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Facial Emotion Recognition

[1]Manisha R Rao, [2]Arvind R, [3]Ancita Maria Andrade, [4]J Mohan, [5]Ayush KamalAnand, [6]Dr. Prabhudev Jagadeesh
[1]UG Student, Department of Computer Science and Engineering, Jyothy Institute of Technology (JIT), Bangalore, Karnataka, India
[2,4,5]UG Students, [6]Professor & Former Head, Department of Computer Science and Engineering, JSSATE, Bangalore, Karnataka, India
[3]UG Student, Department of Computer Science and Engineering, NMAM Institute of Technology, Nitte, Karnataka, India
***Email:**[1]mannu.r.rao@gmail.com, [2]arvindravishankar99@gmail.com, [3]ancitaandrade@gmail.com, [4]jmohanjagadeesh@gmail.com, [5]ayush95045@gmail.com, [6]prabhu.jagadeesh@gmail.com*
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Abstract
Emotion is a complex conscious that humans experience as a result of interactions with the environment. The project basically takes in the image, recognises the emotion by fragmenting the image with the deep learning technique using CNN. The tools and framework used here are keras and TensorFlow respectively. Here the facial feeling analysis refers to computing system that makes an attempt to mechanically analyse and recognise facial feeling and facial feature changes from visual data. The image being pre-processed helps for aiming a better quality of image and hence the emotion can be detected in a better way. This project can be used in many fields and one such field is mental health care centre. Patients with bipolar disorders should be treated by adhering the emotional behavior of patient and our project helps in doing the same.

***Keywords:** Deep Learning, CNN, Kaggle, Keras, TensorFlow, Facial Emotions.*

INTRODUCTION

An emotion is a mental and physiological state which is discretionary and private, it includes a lot of behavior, performance, and responsiveness.

Facial emotion recognition is a curious and a puzzling problem which has important applications in many areas like mental health care centre(i.e.,patients with bipolar disorder). BPAD(bipolar affective disorder) is a emotion disorder characterized by recurrent episodes of depressed or elevated mood and associated symptoms. It has three stages (Figure 1):

1. Face detection: which is one of the challenging and unsolved problem. Though the current algorithm we have done only for near-frontal faces.
2. Feature extraction: The output of face detection is employed for extracting face expression.
3. Facial expression recognition: FER systems are supported pure mathematics and look.

Emotion recognition is well a lot of sophisticated being that digit pictures are way more absolute than face pictures depiction numerous expression.

The convolutional network extracts higher features in a stratified set of layers, it takes large time in training, little time in practice. CNN were designed from the biologically driven models, so far the researchers found that how human(mammals) perceives an image into their brain into different layers and that's how the convolution neural network has

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designed. The concept of Convolutional Neural Network (CNN) was presented by YannLeCun et al.

TensorFlow is the second generation of artificial intelligence research and development system developed by Google, inturn assist Convolutional Neural Network (CNN), Recurrent Neural Network (RNN) and other deep neural network model. In this project we used TensorFlow library to train Convolutional Neural Networks. TensorFlow is a cross platform library of programming function for real time computer vision, we are using this concept for object identification, splitting up and recognising.

Many methods confide on extraction of the facial region. Convolutional networks, and the almost machine learning approaches, gain better accuracy leaning on a provided feature set.

The intended network have been computed on the kaggle. In this work, we uphold a clear resolution for facial expression recognition that utilize a combination of Convolutional Neural Network and distinct pre-processing steps. We employ few pre-processing techniques to root out only expression specific features from a face image and then explore the representation order of the samples in the time of training. To figure the performance of our models, we will be predominantly focusing at the accuracy. Results of investigating on these datasets evidence the success of using a deep layered neural network structure.

Literature Review

The basic idea of using CNN to develop a deep learning system that classifies human faces into 7 distinct human emotions came from a paper by Pham thai ha (2018) and they have used DenseNet for facial emotion recognition. Loosely based on that, we expand the idea to the field of vision which will be discussed in the upcoming sections.

