Facial Emotion Recognition Using Keras and CNN

Aakash Maurya
Department Of Computer Science and Engineering
Student at Galgotias University
Greater Noida, UP, India
aakashm8009@gmail.com

Dr. Vandana Sharma
Department Of Computer Science and Engineering
Professor at Galgotias University
Greater Noida, UP, India
vandana.sharma@galgotiasuniversity.edu.in

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***Abstract*— Deep Learning is penetrating most of the recognition and classification tasks performed through a computer or machine. Human facial emotion recognition plays an important and vital role in the interpersonal relationship. Deep learning (DL) based emotion detection gives much better and exact results than traditional methods with image processing. It has been recognized for a many year and it is a vital topic in the fields of computer vision and machine learning. Artificial Intelligence (AI) system is capable to emotion discovery through facial expressions. By using Neural Network classifier training, five kinds of different emotional orders are attained from pics. Through this we proposed a Computer Vision (CV) based deep learning architecture for emotion detection from images. We collect the datasets from social media platforms and various websites. In this dataset, data will be presented in the form of image type with some facial expressions. The performance of the proposed method is evaluated using datasets for restaurants which are collected from different social media platforms and websites. Our aim is to understand the emotions of different people through their expressions.**

Keywords— Neutral Network, Keras, Deep Learning, Face Emotion Detection, CNN.

I. INTRODUCTION

Human face is the important part of the individual's body and if you want to know the behavior of human body and also if you want to recognize the emotion of an person then human face plays a very important role in that. We can classify the human emotions into different types. Despite their busy schedule, they may try to do something different. For example, suppose a person sees that his face is happy then he will try to be become happier. On the other hand, if anyone sees that his face is sad then he will improve his attitude. Deep learning plays a very important role in detecting the face emotions. Face expressions is a very important factor in detecting the human emotions. Facial expression is the most important application of image processing. Presently, a huge research work done on the field of image processing [1][12][17]. Facial image-based emotion detection techniques provide a fast and useful result for emotion detection. The process of recognizing the expression of feelings through facial emotion was an interesting object. After 1960 face recognition topic became more popular, when a list of universal emotion was established. As a result, persons will try to improve this image-based emotion recognition in different – different ways. There are basically five emotions for human beings. These are neutral, happy, sad, angry and surprise. From face expression we can detect these emotions. In this project we will propose a model to recognize neutral, sad, happy, angry and surprise these five emotions from frontal facial emotions. Here we will use CNN algorithm approach with keras [3][13] because it gives the maximum accuracy in compare to other algorithms. In this paper we are doing the performance analysis on our dataset.

II. LITERATURE REVIEW

Firstly Charles Darwin contributed the theory about the face emotions [2] [11] like he had explained about the various emotions like Happy, Sad, Anger, Hatred, etc. He had also given the theory that emotions are not only in humans but also found in other species like Cats, Horses, Dogs, etc. Facial emotions are detected through the images using the Deep CNN which makes the accuracy high and this directly implies that deep learning is best for recognition of emotions through the facial expressions. Previously many CNN models are trained to detect the facial emotion of humans.

Different range of CNN, modelled and trained for facial emotion recognition through expressions are evaluated in (A. M. Badshaah, J. Ahmed and S. W. Baek, 2017). FER is drawing its own importance in the research field. Facial emotion recognition is inspected and analyzed on all research areas (A. Routrey, M. Swaen and P Kabisetpathy, 2018). Emotions are recognized from facial images using filter banks and Deep CNN (K.-Y. Hueng et al., 2016), this leads to high accuracy rate which implies that deep learning can also be used for facial expression detection.

We can do face emotion detection in three steps firstly the registration of image and after that extraction of feature from the images and in last we can detect the emotion of the face through the expression as shown in [Fig 1]. In research field face emotion detection has its own importance.

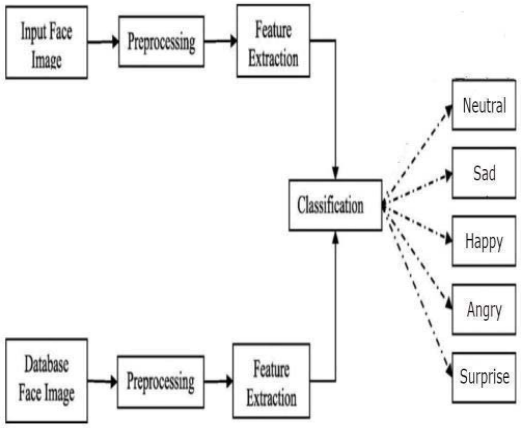

Fig. 1. Face Recognition Architecture

III. METHODOLOGY

CONVOLUTIONAL NEURAL NETWORK(CNN)

In this paper, we used CNN algorithm and keras. Convolutional Neural Network (CNN) is one of the technique/algorithm to do image classification and image recognition in neural networks. This is designed to process the data through multiple layers of arrays [4][14][19]. This type of network used in applications, for example face recognition, etc.

