DYNAMIC HAND GESTURE RECOGNITION

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Abstract

So early human ancestors probably used gestures to Communicate. Once Armstrong said that he thinks gestures involving the hands may well have been the earliest form of complex human communication. As Armstrong said, the beginning stage of human computer Interactions is gesture recognition system and also it is a natural way of communicating with the computers. In this paper, we have designed a Dynamic Hand Gesture Recognition System using Neural Network, which can recognize the gesture using the Computer's or Laptop's Web Camera and do the according tasks.

INTRODUCTION

Chapter – 1 1.1

Introduction Gesture Recognition is an important and active field of Computer Vision. Gestures can be Static or Dynamic (Motion), but direct use of hand can be more attractive and natural way of conveying meaning to the humans and computer. But it also depends on the speed of motion and latency. Gesture recognition has wide-ranging applications in human-computer interaction, signlanguage communication, video surveillance, dance/video annotations and forensic identification.

1.2 Motivation for the work

This project is motivated from the problem that prevailed long ago. The difficulties faced by deaf and mute people are also a motivation for this project. It also eliminates the direct use of hands in public places especially during a pandemic situation like this. So, to develop a system which can detect the gestures and these gestures are widely used for conveying the information or to control the devices. This is the motivation for the work.

1.3 About Introduction to the project including techniques

The introduction to the techniques that we use in this project are as follows. We will use a database of images that represent the gestures and make a Convolutional Neural Network model, then train the model to classify the images based on the gestures from the database. The next step is to use the trained model to predict the gestures from real time live video feed. Finally, we assign some tasks to perform based on the predicted gestures.

2 1.5 Problem Statement

There are many applications where hand gesture can be used for interaction such as videogames. These hand gestures can also be used by handicapped people to interact with the systems. Classical interactions tools like keyboard, mouse, touchscreen, etc. may limit the way we use the system. All these systems require physical contact, in order to interact with system. Gestures can interpret same functionality without physically interacting with the interfacing devices. The problem lies in understanding these gestures, as for different people, the same gesture may look different for performing the same task. This problem may be solved by the use of Deep Learning approaches. Convolution neural networks (CNN's)

are proving to be ultimate tool to process such recognition systems. High computing power is required in order to process gestures with higher accuracy and efficiency.

1.6 Objective of the work

Hand gesture recognition system can be used for interfacing between computer and human. The objective of this project is to develop a model for recognition of hand gestures with reasonable accuracy and also to make the system to perform specific tasks based on the predicted gestures.

1.7 Summary

The detailed summary introduces us to the basic knowledge about hand gesture recognition. It also throws light on the importance of this recognition system and the motivation behind the work. The techniques that were used are also explained along with the problem statement. The final part of introduction contains the main objective of the work.

LITERATURE REVIEW

Hand gestures and gesticulations are a common form of human communication. It is therefore natural for humans to use this form of communication to interact with machines as well. The main objective of this effort is to explore the utility of a neural network-based approach to the recognition of the hand gestures. For instance, touch-less human computer interfaces can improve comfort and safety in vehicles. Computer vision systems are useful tools in designing such interfaces. However, real-world systems for dynamic hand gesture recognition present numerous open challenges. First, these systems receive continuous streams of unprocessed visual data, where gestures from known classes must be simultaneously detected and classified. Here we have taken a vision Based Model for gesture recognition as the vision based model deals with Video capturing, image processing and pattern recognition.The main objective of this effort is to explore the utility of a neural network-based approach to the recognition of the hand gestures. Here we can compare with the other previous works related to hand gesture recognition. It can also motivate us to understand the various advantages and disadvantages respected with their various techniques. In this literature survey we can discuss various methods for capturing the hand gestures, it is like using the physical gloves[2], or just using the camera for capturing the hand motions and mapped some of the shortcuts for opening applications[1], also there are some other methods but that are likely more towards to the colour suppose you need to wear a colored gloves for identity the hand but[3], This paper has four steps involved in order to recognise hand gestures. The hand detection is done using the extended Adaboost method. It is followed by the hand tracking and segmentation operation. At last scale-space features detection is applied to find palm-like and finger-like structures[4].The colored video is taken as input and converted into binary[5].Threshold segmentation is done to the RGB video to convert it to binary video. Expansion and corrosion are done as a part of preprocessing. Contour extraction is done in order to locate the hand. A VGGNet network is used to classify the contour region as hand or face. Then finally the gesture is recognised[5]. There are some other methods for capturing the hand gestures also[6], where they used the microsoft kinect for capturing the human hand which provides us a 3D Skeleton model of the human body virtually, the virtual skeleton consists of the joints and other body parts it includes the fingertips also. This is how its interpret its gesture, let us see the purpose of the gesture recognition, basically here[6] the gesture trajectory is obtained by the microsoft kinect skeleton tracker, it stored in the sequence of the X, Y, Z coordinates to the hand tip of the person, it enabling the algorithm to compare the gestures that is observed independently from the relative point to the person from the sensor[6]. And some other researchers had done with the hand gesture recognition by using sEMG Signals[7], The gesture acquisition is done by sEMG acquisition equipment to store and filter the electric signals that are generated by skin surface[7], Here they explain why they used the sEMG signal because it is a weak signal and it is easy to interface with the bioelectrical signal. This technology adopts 16-channel high spatio-temporal resolution sampling technology, this equipment can also able to collect the upper limb signals, it accounpains the most of the research tasks that are based on the EMG Signals, And Here they designed a lightweight glove kind of