There are works that used CNN for emotion recognition. Lopes et al (2015) created a 5 layer CNN which was trained on kaggle database for classifying 6 different classes of emotions. The main contribution of this review are as follows:

1.The focus is on providing a general understanding the state-of-the art FER approaches.

2. Here kaggle is introduced along with their purposes and characteristics.

3. A new direction and application for future FER studies are presented.

Methodology

Our team developed CNNs with variable depths to judge the performance of those models for facial feeling recognition. Here we have a tendency to thought-about the subsequent design in our investigation.This paper presents the methodology for distinct human facial feeling recognition mistreatment convolutional neural network.

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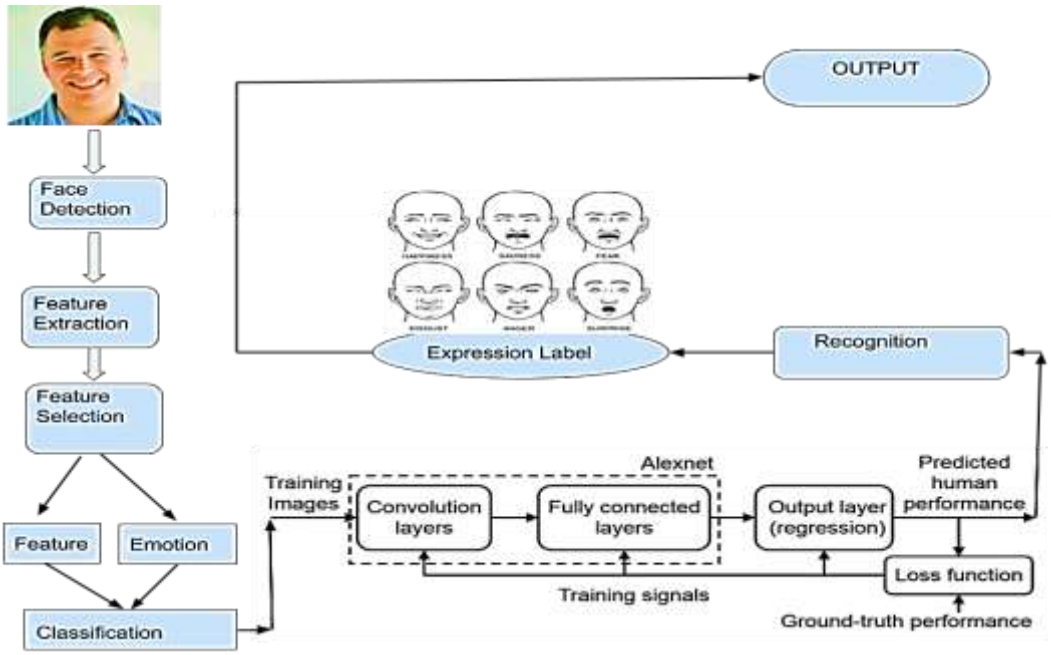

Fig: 1.*Architecture*

This methodology include

- **Face Detection:** Given a picture tells whether or not there's any external body part, if there's it detects.
- **Feature Extraction:** Facial feature extraction is that the method of extracting part options like eyes, nose, mouth, etc from external body part image. Facial feature extraction is incredibly a lot of vital for the initialisation of process techniques like facial feeling recognition.
- **Feature Selection:**
  Features: It detects facial features like eyes,nose,mouth, etc.
  Emotion: As face is a highly non-rigid object,It analysis facial features such as edge,intensity,shape of the detected face.
  Classification: Finally all the image set and every variety of sets with totally different feelings are going to be classified per these coaching motion are going to be known as a special emotion with the various name.Given any type of input image with various emotions, the system may identify the emotions individually & accurately.
- **Training Test**:The information is sometimes split into check and coaching data.Training pictures passes through the convolutional layers and absolutely connected convolutional layer.
- **Recognition:**It involves two task

1. **Face identification**: Given an image of a face that belongs to a person in a database,tells whether the face is there are not.
2. **Face verification**: Given a picture of a face which may not belong to the info,verifies whether or not the image is within the info.