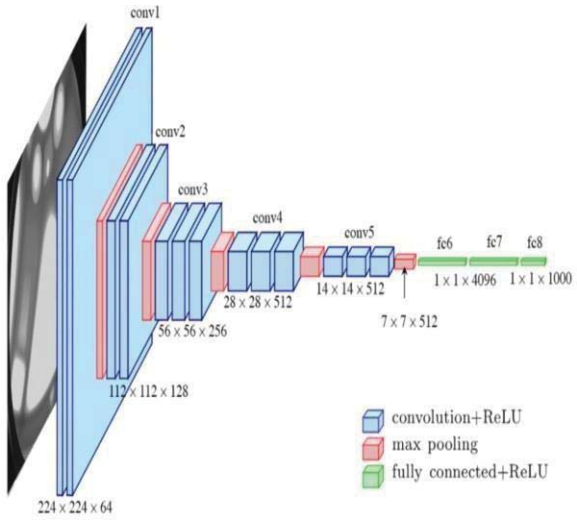

Fig. 2. CNN Architecture [23]

CNN technique uses four layers to complete the process.

1. Convolutional
2. ReLU
3. Pooling
4. Fully Connected

First layer is the convolutional layer as shown in [Fig 2] which uses to derive the features from the image. In this the input data is taken in the form of small squares [17] i.e. in the form of matrix. Next layer is Rectified Linear layer in this there is a function name ReLU and the functions output is zero when the input value is below zero and when input is above the threshold value the linear relationship is formed [5] [20] .

$F(x) = 0$ if $x<0$ & x if $x>= 0$ (ReLU function)

Now the third layer is the pooling layer it plays a very important role in pre – processing of the images. Pooling is small down the image (downscaling) received from the previous layers, we are using the maxPooling (sample-based discretization process) as well as the average pooling (computing the average values of each region).

In the last step that is fully connected layer or dense layer, in this layer the inputs from previous layers will be depressed in to the vectors and the final classification happens here.

CNN technique is the best technique to achieve maximum accuracy in face emotion recognition because CNN automatically detects the important features of images without any supervisions. And we are using keras because it fully supports convolutional neural networks and keras runs excellent on CPU as well GPU.

IV. BUILDING THE CONVOLUTIONAL NEURAL NETWORK MODEL

Here we are creating a CNN model through the convolutional layer and fully controlled layer. Our CNN model is using 25 epochs. Let see the [Table 1] of structure of CNN model with parameters.

TABLE I. STRUCTURE OF CNN MODEL

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 48, 48, 32)	320
activation (Activation)	(None, 48, 48, 32)	0
batch_normalization (BatchNo	(None, 48, 48, 32)	128
conv2d_1 (Conv2D)	(None, 48, 48, 32)	9248
activation_1 (Activation)	(None, 48, 48, 32)	0
batch_normalization_1 (Batch	(None, 48, 48, 32)	128
max_pooling2d (MaxPooling2D)	(None, 24, 24, 32)	0
dropout (Dropout)	(None, 24, 24, 32)	0
conv2d_2 (Conv2D)	(None, 24, 24, 64)	18496
activation_2 (Activation)	(None, 24, 24, 64)	0
batch_normalization_2 (Batch	(None, 24, 24, 64)	256
conv2d_3 (Conv2D)	(None, 24, 24, 64)	36928
activation_3 (Activation)	(None, 24, 24, 64)	0
batch_normalization_3 (Batch	(None, 24, 24, 64)	256
max_pooling2d_1 (MaxPooling2	(None, 12, 12, 64)	0
dropout_1 (Dropout)	(None, 12, 12, 64)	0
conv2d_4 (Conv2D)	(None, 12, 12, 128)	73856
activation_4 (Activation)	(None, 12, 12, 128)	0
batch_normalization_4 (Batch	(None, 12, 12, 128)	512
conv2d_5 (Conv2D)	(None, 12, 12, 128)	147584
activation_5 (Activation)	(None, 12, 12, 128)	0
batch_normalization_5 (Batch	(None, 12, 12, 128)	512
max_pooling2d_2 (MaxPooling2	(None, 6, 6, 128)	0
dropout_2 (Dropout)	(None, 6, 6, 128)	0
conv2d_6 (Conv2D)	(None, 6, 6, 256)	295168
activation_6 (Activation)	(None, 6, 6, 256)	0
batch_normalization_6 (Batch	(None, 6, 6, 256)	1024
conv2d_7 (Conv2D)	(None, 6, 6, 256)	590080
activation_7 (Activation)	(None, 6, 6, 256)	0
batch_normalization_7 (Batch	(None, 6, 6, 256)	1024
max_pooling2d_3 (MaxPooling2	(None, 3, 3, 256)	0
dropout_3 (Dropout)	(None, 3, 3, 256)	0
flatten (Flatten)	(None, 2304)	0
dense (Dense)	(None, 64)	147520
activation_8 (Activation)	(None, 64)	0
batch_normalization_8 (Batch	(None, 64)	256
dropout_4 (Dropout)	(None, 64)	0
dense_1 (Dense)	(None, 64)	4160
activation_9 (Activation)	(None, 64)	0
batch_normalization_9 (Batch	(None, 64)	256
dropout_5 (Dropout)	(None, 64)	0
dense_2 (Dense)	(None, 5)	325
activation_10 (Activation)	(None, 5)	0