wearable[8]. That glove can capture and send hand motions wirelessly and in real time. They adhered with the IMU sensors on the surface of the fabric in that glove to track the motion of the palm and the motion or the rotations of the hand joints of the fingers[8]. The hand positions and gestures are obtained from the leap motion that is recorded in the coordinate to the centre of the leap motion; they have done the coordinate transformation for embedding the leap motion control based interaction in the existing system[10]. They did the transformation by using the affine transformation method[1 For the data fusion they used the methods kuke kalman filter[11]. for combining the data from the leap motion and Myo sensors to create 3D simulation of the Hand motion, kalman mapping also used to optimise the estimation of hand position and orientation[11], they used the interpolation based resampling for the combining both the sensors and SLR[11]. How they are detecting means by using the LMC-API it allows access to detect the hands or arms and also they have implemented the 21 features[11]. These three fingers have the Raw data returned by IMUs processed by the fusion algorithm and they have done several processing and extracting the hand gestures[8].Sensors used for hand gesture recognition include wearable sensors such as data gloves and external sensors such as video cameras[9]. Hand position and movement can be accurately measured using data gloves[9]. But data gloves are very expensive[9]. A detector is used as a switch to activate the classifier if a gesture gets detected[11]. Its job is to distinguish between gesture and no gesture classes by running on a sequence of images. Two models C3D and ResNext are used as a classifier model[11].

Hand gestures and gesticulations are an ordinary form of human ideas. It is so natural for persons to use this form of ideas to communicate accompanying machines as well. This uses the webcam to discover salute created for one consumer and act elementary operations therefore. From the Existing Research Papers, we raise that Human Computer Interaction has a more important alive field, One of the Major Field of calculating apparition in the understanding of human gestures. Hand gestures hopeful a habit of trading news accompanying added crowd in a in essence scope, directing few bots to act sure tasks in surroundings, or interplay accompanying the calculating. In that we have two various fads of recognitions like One is the Vision Based model but this depends on the Environment and another is sensor located accompanying wanted environment belongings like lights and unique Environment. In that we have two different modes of recognitions like One is the Vision Based model but this depends on the Environment and another is sensor based with needed background things like lights and isolated Environment. These hardware ploys are mainly some sensors or some other somewhat Arduino manoeuvre accompanying some alternative of sensors contained in it. Thus, the interaction between human and calculating becomes less “unaffected” by way of the use of aforementioned devices. Also, these schemes are not inexpensive, aesthetic and smooth to claim. For these reasons, it becomes unsettled too low for people to approach and use bureaucracy with ease. Human Computer Interaction (HCI) electronics are briskly evolving the habit we communicate accompanying calculating devices and conforming to the uniformly growing demands of new paradigms. One of ultimate beneficial forms concerning this is the integration of Human-to-Human Interaction gestures to further ideas and meaning plans. The big objective of transporting this Systematic Literature Review (SLR) searches out the focal point of the state-of-the-creativity in the circumstances of fantasy-located gesture acknowledgment accompanying distinguishing devote effort to something hand sign acknowledgment (HGR) methods and permissive technologies. After a painstaking orderly excerpt process, 100 studies having to do with the four research questions were selected. While it cannot be of excellent use for skimming computer networks or article a paragraph document, it is beneficial in news performers and while learning documents or files. A plain nod could pause or play the picture or increase the capacity even while situated a great distance away from the calculating screen. One keeps a manuscript through an eBook or a performance even while bearing a luncheon. Existing orders for only numbers and few elementary gestures so we can’t invite to do battle for all, but likely expected change always we have secondhand these gestures to communicate accompanying the calculation. For example, appearance, your touch to increase the book, existent orders for only numbers and few elementary gestures so we can’t invite to do battle for all - meaning likely expected change forever. We have used these gestures to communicate while calculating or they were utilising the fittings like Kinect or leap motion that cost about nearly 100 USD that is much costlier in our country and still energetic supplies are skilled but that form

