FACIAL EMOTION DETECTION

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1. Abstract

Humans often have different moods and facial expressions changes accordingly. Human emotion recognition plays a very important role in social relations. The automatic recognition of emotions has been an active analysis topic from early eras. In this deep system user's emotions using its facial expression will be detected. Real time detection of the face and interpreting different facial expressions like happy, sad, angry, afraid, surprise, disgust, and neutral. Etc. An automatic facial expression Recognition system has to perform detection and site of faces during a cluttered scene, facial feature extraction, and facial expression classification. This system has ability to monitor people emotions, to discriminate between emotions and label them appropriately and use that emotion information to guide thinking and behavior of particular person.

2. Introduction

2.1 Background

The study of facial expressions comes back to Darwin's research on evolution of the species which it appeared as a shape of nonverbal communication. In his studies, the facial behavior was categorized into several groups. This type of communication is faster than verbal and it brought more advantages to the human species than others. Facial emotion stated as person's internal state, intentions and its feeling response to external stimulus. Emotions are an important property of humans and are essential for effective interactions among the society. Human communication can be either verbal of nonverbal, which it has been shown most of them refer to nonverbal communication. In nonverbal communication, emotion plays effective role because it conveys humans feeling about the subject, and in the psychology research it is proven that facial expressions are more effective then spoken word in conversation. Emotion recognition has intersection of several areas of computer science, cognitive science and psychology, and it can be carried out by several methods such as body language, voice. Information from facial expression distributed in different area of face and each of them has different information so that mouth and eyes include more

information that cheek and forehead. There were shown on several psychological studies which culture and environment can influence the impact of emotion and the way of expressing feeling for human beings. In many of these studies shown that gender, cultural background, age have bias in expressing emotion while there is not clear evidence on importance of environment for tendency the emotion. Emotion recognition methods can be divided into two main groups: First group work on static images and second one work on dynamic image sequences. In the static approaches, temporal information is not considered and they just use current image information, while in the dynamic approaches images temporal information used in order to recognize expressed emotion in frame sequences. Automatic emotion expression recognition includes three steps: face image acquisition, feature extraction, and facial emotion expression recognition.

2.2 Aim

The aim of this project is to detect up to five distinct facial emotions in real time. This project runs on top of a Convolutional Neural Network that is built with the help of Keras whose backend is TensorFlow in Python. This is a special type of deep learning technique that gives us the solution to many problems in facial emotion recognition after significant amount of training. The facial emotions that can be detected and classified by this system are Happy, Sad, Anger, Surprise and Neutral. We have used OpenCV for image processing tasks where we identify a face from a live webcam feed which is then processed and fed into the trained neural network for emotion detection.

2.3 Objectives

- To detect human face from a video
- To extract the expression
- To classify it into one of the following - happy, sad, angry, surprise and neutral expressions.

2.4 Scope

Planned approach towards working: - The working in the organization will be well planned and organized. The data i.e. Image will be stored properly in database stores which will help in retrieval of information as well as its storage.

b. Accuracy: - The level of accuracy in the proposed system will be higher. All operation would be done correctly and it ensures that whatever information is coming from the center is accurate.

c. Reliability: - The reliability of the proposed system will be high due to the above stated reasons. The reason for the increased reliability of the system is that now there would be proper storage of information.

d. No Redundancy: - In the proposed system utmost care would be that no information is repeated anywhere, in storage or otherwise. This would assure economic use of storage space and consistency in the data stored.

e. Immediate retrieval of information: - The main objective of proposed system is to provide for a quick and efficient detection of required information. Any type of detection would be available whenever the user requires.

f. Immediate storage of information: - In manual system there are many problems to store the largest amount of information for processing.

g. Easy to Operate: - The system should be easy to operate and should be such that it can be developed within a short period of time and fit in the limited budget of the user.

