and GPU acceleration. Instead of constructing complex handcrafted features, CNNs are able to auto- mate the process of feature construction. We are able to recognize 20 Italian gestures with high accuracy

In [8], A Comprehensive Study on Deep Learning-based Methods for Sign Language Recognition, Nikolas Adaloglou ,Theocharis ,ax 19 March 2021, In this paper, a comparative experimental assessment of computer vision-based methods for sign language recog-nition is conducted. By implementing the most recent deep neural network methods in this field, a thorough evaluation on multiple publicly available datasets is performed. The aim of the present study is to provide insights on sign language recognition, focusing on mapping non-segmented video streams to glosses. For this task, two new sequence training criteria, known from the fields of speech and scene text recognition, are introduced.

In [9],Real-time American Sign Language Recognition with Convolutional Neural Networks, Brandon Garcia Alarcon Viesca, 2017,In This paper present the development and implementation of an American Sign Language (ASL)

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fingerspelling translator based on a convolutional neural network. We utilize a pre-trained GoogLeNet architecture trained on the ILSVRC2012 dataset, as well as Surrey University and Massey University. A real-time sign language translator is an important milestone in facilitating communication between the deaf community and the general public

In [10]Sign Language to Text, Rajesh Singh, Satyam Shekhar,Shashank Shaurya , Shivang Kumar , Dr. Rekha. K.S 5, 2020 IJESC, This paper shows the sign language recognizing of 28 including backspace and whitespace hand gestures in American sign language. The proposed system contains five modules such as: Setting up the model, caching bottlenecks, adding FC layer to the model, training the model and writing about trained graphs and labels.

In [11], Automatic Sign Language Finger Spelling Using Convolution Neural Network: Analysis, Beena M.V., Dr. M.N. Agnisarman Namboodir, International Journal of Pure and Applied Mathematics,2017, This paper focuses on the recognition of static gestures of ASL which are collected from Kinect sensors. The most challenging part in the design of an automatic sign language translator is the design of a good classifier that can classify the input static gestures with high accuracy.

III. MOTIVATION

The 2011 Indian census cites roughly 1.3 million people with "hearing impairment". In contrast to that, numbers from India's National Association of the Deaf estimates that 18 million people –roughly 1 percent of the Indian population are deaf. These statistics formed the motivation for our project. As these speech impairments and deaf people need a proper channel to communicate with normal people, there is a need for a system .Not all normal people can understand sign language of impaired people.

IV .PROBLEM STATEMENT AND OBJECTIVES

To train a Convolutional Neural Network (CNN) model for recognition of Sign Language gestures from video input and develop a UI which will work using Python and OpenCV.

1. To provide an efficient and accurate way to convert sign language into text or voice.
2. To generate dataset related to gestures for further synthesis.
3. To train a pre-trained CNN model for gesture recognition.
4. To develop proper and user friendly UI, for fluent user experience for getting desired result from the model.

V. SYSTEM ARCHITECTURE

System architecture is a conceptual model which specifies the overview of the whole process of the project. It describes each step in the project making with the help of a flow. It specifies each and every step descriptively.

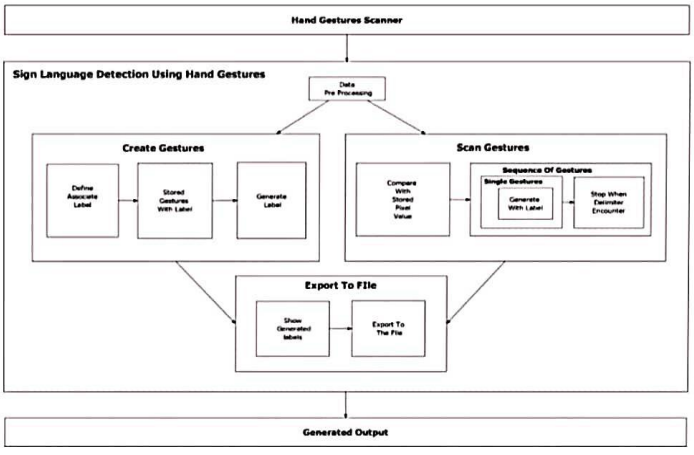

Figure 5.1: System Architecture

The system architecture is as follows,

- There are mainly two parts in system Architecture: In first part, based on the object detected in front of the camera its binary images are being populated.
- Meaning the object will be filled with solid white and the background will be filled with solid black.