more explosion so we have created this plan. We have captured a fantasy Based Model for signal Recognition, Gesture acknowledgment is a numerical understanding of a human motion to a computer, the view-located approach handles the Video Capturing, countenance dispose of and pattern acknowledgment. For this we should use the CNN classifier to decide the shape of the help. In the dream-located approach they have prevented skin colour separation. The aim search out identify active help gestures accompanying asserting the extreme veracity and moment of truth captured to acknowledged gestures from the Beginning they were second hand the sensor located manoeuvres like Use of photoelectric fittings, but it was Complex to use cause the Physical fastening accompanying the model is necessary and more explosion were caused while evolution and they create the protection but it again have a concurrent Problems and Kinect find a resolution but it was more expensive so achieving for all it was more troublesome so we have projected to work the unchanging use in our calculating arrangements accompanying the use of desktop computer or calculating's webcam. We are making use of implementing a plan that identifies Gesture recommendation utilising webcam & performs the Specified Operation. This use may be fashioned to arrest the backdrop while the consumer runs added programs and uses. This is very useful for a hands-free approach. In order to remove the disadvantage of bureaucracy, we can train the model accompanying images that contain few cry secrets. In other words, we can train the model accompanying concepts accompanying the culture. The training dataset concedes the possibility of a merger of concepts accompanying and outside culture. Further tweaks may be organised in the rule to increase the efficiency of the signal acknowledgment process. The rule may be upgraded for better understanding and acknowledgment of the gestures and more recent gestures can be incorporated for more functionalities. The program that controls display for accumulating and inspecting gestures in addition to running the program may be enhanced considerably, such as providing an interactive GUI alternatively utilising terminal commands. By this habit we can build a robust model that acts less computations. So, at last we have projected to work the unchanging service in our calculating arrangements with the use of a desktop computer or calculating's webcam.

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SYSTEM ANALYSIS

Chapter - 3 3.1

Introduction Our Hand Gesture recognition system consist Convolutional Neural Network has used to Predicting the Gesture our CNN was created using the Keras which is interface of Tensorflow to detecting the gesture and control the operating system according to the assigned task and also for training the CNN.

3.2 Disadvantages/Limitation in the Existing System

Existing methods for only numbers and some basic gestures so we can't do it for all, meaning tend to be change always we have used these gestures to interact with the computer. For example, showing your palm to increase the volume, existing methods for only numbers and some basic gestures so we can't do it for all - meaning tend to be change always. We have use these gestures to interact with the computer or they were using the hardware like kinect or leap motion which costs around approximately 100 USD which is much costlier in our country and also electrical equipment are there but that makes more noise so we have come up with this idea.

3.3 Proposed System

We can segment our proposed work in three units/modules – 6 CNN Model Generation: Here, we will use a database of images and make a CNN model, train it to classify the images and any other same kind of image. User Feed Taking: Now, as we have made the CNN model, we will use this model to predict the gesture from real time live video feed. Doing the Task: As the prediction goes on, the system will do the task assigned to each gesture when they are predicted.

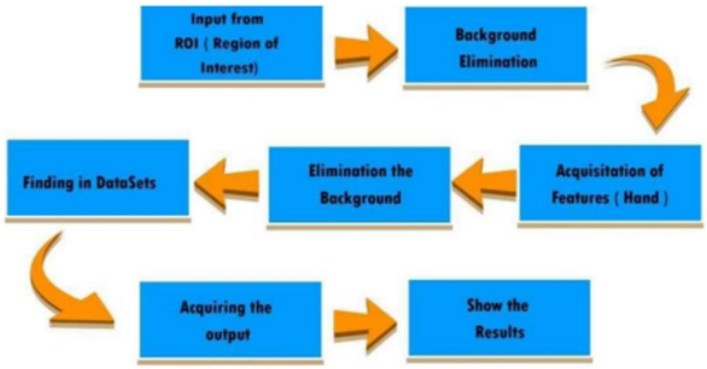


Figure 2 – Process of Hand Gesture Recognition

SYSTEM DESIGN AND IMPLEMENTATION

Chapter - 4 1.1

Introduction We will see the systematic design of the work along with the detailed implementation of various modules which are the building blocks of this project. There are three modules in total and are explained below.