3. Project Resource Requirements

3.1 Software Requirements

Jupiter Notebook,

Python,

Browser (chrome, mozilla)

3.2 Hardware Requirements

Laptop with following specification:

For jupyter Notebook

1.6 GHz or faster

processor 1 GB of RAM

1GB of Disk + 0.5 CPU Core

4. LITERATURE REVIEW

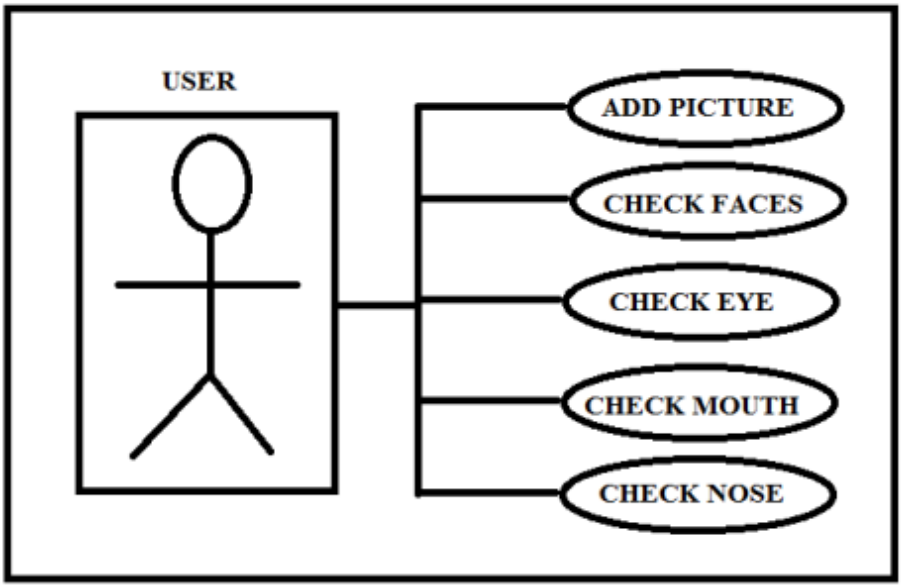
Author, Title , Journal, Name, Year	Technique	Advantages	Disadvantages
Emotion Recognition from Facial Expression using Deep Learning- Nithya Roopya. S, 2019. (IJEAT).	Kaggle's Facial Expression Recognition Challenge and Karolinska Directed Emotional Faces (KDEF) datasets were used , implemented using tensor-flow.	1) This paper presents application for the emotion in network teaching system. 2)Wearing glasses on the face area has no effect on emotion recognition	1) Distance between the camera and face will have an impact on an area of face recognition. 2) Regional impact of the human face effect the performance of emotion recognition like- Hear, Sitting postures, Light strength.

Automatic Emotion Recognition using Facial Expression :A Review-Monika Dubey, Prof. Lokesh Singh, Feb 2016 (IRJET).	Multi-modal deep learningis used for feature selection, image recognition. Segmentation, Pre-processing & feature extraction were used.	1) This paper introduced a novel architecture of the future interactive w. 2) Proposed technique is based an real time emotion recognition system.	1) Recognition rate differ with type of facial database used. 2) Need to improve performance of recognition and timing for real time application
		3) It can operate at over 15 frames per second.	
A Brief Review of Facial Emotion Recognition Based an Visual Information-Byoung Chul Ko. 25-01-2018 (MDPI).	Deep-Learning Based FER Approaches.	Outperform conventional approaches with an average of 72.65% to 63.2P.	Large scale dataset & massive computing power required, making it ill-suited for mobile platforms with limited resources.
Facial Expression Recognition, Yinli Tian, Jeffery F Cohn	Sequence Based Expression Recognition & Multimodal Expression Analysis.	Recognizes diversity of facial structures.	May not be suitable for real time application.
Facial Emotion Recognition: A Survey & Real World User Experiences in Mixed Reality, Dhwani Meta, Ahmed Y. Javaid. (MDPI)	Mixed Reality Device Microsoft Halo-lens is used for observing emotion recognition in Augmented Reality(AR)	Wide range of Output is produced thus removing the imitations of older versions	Requires complex De-bugging and Highly advance sensors. So it may not be suitable for everyday use.

