Facial Emotion Analysis Implementation Using Deep Neural Networking Methods

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ABSTRACT: One of the biggest issues for cognitive computing is figuring out how people perceive and distinguish one another's faces and emotions, as well as how to produce automated and effective face recognition. In the realm of computer science, there has been a lot of effort spent into researching ways to classify and identify faces automatically. The difficulty of recovering face traits has been approached in many ways. The crucial constraint is to create believable face representations that are robust in terms of facial feature variation. Finding faces in the scene, extracting facial features from the detected face region, and analyzing the motion of facial features and/or changes in the appearance of facial features are the three subproblems that make up the problem of machine recognition of human facial expression.

Keywords : Deep Neural Networks, Emotion detection, Face recognition

I. INTRODUCTION

In interpersonal contact, the face is very essential. This serves as a 'bridge' into human personality, sentiments, and cognition. The face we are looking at is a mash-up of physical attributes and emotional responses. As per psychological studies, the nonverbal element of social communication is perhaps the most instructive medium. The verbal factor responsible for roughly 7% of the communication, the vocal component accounts for 34%, and the facial expression accounts for 55%. As a result, the facial expression is researched in many fields of science, including psychology, cognitive science, medicine, and, lastly, information science.

II. LITERATURE REVIEW

The goal of this paper is to write out the challenge of facial emotion recognition, which is a significant difficulty in the field of image processing. The benefits of developing a completely autonomous system for facial feature interpretation are a continuing source of motivation for researchers in this area.[1] It is a considerable challenge to design an intelligent system capable of recognizing and comprehension human emotions for a number of important uses, such as safety, community, recreation, medical services, human-computer interaction, industrial and personal mechatronics, intelligence gathering, and public transit.

Many already created emotion detection systems have shown their potential in several facets of life; for example, they can predict crime by examining pictures of individuals faces recorded by a security camera. Moreover, one such method is very beneficial and effective in deaf people's sign language recognition [2][3] It is also used in the development of smart vehicle solutions that will allow the vehicle to detect the physical state of its driver. Aside from its usage to improve the productivity of robotics for specialized jobs such as healthcare solutions, combat activities, clinical bots, and industrial servicing, the sentiment analysis system has had a significant impact on the gaming and entertainment areas also. In general, a smart computer integrated with a recognition of emotions can be used to enrich our daily life. The goal of face expression recognition is to mimic the human visual system as precisely as possible. This is a difficult subject in the realm of computer vision since it requires not only excellent image/video processing methods, but also well-suited feature representation.

It is essential that this system be both simple and effective [3][4].The primary concept is that it must be entirely automated in order to eliminate manual intervention. The system should be able to avoid limiting body and head movements, which are both critical for recognizing exhibited emotions[5]. If possible, keep facial hair, glasses, and extra make-up to a minimum. In this type of system, the algorithm must be independent of user variables such as skin colour, age, gender, and nation.[6]

III. FACE DETECTION METHODS

Face detection is a significant phase of FER. A proficient automated system can be developed for recognizing the face region in static or video image spontaneously. A face region is detected in the image sequence using facial features such as edge, skin colour, texture and face muscle motion. These features easily distinguish a face region from the background. In this phase, the input image is segmented into two parts: one is the face region and other representing a non-face region. There are many face detection methods available like eigenspace method, adaptive skin colour and Viola–Jones method and their algorithms are developed based on Haar classifier, Adaboost and contour points. The survey is about the accurate identification of faces and its performance under a constrained and unconstrained environment. Table **1** gives an outline of face detection methods.

Table 1. Summary of face detection

S.no	Method/algorithm	Accuracy	Comments

1	Eigenspace method	high accuracy for face detection under variable pose conditions	head motion allowed in horizontal direction makes the system robust
2	Adaptive skin colour	accuracy is good as it identifies the skin colour easily but fails due to illumination	adaptive gamma correction method is used to overcome the illumination problem
3	Haar classifier	high accuracy obtained by Haar features	computational complexity is less due to minimum features
4	Adaboost classifier	high accuracy because of the strong classifier and detects a single face	uses trained model so reduced computational cost
5	Contours	accuracy is good as it uses contour points	due to minimum features, the computational cost is less.

