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Face Emotion Detection Using CNN

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ABSTRACT - Face detection has been around for ages. Taking a step forward, human emotion displayed by face and felt by brain, captured in either video, electric signal (EEG) or image form can be approximated. Human emotion detection is the need of the hour so that modern artificial intelligent systems can emulate and gauge reactions from face. This can be helpful to make informed decisions be it regarding identification of intent, promotion of offers or security related threats. Recognizing emotions from images or video is a trivial task for human eye, but proves to be very challenging for machines and requires many image processing techniques for feature extraction. Several machine learning algorithms are suitable for this job. Any detection or recognition by machine learning requires training algorithm and then testing them on a suitable dataset.

Why faces don't always tell the truth about feelings?

The human face has 43 muscles, which can stretch, lift and contort it into dozens of expressions. Despite this vast range of movement, scientists have long held that certain expressions convey specific emotions. Another reason for the lack of evidence for universal expressions is that the face is not the whole picture. Other things, including body movement, personality, tone of voice and changes in skin tone have important roles in how we perceive and display emotion. For example, changes in emotional state can affect blood flow, and this in turn can alter the appearance of the skin. This project explores a couple of machine learning algorithms as well as feature extraction techniques which would help us in accurate identification of the human emotion.

I.INTRODUCTION

With the advent of modern technology our desires went high and it binds no bounds. In the present era a huge research work is going on in the field of digital image and image processing. The way of progression has been exponential and it is ever increasing. Image Processing is a vast area of research in present day world and its applications are very widespread.

Image processing is the field of signal processing where both the input and output signals are images. One of the most important applications of Image processing is Facial expression recognition. Our emotion is revealed by the expressions in our face. Facial Expressions plays an important role in interpersonal communication. Facial expression is a non-verbal scientific gesture which gets expressed in our face as per our emotions. Automatic recognition of facial expression plays an important role in artificial intelligence and robotics and thus it is a need of the generation. Some application related to this include Personal identification and Access control, Videophone and Teleconferencing, Forensic application, Human-Computer Interaction, Automated Surveillance, Cosmetology and so on.

The objective of this project is to develop Automatic Facial Emotion Detection System which can take human facial images containing some expression as input and recognize and classify it into seven different expression class such as:

I. Neutral
II. Angry
III. Disgust
IV. Fear
V. Happy2
VI. Sadness
VII. Surprise

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II. PROCEDURE

1.Install and import libraries:

The libraries used in this system are:

OpenCV:

OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

NumPy:

NumPy is an acronym for "Numeric Python" or "Numerical Python". It is an open-source extension module for Python, which provides fast precompiled functions for mathematical and numerical routines. Furthermore, NumPy enriches the programming language Python with powerful data structures for efficient computation of multi-dimensional arrays and matrices. The implementation is even aiming at huge matrices and arrays. It is the fundamental package for scientific computing with Python.

- **Keras:**

Keras is a high-level neural network API, written in Python and capable of running on top of TensorFlow, CNTK, or Theano. It was developed with a focus on enabling fast experimentation. Keras contains numerous implementations of commonly used neural network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with image and text data easier.

- **Tensor Flow:**

TensorFlow is a Python library for fast numerical computing created and released by Google. It is a foundation library that can be used to create Deep Learning models directly or by using wrapper libraries that simplify the process built on top of TensorFlow.

2. Pre-processing:

Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. Most preprocessing steps that are implemented are –

A. Reduce the noise

B. Convert The Image To Binary/Grayscale.

C. Pixel Brightness Transformation.

D. Geometric Transformation.

Face Registration:

Face Registration is a computer technology being used in a variety of applications that identifies human faces in digital images. In this face registration step, faces are first located in the image using some set of landmark points called “face localization” or “face detection”. These detected faces are then geometrically normalized to match some template image in a process called “face registration”.