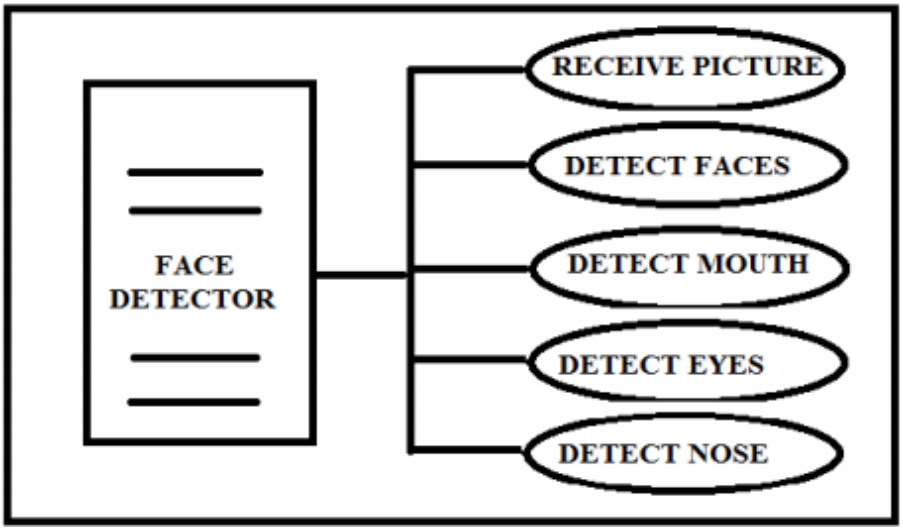
FACIAL EXPRESSION RECOGNITION USING ARTIFICIAL NEURAL NETWORKS	The expression recognition task is divided into two steps – an automatic facial feature extraction step, and a classification step that employs Multilayer Perceptron's and Radial Basis Function Networks. In this paper, we first automatically extract the facial features that are essential for discriminating between-facial expressions. This is an improvement over the-manual annotation method for Facial Characteristic Points	1) This paper presents application for the emotion in network teaching system. 2) Wearing glasses on the face area has no effect on emotion recognition. 3) Proposed technique is based on real time emotion recognition system.	1) Distance between the camera and face will have an impact on an area of face recognition. 2) Regional impact of the human face effect the performance of emotion recognition like Hear, Sitting postures, Light strength. 3) We also need to improve the accuracy of the contour estimation technique, because this is a crucial step for accurate facial expression recognition.
Fuzzy Emotion Recognition Using Semantic Facial Features and Knowledge-based Fuzzy	Our proposed research is creating fluffy feeling recognition structure as a speculation of blended feeling. Fluffy feeling recognition is the programmed feeling recognition from facial expression which consents to the standards of the rapists in examining feelings by zeroing in on changes in facial segments just as obliging the part of uncertainty and FRS.	Fuzzy terms use natural linguistic or language variables that are understood by humans in everyday life. Fuzzy linguistic variables have both quantitative and qualitative value; the quantitative value is a real value and the qualitative value is the linguistic value, e.g., low, medium, high.	Subsequently, the recognition emulates the manner in which an analyst examination feeling from a facial expression and facial part changes. The aftereffect of the testing utilizing own-made Indonesian Mixed Emotion Dataset (IMED) shows that the proposed framework acquired high exactness rate 88.519%, accuracy.