4.2 Module 1

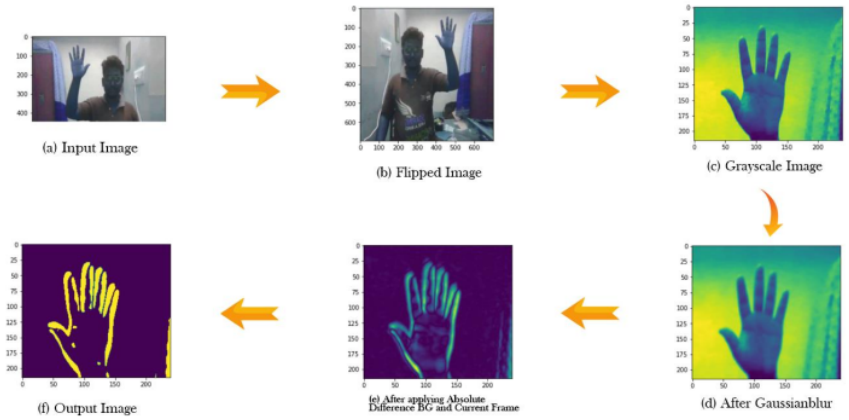
Module 1 is about building a CNN model which we use to predict the gestures. For that we use Keras (interface for TensorFlow) to build and train the model using a local database of images. This forms the basis of our work

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 98, 118, 32)       320

 max_pooling2d (MaxPooling2D  (None, 49, 59, 32)       0
 )