- **Expression Label**: After recognizing the detected face the expressions are labelled in accordance.

Implementation

Machine learning is that the technology that makes the computers to act while not being expressly programmed. Instead the pcs are trained on talents like computer vision, language process, pattern recognitionetc. In our project we use facial emotion recognition capabilities by training it to recognize individual emotions through image processing. The database was created using a lot of preprocessing

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steps such spatial and intensity normalization of images. The dataset is having 2 folders consisting, images and emotions respectively. Convolution neural network is a subdomain of deep,feedforward artificial neural network which is mainly used for analyzing visual content. Our project mainly uses this architecture to implement the solution for the given emotion recognition problem.The initial phase is design phase.This phase includes face detection step. Given an image as input,the model tells, whether there is any human faces given in the image. The input is given as a .png image file. All the images given are of the same size with minimal reduced background noise i.e. the image should contain almost only the face. This task is to locate the face on each image, convert it to grayscale, crop it and save the image to the dataset**.** Once the face is detected then comes the feature extraction step. This includes facial features like eyes, nose, lips etc.

The classification and training of data is the next step to be followed. The data we use are usually split into test and training set. So we divide our data in a ratio of 0.67 for training set and 0.33 for validation set. The training set we use it to train our classification model and use the validation set to assess the performance of our model on generalization of its recognition capability to new and the kaggle dataset it has not been trained on.

In the project our team used a Convolution Neural network of 3 layers containing 2 convolution and one Max pooling layer.

```
number of instances:  35918
instance length:  2304
28709 train samples
3589 test samples
Epoch 1/5
512/512 [==============================] - 2425s 5s/step - loss: 1.6242 - acc: 0.3458
Epoch 2/5
512/512 [==============================] - 2434s 5s/step - loss: 1.2244 - acc: 0.5346
Epoch 3/5
512/512 [==============================] - 2435s 5s/step - loss: 1.0221 - acc: 0.6161
Epoch 4/5
512/512 [==============================] - 2425s 5s/step - loss: 0.8435 - acc: 0.6879
Epoch 5/5
512/512 [==============================] - 2420s 5s/step - loss: 0.6480 - acc: 0.7613
```

Fig: 2. *MATRIX*

Each CNN layer is having the activation function Relu, which is most commonly used. The last layer of CNN contains the softmax activation function. The softmax function is used for multiclass classification. Since we classify the emotions into 7 labels(Figure 3), this function is used. We have 5 epochs, each of 512 batch size. With this we are able to achieve the accuracy of 75-85%.

The result is a bar chart containing the amount of each emotion for the given input image.

RESULT

Results of the image emotion classification task in unseen faces can be observed in Figures 4,5,6.

The figure shows a comparison of the learned features between several emotions and both of our proposed models. The white areas as shown in figure correspond to the pixel values that activate a selected neuron in our model's last convolution layer. The selected nerve cell was perpetually chosen in accordance to the

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very best activation. The observation created is that the CNN learnt to urge activated by considering facial expression like the frown, the teeth, the eyebrows and also the widening of one's eyes, and also the every feature remains constant inside a similar category.These results obtained reassure that the CNN learned to interpret graspable human-like options, which has feeling recognition.

Some of these explicable results have helped us realise that many common mis-classification like persons with glasses being identifies as "angry". This happens attributable to the label "angry" is extremely activated once it believes an individual is displeased and thanks to the darker glass frames displeased options are confused.

