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Identification of Emotion from Facial Expression Using Deep Learning

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ABSTRACT

Automatic emotion recognition and classification is an interesting research field which has many applications. Facial expression plays important role during communication which conveys emotional state of an individual. The present project focuses on identification and classification of facial emotion from facial expression using deep learning with convolutional neural network and vgg16 model. The aim of this project is to study the classification of emotion from facial expression with supervised learning by using deep learning. The VGG16 which was pre-trained on Image Net via transfer learning method. The emotion dataset in this study consists of 250 images which has three emotions such as Angry, Happy and Neutral and are used for training, testing and validation purpose. The accuracy achieved using this model is 94 %.

Keywords: Emotion recognition, Facial expression, deep learning, Convolutional neural network(CNN),VGG16.

I. INTRODUCTION

A Facial expression can be defined as "A Facial expression is a one or more motionsor positions of muscles beneath the skin of the face". Facial expression is primary mean ofconveying social information between the humans but they also occur in most of the mammalsand some species of animals. Human can change and adopt facial expression voluntarily andinvoluntarily [1].

Facial expression is one of the most important areas having effective, natural anduniversal signals for human being to convey their emotional state and intentions. There are manyresearch been conducted in this area where recognition, identification and classification of facialemotion based on facial expression has been done using different Machine learning and deeplearning techniques[2].

Emotion is very important aspect of human communication which plays a crucial role whenit comes to describe emotion behind any speech system. Emotions are basically divided intoseven categories such as Anger, Happiness, Neutral, Disgust, Surprise, Fear and Sadness [3].

Facial emotions can be positive and negative. Positive emotions represent healthy mentalstates such as Happy, Pleasure, etc. and negative emotions represent unhealthy mental state bycarrying Angry or Sad facial expressions. Therefore both positive and negative emotions closelyaffects the emotional health of an individual in day-to-day life[4].

Human emotions are an inevitable part of interpersonal communication which can be expressed in many forms [5].

When it comes to forensic science, facial expression can be applied in the field ofBiometrics, Human-Computer Interaction (HCI), Forensic Psychology, Pattern Recognition,Criminal Profiling, Tampered videos, Forgery detection in face forensics and related fields offorensics.

A. VGG16 Model :

VGG16 is Visual Geometry Group model and it was proposed by Karen Simonyan and Andrew Zisserman of the Visual Geometry Group Lab of Oxford University in 2014 in the paper "VERY DEEP CONVOLUTIONAL NETWORKS FOR LARGE-SCALE IMAGERECOGNITION".

This model has used on ImageNet dataset which consists of 14 million images belonging to 1000 classes. And the model achieved 92.7 % top-5 test accuracy on it. The Image net dataset which was used in this model contains fixed size of images 224*224 and have RGB channel. VGG16 is a convolutional neural network(CNN) architecture which was used to win ImageNet competition in 2014. It is considered as one of the excellent vision model architecture till the date.

B. Image Processing and pattern recognition:

An image may be defined as a two dimensional function, f(x, y), where x and y are spatial coordinates and the amplitude of at any pair of coordinates (x,y) is called intensity or grey level of image at the point. When this all values are finite, discrete quantities, then this image is calledas a digital image. The field of digital image processing refers to processing digital image by means of digital computer.

Pattern recognition is a scientific discipline whose goal is his classification of objects intonumber of categories or classes". Pattern recognition is an integral part of most machineintelligence systems built for decision making.Machine vision is an area in which pattern recognition is of importance. A machine visionsystem captures image via a camera and analyses them to produce descriptions of what is
imaged [7].

II. METHODS AND MATERIAL

The present research focuses on identification of emotion from facial expressions using deep learning algorithm with VGG16 model and CNN Classifier for testing/ Identification purpose. In Current research project, digital images dataset of three basic emotions (Angry, Happy and Neutral) has been created and used by using deep learning i.e. a simple CNN multiimage classifier.

The database of digital images with three basic facial expressions Angry, Happy and Neutral were collected from B.Sc. -III and M.Sc. II year students of GIFS, Aurangabad using Samsung Galaxy A31 Smartphone in controlled environment with properlight and seating arrangement. Three folders named Angry, Happy and Neutral were made. Each emotion folder containing 54 images.All these folder were stored in single folder named "Project Database" for easy execution of code. From total 18 subject images were collected, for each single emotion there are three images were captured from 18 subjects. And all these images were cropped manually to acquire the region of interest. Therefore total 162 images were collected, cropped and all the samples were used for further processing.