Total params: 1,328,037
Trainable params: 1,325,861

V. IMPLEMENTATION

A. Importing the necessary libraries/module

We are importing the necessary libraries/modules/functions like importing the load_model function from model class, from time module we are importing the sleep() function, from preprocessing image model importing the img_to_array() function, from keras preprocessing model importing the image() function, importing the cv2 library and at last we are importing the numpy library [6][15].

B. Building validation and training batches

For making the trained model, training batches as well as validation batches are generated through the face emotion recognition dataset which have size of 48*48. In this phase firstly we are declaring the path of training dataset and validation dataset. In ImageDataGenerator() class by setting the values of attributes rescale as 1/255, rotation_range as 30%, shear_range as 30%, zoom_range as 30%, width_shift_range as 40%, height_shift_range as 40%, horizontal_flip value as true and fill_mode as nearest we are generating the 8 images from the 1 image to increase the accuracy of model after this we are scaling down the image[9][18]. After that we are using the flow_from_directory function and setting the values for attributes color_mode as grayscale, target_size as 48*48, batch_size as 32, class_mode as categotical and shuffle as true and same process we are doing for validating dataset.

C. Convolutional layer and dense layer model

In training, image will proceed layer by layer so that firstly it will able to extract features in some layers and will able to classify between different emotions in some layers so that at last it will able to memorize the different emotions. For this we are adding Convolutional2D layer in our model with attributes kernel_size as 32, stride as 3*3, padding as same, kernel_initializer as he_normal, input_shape as (48,48,1), next we are using the elu activation function which will help to set the threshold value so that it will help in deciding the final emotion if our model is confused between two emotions, next we are adding BatchNormalization() [7][21] function to our modelso that it will helps in improve speed and performance, and next we are using the MaxPooling2D() function so that it will help in deciding the important features of image so that feature will forwarded to next layer of our model, in last we are using the Dropout() function.

D. Starting the training

For starting the training datasets firstly we are setting the some checkpoints using ModelCheckpoint() function [16], after that using the compile() function we are printing the summary of our model, in last step of training by using the fit_generator() function we are starting the training with value of attribute steps_per_epoch as 24176//32, epochs as 25, validation_data as validation_generator and validation_steps as 3006//25.

E. Emotion Detection

This is the last phase, in this phase we will finally detect our emotion through the expression. In this step firstly we are defining the class_labels as [Angry, Happy, Neutral, Sad and Surprise] after this we are using the function VideoCapture() with the parameter value as 0 [8][22] because we are using the internal camera, after that we are creating the blue colored rectangle box using the function rectangle() with parameter thickness as 2, color as (255,0,0), after that we are using the putText(),imshow(), release() and destroyAllWindows() function, finally our system will show the emotion of face through expressions as shown in [Fig 3].