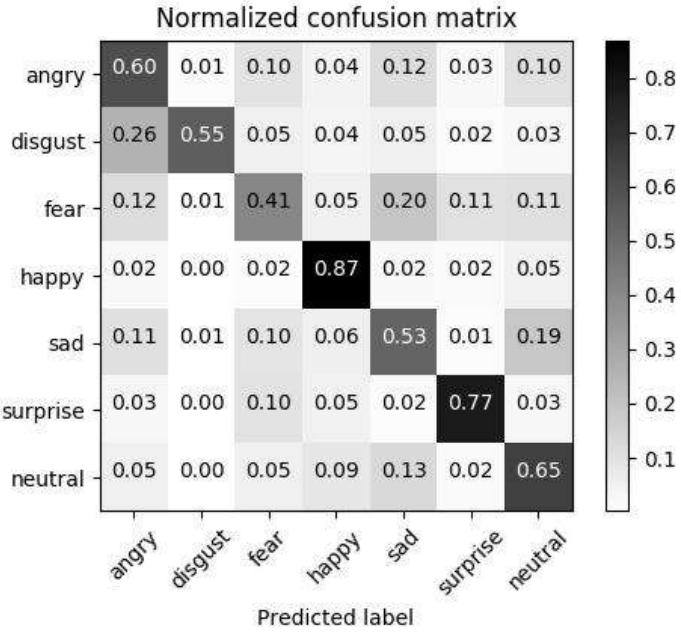

Fig:3.*Normalised confusion matrix*

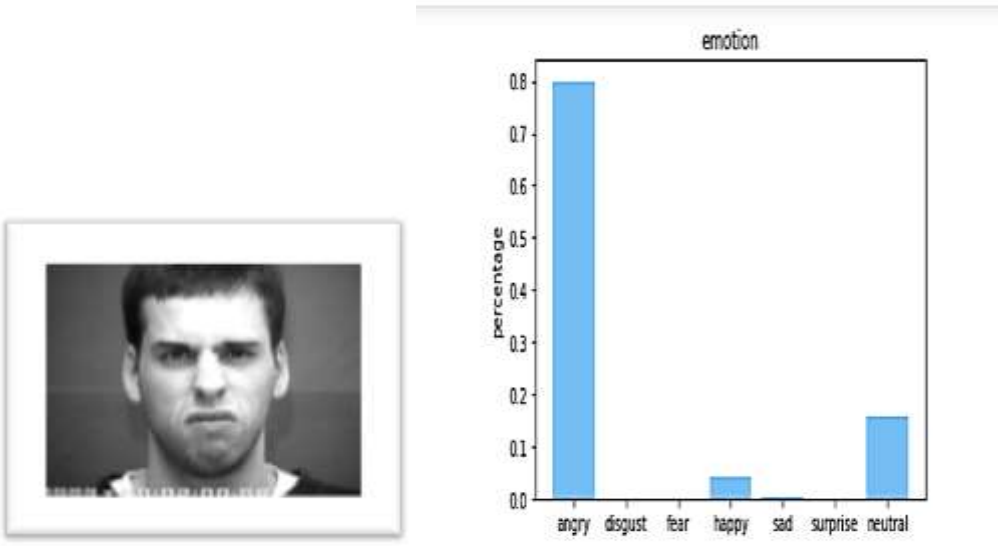

Fig:4.*Model and Graph*

This person seems to be angry. Our model has predicted it with the accuracy of approximately 79%.

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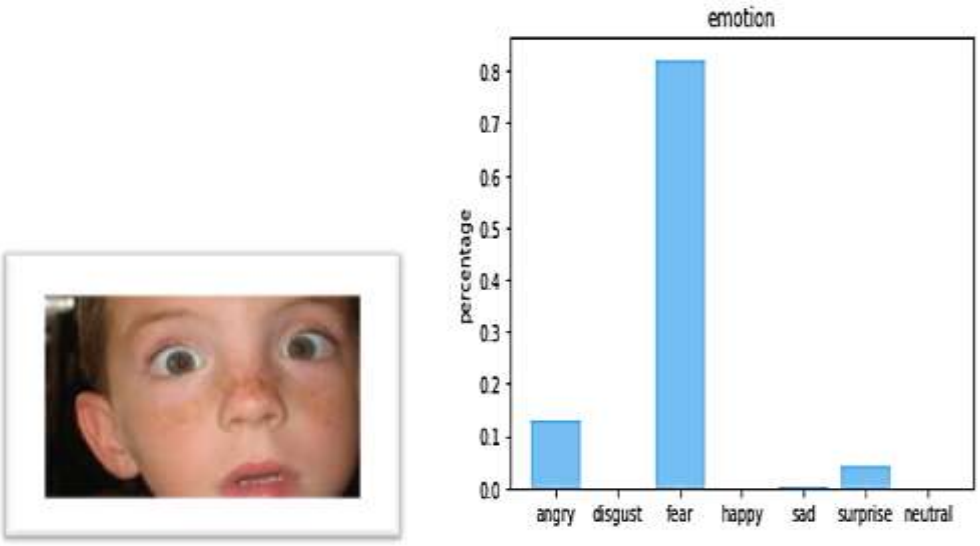