4.2 Use case Diagram

User Module:

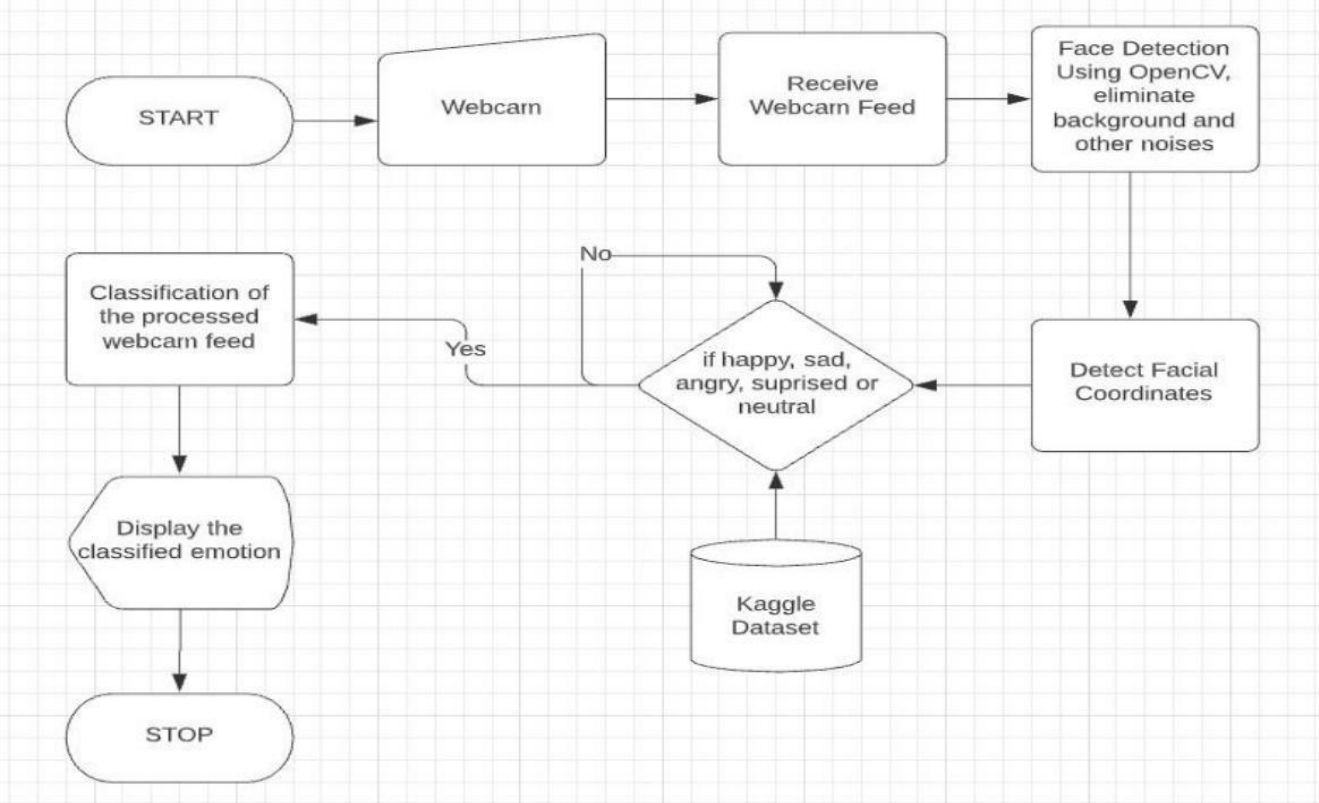


Software Module:



4.3 Proposed Method

Through this project we will build a facial recognition system that has ability to monitor people emotions, to discriminate between emotions and label them appropriately and use that emotion information to guide thinking and behavior of particular person. In our project, we have made considerable progress in developing automatic expression classifiers. Some expression recognition systems classify the face into a set of prototypical emotions such as happiness, sadness and anger. Others attempt to recognize the individual muscle movements that the face can produce in order to provide an objective description of the face. The best-known psychological framework for describing nearly the entirety of facial movements is the Facial Action Coding System. FACS is a system to classify human facial movements by their appearance on the face using Action Units. Moreover, there have been several developments in the techniques used for facial expression recognition: Bayesian Networks, Neural Networks and the multilevel Hidden Markov Model. Some of them contain drawbacks of recognition rate or timing. Usually, to achieve accurate recognition two or more techniques can be combined; then, features are extracted as needed. The success of each technique is dependent on pre-processing of the images because of illumination and feature extraction.