 flatten (Flatten)           (None, 92512)             0

 dense (Dense)               (None, 128)               11841664

 dropout (Dropout)           (None, 128)               0

 dropout_1 (Dropout)         (None, 128)               0

 dense_1 (Dense)             (None, 64)                8256

 dense_2 (Dense)             (None, 32)                2080

 dropout_2 (Dropout)         (None, 32)                0

 dense_3 (Dense)             (None, 6)                 198

=================================================================
Total params: 11,852,518
Trainable params: 11,852,518
Non-trainable params: 0
_________________________________________________________________
None
```

Figure: Keras Model

4.3 Module 2

Our second module is about predicting the gesture through live video feed. The web camera is used to take real time input from the user. From that input we predict the gestures by the users 8 by using the trained model. We used OpenCV for the purpose of image and video processing. NumPy is used to make images as array for further computations and lastly TensorFlow keras to predict the gesture. The below image shows various steps of processing. It includes converting the image into grayscale followed by the Gaussian blur. Then we find the absolute difference between the background and the current frame which gives the output image.



4.4 Module 3

This is the final module of the work. This module is about assigning a specified task for a particular predicted gesture. It actually controls the devices using the gestures. So, we use PyAutoGUI for controlling devices like mouse and keyboard. Finally, the system is made to do some desired tasks in response to the gestures.

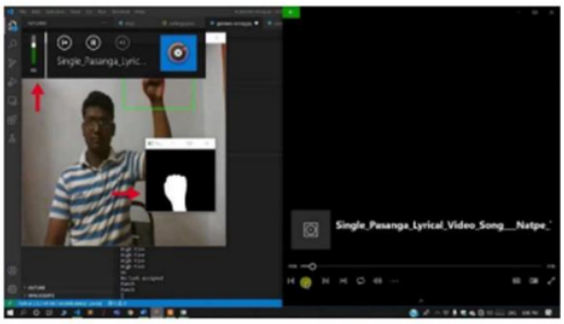


Figure 4 – Get live prediction

4.5 Summary

To Summarise, the whole work is divided into three modules, each for a specific purpose. The first part is to train the model for prediction for which we use keras. The next part deals with getting the user input in real time. We use OpenCV for that. NumPy is also used for computational purposes. And finally, to make the system perform a specific task, we use PyAutoGUI and by doing so, we are able to control the devices.

PERFORMANCE ANALYSIS

Chapter - 5 5.1

Introduction Here we are going to analysis how our model was performing in the stream of hand gesture Recognition. Our model is using CNN and using Tensorflow for model training as giving the accuracy of 99% approximately.

Previous work accuracy:

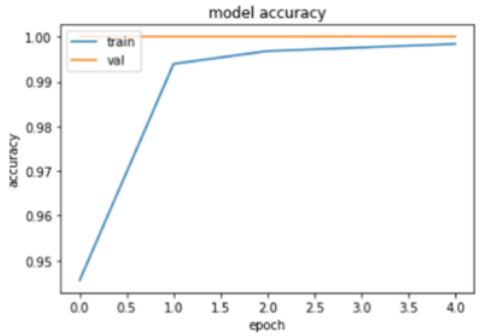
The table here shows some of the work related t hand gesture recognition problems,

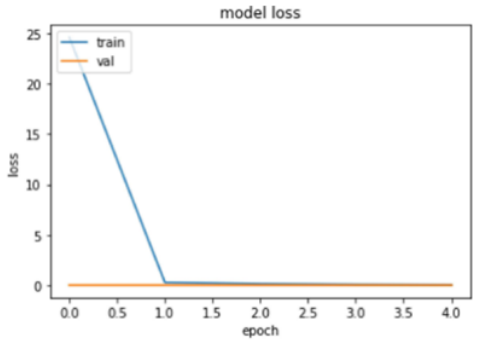
Other Works	Accuracy %
Hand Gesture Recognition Using micro-Doppler Signatures with Convolutional Neural Network [18]	85.6
Human hand gesture recognition using a convolution neural network[19]	95.96
Hand Gesture Recognition With 3D Convolutional Neural Networks[20]	77.5
Max-pooling convolutional neural networks for vision-based hand gesture recognition[21]	96
Dynamic hand gesture recognition based on short-term sampling neural networks[22]	95.73
Dynamic hand gesture recognition based on short-term sampling neural networks[23]	94.04
CNN+RNN Depth and Skeleton based Dynamic Hand Gesture Recognition[24]	85.46
Hand Gesture Recognition Using Convolutional Neural Network[25]	90.12

Here we are providing the chart that shows how our model was performing while training.

```
Epoch 1/5
197/197 [==============================] - 16s 43ms/step - loss: 24.5892 - a
ccuracy: 0.9456 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 2/5
197/197 [==============================] - 8s 40ms/step - loss: 0.2535 - acc
uracy: 0.9940 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 3/5
197/197 [==============================] - 8s 40ms/step - loss: 0.1321 - acc
uracy: 0.9968 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 4/5
197/197 [==============================] - 8s 40ms/step - loss: 0.0617 - acc
uracy: 0.9976 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
Epoch 5/5
197/197 [==============================] - 8s 39ms/step - loss: 0.0287 - acc
uracy: 0.9984 - val_loss: 0.0000e+00 - val_accuracy: 1.0000
```

Figure: Values of epoch and Training and Testing Accuracy





5.3 Summary

This is how our model was performing. Here we have included the Graph, Table and Charts, our model has reached the accuracy as 0.9984999895095825 that is approximately 99% you can see the results.

FUTURE ENHANCEMENT AND CONCLUSION

Chapter - 6 6.1

Introduction The following part discusses the enhancements that can be made to the system in the future. Hand gesture recognition is inevitable in this modern age of communication. Here we propose some of the limitations that exist and a new way of overcoming those limitations

6.2 Limitation/Constraints of the System

It is very difficult to build a system for hand gesture with higher efficiency. Because it involves lot of computations. In many applications, hands only occupy about 10% of the image, whereas the most of it contains background, human face, and human body. So, we need to perform image segmentation and background elimination at real time. This is a constraint of the system.

6.3 Future Enhancements

In order to eliminate the limitation of the system, we can train the model with images thatcontain some noise in the background. In other words, we can train the model with images with the

background. The training dataset should be a combination of images with and without background. By this way we can build a robust model that performs less computations.

6.4 Conclusion

To conclude, we can eliminate the existing problem in the system by adding some images to the dataset that contain different background. Thereby a robust model is built with a reasonable accuracy and involving less computations.

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DYNAMIC HAND GESTURE RECOGNITION

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