A. Plan of work

B. Pre-Processing Database :

Once the database was collected pre-processing was done. In pre-processing step, various emotions images were manually cropped by removing unnecessary area in an image. Unnecessary area contains uneven edges of an image and extra background contained in the image. After pre-processing, the images containing only the facial area has been selected and the images were prepared for further processing.

C. Loading Dataset Into CNN And VGG16 Model:

Once pre-processing is being done, according to different facial expression dataset was divided into three datasets such as training, validation and testing dataset. And then the datasetwere loaded into CNN and VGG16 model.

D. Creating Weight/Features With VGG16 For Train, Validation And Test Data:

Once the dataset were loaded into CNN and VGG16 model feature extraction was done. In this step we defined dimenions of image depending upon image size. Then bottleneck file system was created, which will be used to convert all image pixels into their number (numpy array) correspondent and store it in our storage system. Finally, we defined the epoch and batch sizes for our machine. For neural networks, this is a key step.

E. Loading Extracted Features of Training, Validation & Testing Data:

Before doing this step we imported transfer learning model vgg16. In this step whatever bottleneck files have created and saved for training, validation and testing that has loaded and prepared for convolutional neural network.

F. Creation Of Our Model :

First step is to initialize the model with Sequential(). After that we flatten our data and add our additional 3 (or more) hidden layers. This step is fully customizable to what we want. This is a labeled categorical classification. Then after we have created and compiled our model, we fit our training and validation data to it. Finally, we create an evaluation step, to check for the accuracy of our model.

III. RESULTS AND DISCUSSION

The present research focused on identification of emotion from facial expression using deep learning. The dataset was created by capturing images of fellow students of cyber department as well as other departments. By applying CNN and VGG16 model extracted bottleneck features and stored bottleneck files for training, validation and testing data and loaded bottleneck files in model. CNN is used in this model. Then model was trained and accuracy is compared with different dataset division. We have used 250 image samples of Angry, Happy and Neutral of which and 60% were used for training purpose and 20% samples were used for validation purpose and 20 % for testing purpose.

TABLE I: RESULT ACHIEVED

Sr. No.	Model Dataset	Accuracy Rate in (%)
1	Training images : 60% Validation images : 20% Testing images :20 %	94.00 %

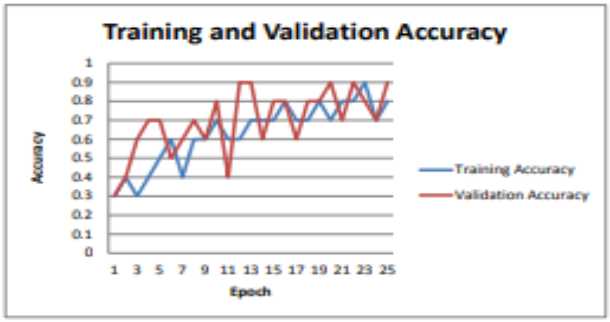

Fig. 1 Training and Validation Accuracy

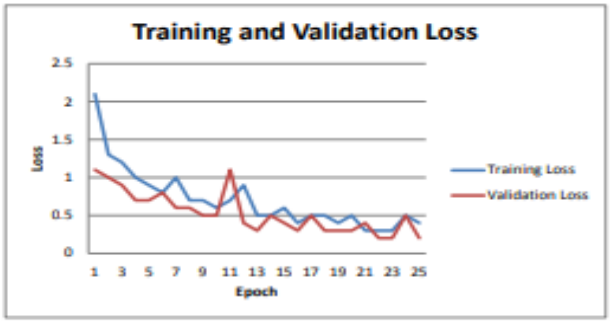

Fig. 2 Training and Validation Loss

IV. CONCLUSION

In order to apply deep leaning the CNN and VGG16 model is used for identification and classification of emotions such as Angry, Happy and Neutral. The CNN Classifier algorithm isused in this model. In which the training and validation accuracy has analysed and concludedthat the model has good accuracy for emotion identification and classification from facialexpression. And this model has achieved 94 % accuracy.

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