5. Implementation Details and User Manuals

5.1 Introduction

This project runs on top of a Convolutional Neural Network (CNN) that is built with the help of Keras whose backend is TensorFlow in Python. Thus, we have to install both the python libraries in our respective computers.

Next we need a platform to run our python code. We have taken spider environment to run the code.

Our project code setup consists of the following steps:

- Detection of face through webcam. We have used OpenCV for image processing tasks where we identify a face from a live webcam feed.

- Eliminating the background for better performance.

- Detection the facial coordinates and happy it in the datasets. The facial emotions that can be detected and classified by this system are Happy, Sad, Anger, Surprise and Neutral.

- An emoji of the matched emotion is displayed on the face.

. **FACE DETECTION STEPS:**

1. Pre-Processing: To reduce the variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.

2. Classification: Neural networks are implemented to classify the images as faces or non faces by training on these examples. We use both our implementation of the neural network and the MATLAB neural network toolbox for this task. Different network configurations are experimented with to optimize the results.

3.Localization: The trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various Feature of Face on which the work has done on:- Position Scale Orientation Illumination.

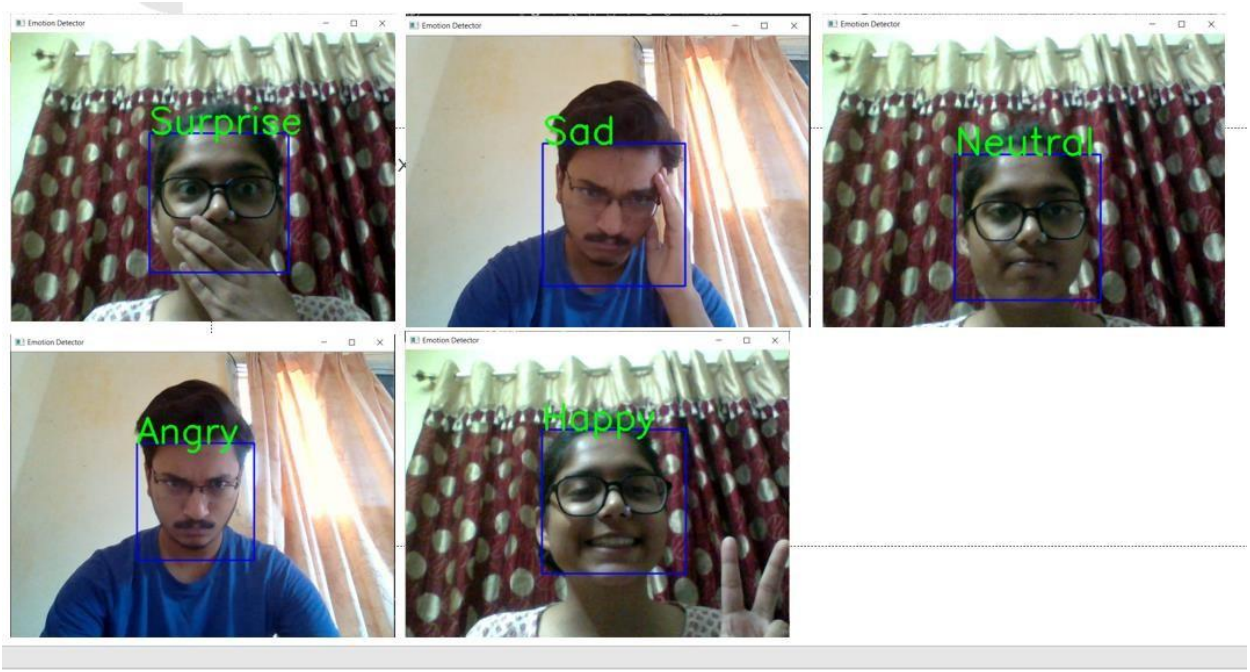
5.2 Dataset

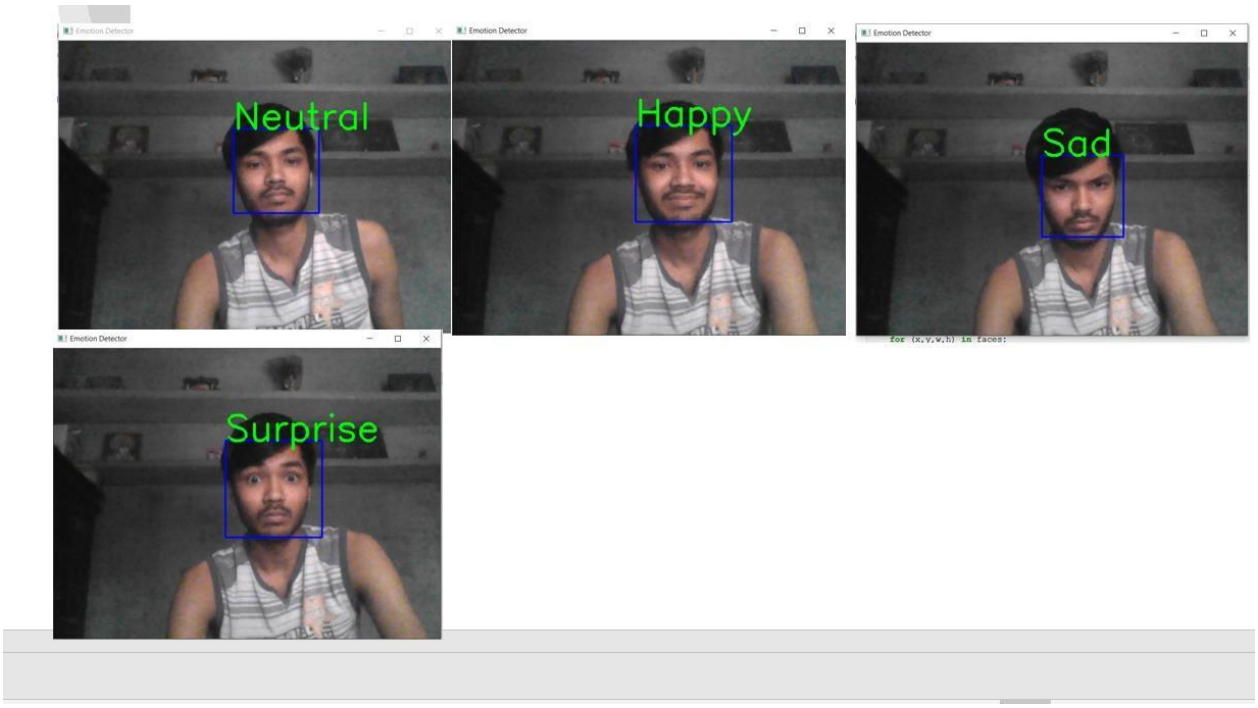
In this project, we used a dataset provided by Kaggle website, which consists of about 37,000 well-structured 48 × 48 pixel gray scale images of faces. The images are processed in such a way that the faces are almost centered and each face occupies about the same amount of space in each image.

Each image has to be categorized into one of the seven classes that express different facial emotions. These facial emotions have been categorized as: 0= Angry, 1=Happy, 2=Sad, 2=Surprise, and 4=Neutral.

In addition to the image class number (a number between 0 and 4), the given images are divided into three different sets which are training, validation, and test sets.