Fig:5.*Model and Graph*

The boy in the picture looks frightened due to some reasons. Our model was able to predict it with the accuracy of around 78%.

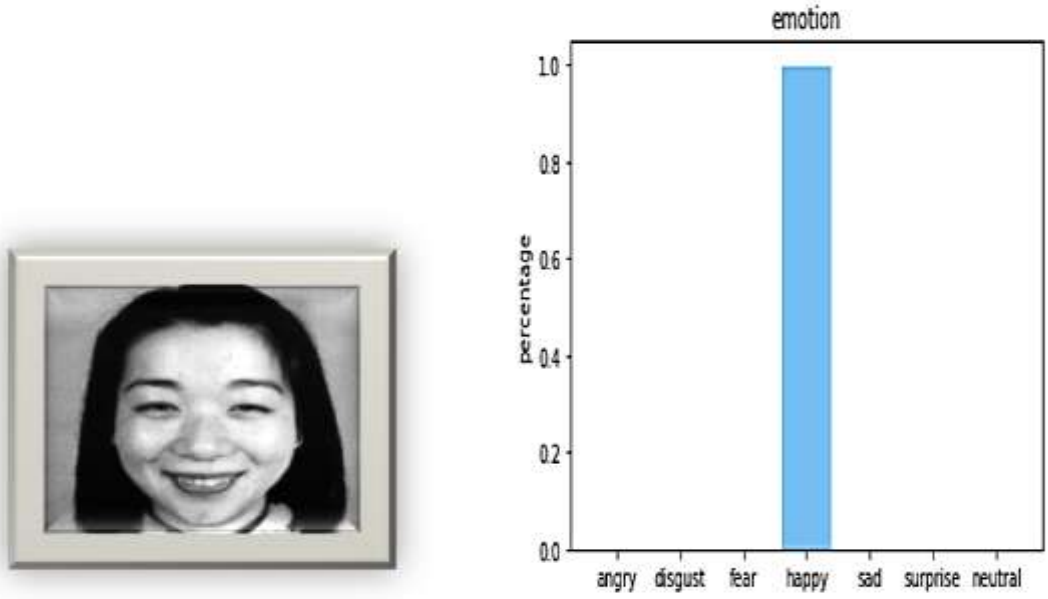

Fig:6.*Model and Graph*

The lady in the image can be seen very happy. Our model also find the same and predicated with the accuracy of around 98%.

CONCLUSION

Recent trends in automatic countenance analysis is diversity of countenance in an attempt to extend the amount of expressions area unit recognized.In the carried out experiment,we used tensorflow as tool for recognise 7 emotional states,we accomplished an excellent classification accuracy of emotions – 95% for different division of data and we got agreeable classification accuracy of -77%.

Machine learning models are biased in conformity to their coaching information.In our distinct proposal we

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have empirically found that our trainees CNNs for emotion classification are biased in the direction of disgust expression.We are engaged on real time feeling classification.

Beyond doubt, the classification accuracy was influenced by the manner users show specific expressions .In real condition the classification accuracy can be affected by many additional circumstance.When you feel real emotions,facial expression can vary incredibly- may be accessible to a greater or lesser extent.

To establish a correlation between feeling recognition ability and also the evolution of bipolar illness.We can use our working model with the real camera to detect the emotions of patients.The individuals with bipolar disorder have complexities in substantiating facial emotions, so we can carry out our model for this purpose.

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