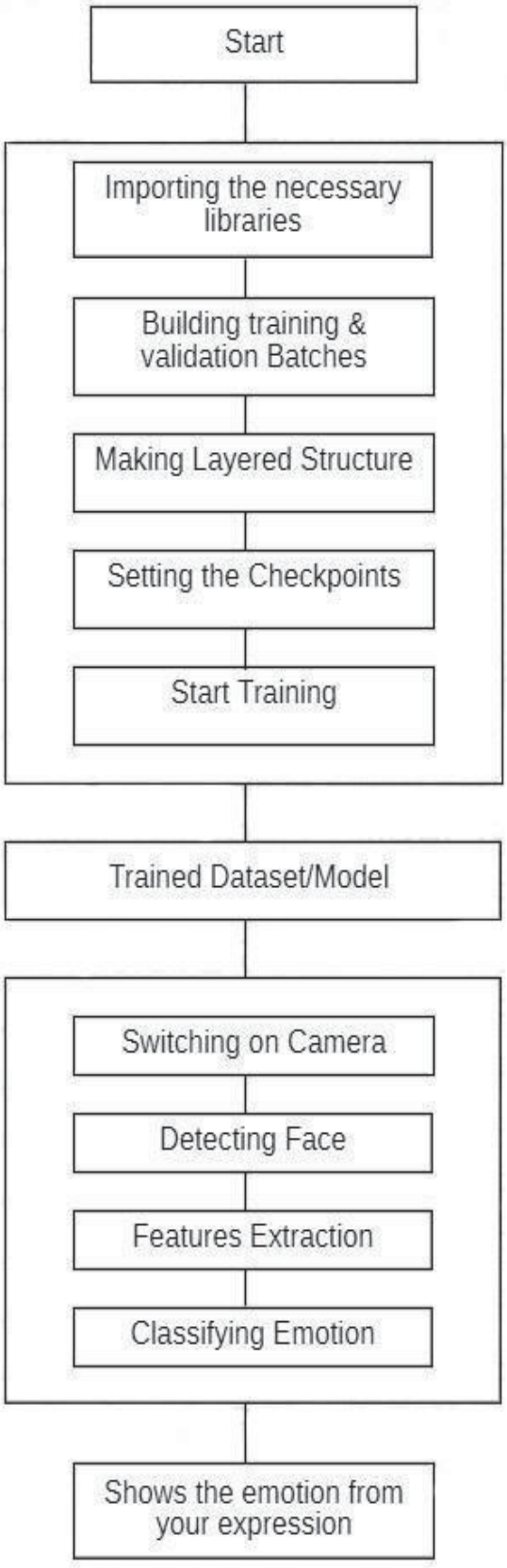

Fig. 3. Work Flow Diagram

VI. RESULT AND OUTPUT

Fig. 4. Output of our trained model

We have successfully implemented the project. Here we have taken approx 24176 grayscale images (dataset) of 48*48 sizes and successfully validated and trained the model , for training the model we have uses the classes like ImageDataGenerator(), etc. We have trained our convolutional neural network model successfully. We are creating the four convolutional layers and then controlled layer model. In training the dataset firstly we are importing the necessary modules and libraries like keras,etc. After that we are training the model using the ImageDataGenerator() class and number of epochs is 25.For capturing the image firstly we are import the cv2 library then we are using the function VideoCapture() with argument as 0. For activation we have uses the eLU function. The image dataset we have divided into two folders named as train and test, and these folders are having the subfolders containing one type of emotion from the five emotions (Happy, Sad, Anger, Surprise, Neutral).

VII. APPLICATIONS

Face emotion detection has already a very important research topic and it has its own importance. Emotions are the change in the feeling that may results in change of your behavior or may be any psychological changes [10]. Face emotions tells about the mood of a person that going through in real – time. There are many real world applications of face emotions recognitions are there, some of them are given below:-

- In Monitoring of Old Age Person Health. – Some times emotion detection plays a very important role in counseling the old age persons.
- In testing of video games – In testing of video games face emotion recognition plays a very important role , we can take feedbacks from his emotions that he is happy or not after using our this video game.
- In mood detecting devices – Sometimes at the time of making the mood detecting device Face emotion recognition is used to detect the emotion of the human being.
- For lie detection – Face emotion recognition helps in the lie detection like if a person is lying then its face expression will be of fear then we can detect the emotion of fear from its face.
- In autonomous cars – To understand the driving experience of a customers, in future the autonomous cars have many sensors for monitoring the experience of customers.
- For security purposes – Face emotion recognition sometimes uses for security purposes like someone having the suspicious behavior then we can detectit through from his emotions.
- In recruiting – To understand the credibility of a candidate sometime face / face emotion recognition is used in softwares.

VIII. CONCLUSION

We have uses the approach of convolution neural network with keras for face emotion recognition. Approx we have trained 24176 images samples and validated 3006 images sample. As we have uses the dataset image of 48*48 sizes (grayscale). Our designed model is successfully validated as

we can see that our model can easily detect the different - different facial emotions like neutral, happy, sad, angry and surprise. The results we have achieved through our trained model are satisfactory. In output our face are bounded by a box which have blue borders and the face emotion are shown as per the human expression as shown in [Fig 4]. Our model is set to 25 epochs and after the training its accuracy is about 69%.We can increase the accuracy of model or wecan say that we can make a better trained model through increasing the number of epochs up to a limit but we can't make the accuracy exactly 100%.

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