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- Based on the pixel's regions, their numerical value in range of either 0 or 1 is being given to next process for modules.
- In second part, A gesture scanner will be available in front of the end user where the user will have to do a hand gesture. Based on Pre-Processed module output, a user shall be able to see associated label assigned for each hand gestures, based on the predefined American Sign Language (ASL) standard inside the output window screen

VII. IMPLEMENTATION

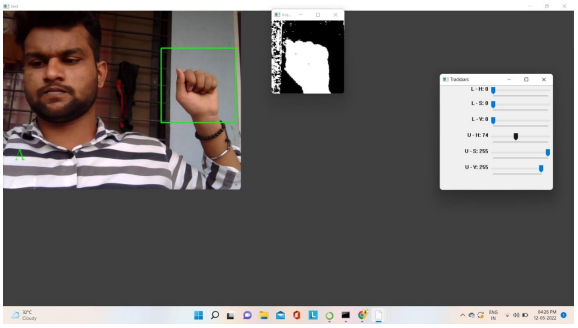

Figure: User interface

We take input from the user which is in real time through the webcam.

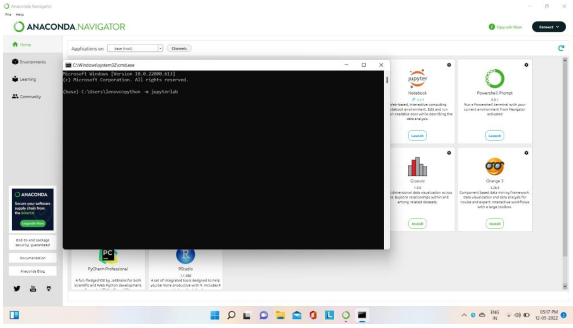

Figure: Run code.

To start the application we have to run it through the command line / terminal.

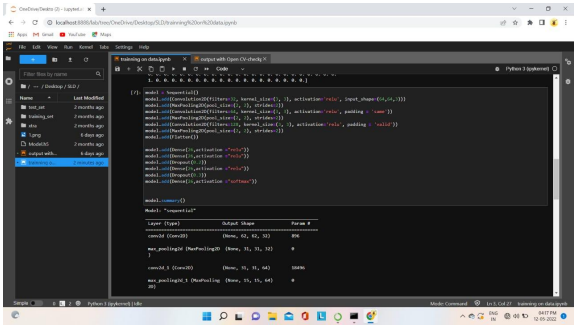

Figure: Training data

After taking the required input we train the available data in 3 parts.

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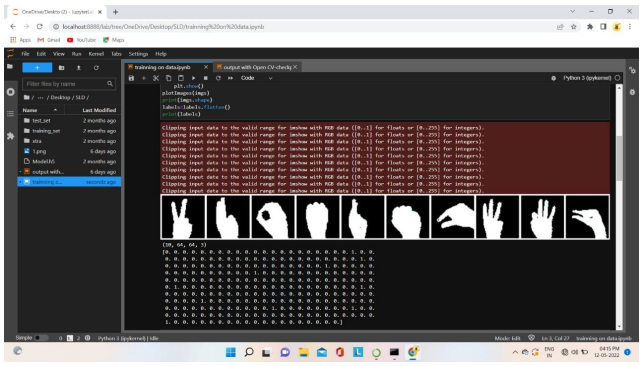

Figure: Dataset used

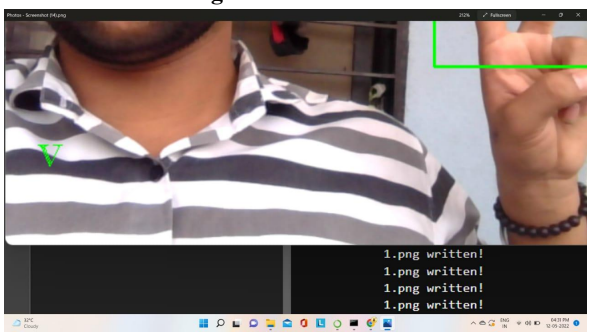

Figure: Conversion of image

Here we convert the real time data to 2-D image

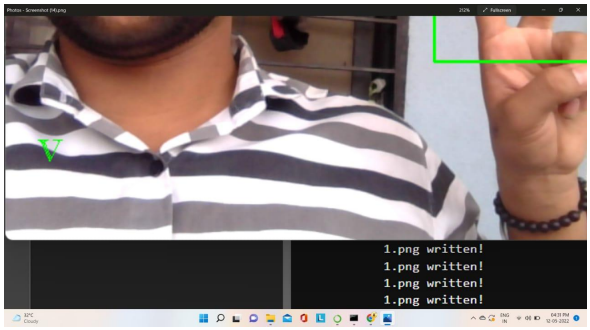

Figure: Output

Real time output of gestures is shown on screen.

VII. Future Work

It can be integrated with various search engines and texting applications such as google, WhatsApp. So that even the illiterate people could be able to chat with other persons, or query something from the web just with the help of gestures. Developing ways to filter and cover up for the errors getting carried forward from the previous components.

VII. Conclusion

With this application a person will quickly adapt various gestures and their meaning as per ASL standards. They can quickly learn what alphabet is assigned to which gesture. Add-on to this custom gesture facility is also provided along with sentence formation. A user need not be a literate person if they know the action of the gesture, they can quickly form the gesture and appropriate assigned character will be shown onto the screen.

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