5.3 Results:





6. Conclusion and Future Work

6.1 Challenges

- The accuracy of the facial detection system will grossly depend on the number of images in the training dataset. As explained before, we have chosen Kaggle Dataset consisting of 28,709 training images. Therefore, we expect a fairly accurate result.
- The resolution of the camera used to extract the video of the user is also essential for the accuracy. Our project uses a webcam. Therefore, we have a pre-processing stage where the background noises will we removed to improve accuracy.
- Even an accurate facial emotion recognition may not give us an insight on the person's thought as sometimes they can be feigned.

6.2 conclusion

In this project user's emotions using its facial expression will be detected. Real-time detection of the face and interpreting different facial expressions like happy, sad, angry, surprise, and neutral etc.

An automatic facial expression Recognition system will perform detection and site of faces during a cluttered scene, facial feature extraction, and facial expression classification. It provides a proposed model to solve the problems of emotion recognition based on facial recognition in virtual learning environments, and the efficiency and accuracy are considered at the same time.

This system has ability to monitor people emotions, to discriminate between emotions and label them appropriately and use that emotion information to guide thinking and behavior of particular person.

6.3 Future work

The future of facial recognition technology is bright. Forecasters opine that this technology is expected to grow at a formidable rate and will generate huge revenues in the coming years. Security and surveillances are the major segments which will be deeply influenced. Other areas that are now welcoming it with open arms are private industries, public buildings, and schools. It is estimated that it will also be adopted by retailers and banking systems in coming years to keep fraud in debit/credit card purchases and payment especially the ones that are online. This technology would fill in the loopholes of largely prevalent inadequate password system. In the long run, robots using facial recognition technology may also come to foray. They can be helpful in completing the tasks that are impractical or difficult for human beings to complete. Embed Systems such as Arduino, Raspberry Pi, and others can be incorporated easily and take the benefits of this system not only as the attendance system but also as the security system too and it can be developed in various other industries as AI has become a need of every company.

7 References

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•https://www.researchgate.net/publication/343921384_Feature_Selection_on_2D_and_3D_Geometric_Features_to_ Improve_Facial_Expression_Recognition.

8. Code

```
from keras.models import load_model
from time import sleep
from keras.preprocessing.image import img_to_array
from keras.preprocessing import image
import cv2
import numpy as np

face_classifier =
cv2.CascadeClassifier('./haarcascade_frontalface_default.xml')
classifier =load_model('./Emotion_Detection.h5')

class_labels = ['Angry','Happy','Neutral','Sad','Surprise','Disgust','Fear']

cap = cv2.VideoCapture(0)



while True:
    # Grab a single frame of video
    ret, frame =  cap.read()
    labels = []
    gray = cv2.cvtColor(frame,cv2.COLOR_BGR2GRAY)
    faces = face_classifier.detectMultiScale(gray,1.3,5)

    for (x,y,w,h) in faces:
        cv2.rectangle(frame,(x,y),(x+w,y+h),(255,0,0),2)
        roi_gray = gray[y:y+h,x:x+w]
        roi_gray = cv2.resize(roi_gray,(48,48),interpolation=cv2.INTER_AREA)

        if np.sum([roi_gray])!=0:
            roi = roi_gray.astype('float')/255.0
            roi = img_to_array(roi)
            roi = np.expand_dims(roi,axis=0)

        # make a prediction on the ROI, then lookup the class

            preds = classifier.predict(roi)[0]
            print("\nprediction = ",preds)
            label=class_labels[preds.argmax()]
            print("\nprediction max = ",preds.argmax())
            print("\nlabel = ",label)
            label_position = (x,y)

cv2.putText(frame,label,label_position,cv2.FONT_HERSHEY_SIMPLEX,2,(0,255,0),3
)
        else:
            cv2.putText(frame,'No Face
Found',(20,60),cv2.FONT_HERSHEY_SIMPLEX,2,(0,255,0),3)
        print("\n\n")
    cv2.imshow('Emotion Detector',frame)
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break
cap.release()
cv2.destroyAllWindows()
```