Facial Feature Extraction:

Facial Features extraction is an important step in face recognition and is defined as the process of locating specific regions, points, landmarks, or curves/contours in a given 2-D image or a 3D range image. In this feature extraction step, a numerical feature vector is generated from the resulting registered image. Common features that can be extracted are-

A. Lips

B. Eyes

C. Eyebrows

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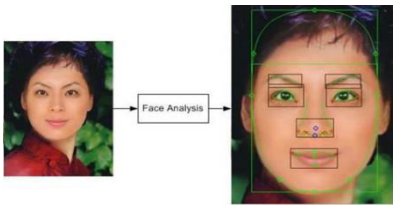
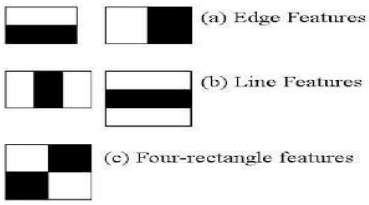
D. Nose tip



Emotion Classification:

In the third step, of classification, the algorithm attempts to classify the given faces portraying one of the seven basic emotions.



Approach for Facial Expression Recognition:

Neural Network Approach:

The neural network contained a hidden layer with neurons. The approach is based on the assumption that a neutral face image corresponding to each image is available to the system. Each neural network is trained independently with the use of on-line back propagation.

Face Registration:

Haar Features:

Haar feature is similar to Karnals, which is generally used to detect edge. All human faces share some similar features, like eye region is darker than upper check region, nose region is brighter than eye region. By this match able features, their location and size will help us to detect a face.

3. Layers of Neural Network

Input Layers: The input layer has pre-determined, fixed dimensions, so the image must be pre-processed before it can be fed into the layer. We used OpenCV, a computer vision library, for face detection in the image. The haar-cascade_frontalface_default.xml in OpenCV contains pre-trained filters and uses Adaboost to quickly find and crop the face.

Convolutional Layers: The NumPy array gets passed into the Convolution2D layer where we specify the number of filters as one of the hyperparameters. Convolution generates feature maps that represent how pixel values are enhanced, for example, edge and pattern detection. A feature map is created by applying filter 1 across the entire image. Other filters are applied one after another creating a set of feature maps.

Output Layer: Instead of using sigmoid activation function, we used SoftMax at the output layer. This output presents itself as a probability for each emotion class. Therefore, the model is able to show the detail probability composition of the emotions in the face. Our expressions are usually much complex and contain a mix of emotions that could be used to accurately describe a particular expression.

4. Prediction and Evaluation:

We valuate the model using confusion matrix.

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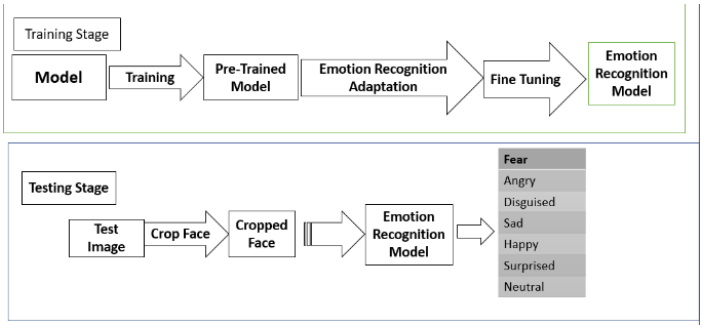
It is used to compare actual values with values predicted by the neural network model.

5.Test the Model:

After the model is trained, we tested the model with real time emotions of the human faces and check if the emotions are correctly detected.

III. SYSTEM ARCHITECTURE



OUTPUT

The output shows the five of the emotions predicted by the model.

IV. FUTURE SCOPE

In this project we got an accuracy of almost 70% which is not bad at all comparing all the previous models. But we need to improve in specific areas like-number and configuration of convolutional layers

number and configuration of dense layers

Dropout percentage in dense layers

But due to lack of highly configured system we could not go deeper into dense neural network as the system gets very slow and we will try to improve in these areas in future.

We would also like to train more databases into the system to make the model more and more accurate but again resources become a hindrance in the path and we also need to improve in several areas in future to resolve the errors and improve the accuracy.

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V. CONCLUSION

The facial emotion detection system presented in this research work contributes a resilient face recognition model based on the mapping of behavioral characteristics with the physiological biometric characteristics. The physiological characteristics of the human face with relevance to various expressions such as happiness, sadness, fear, anger, surprise and disgust are associated with geometrical structures which restored as base matching template for the recognition system.

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