IV. PROPOSED ALGORITHM

Step 1 :Collection of a data set of images. In this case we are using FER2013 database of 35887 pre-cropped, 48-by-48-pixel grayscale images of faces each labeled with one of the 7 emotion classes: anger, disgust, fear, happiness, sadness, surprise, and neutral.

Step 2 :Pre-processing of images.

Step 3 :Detection of a face from each image.

Step 4 :The cropped face is converted into grayscale images.

Step 5 : The pipeline ensures every image can be fed into the input layer as a (1, 48, 48) numpy array.

Step 6 :The numpy array gets passed into the Convolution2D layer.

Step 7 :Convolution generates feature maps.

Step 8:Pooling method called MaxPooling2D that uses (2, 2) windows across the feature map only keeping the maximum pixel value.

Step 9 :During training, Neural network Forward propagation and Backward propagation performed on the pixel values.

Step 10:The Softmax function presents itself as a probability for each emotion class.

V. RESULTS

The trained model was used to test against 3,589 images for emotion classification in real-time and its results are shown in Fig. 1. In Table 1, the confusion matrix for various emotions has been shown. The matrix shows the comparison of actual values with the predicted values for each emotion. The matrix shows that angry and sad are confused with a probability of 0.14. Similarly surprise and fear are also confused with a probability of 0.13. The diagonal values give us the accuracy of predicting various emotions. The highest accuracy is that of happy with an accuracy of 87%. The least accurately detected emotions is fear with an accuracy of 42%.

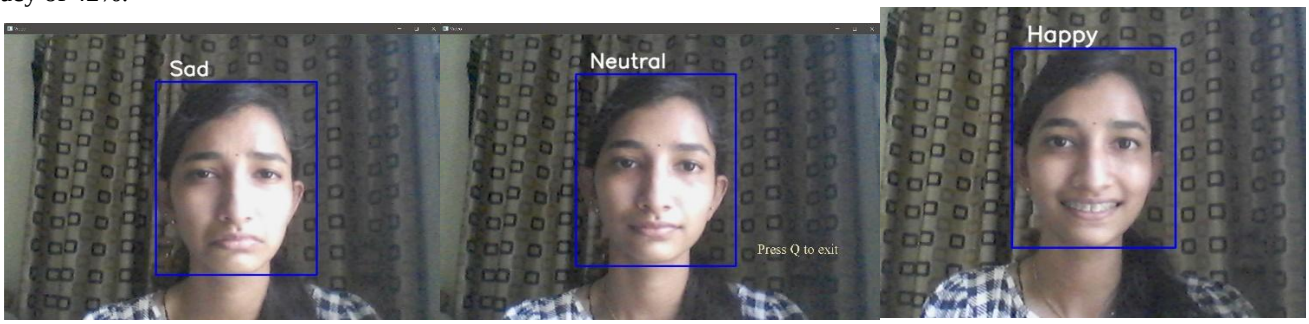


Fig. 1: Sample results of emotion classification of unseen data

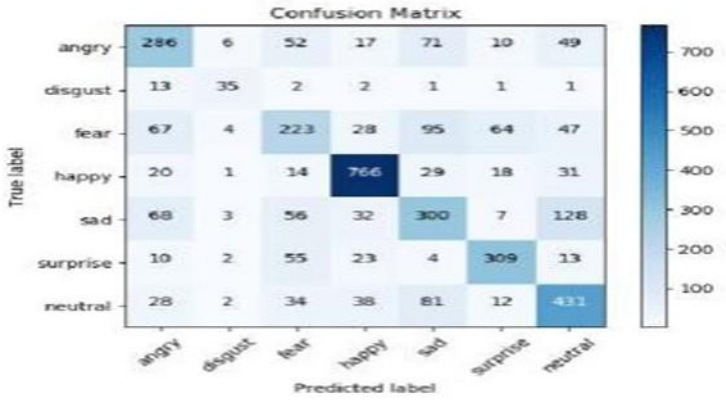
Overall Accuracy = Number of correct predictions / Total number of predictions

Total number of predictions = (286+35+223+766+300+309+431 /3589) x 100 = 65.48%

Target Class	Predicted Class							Accuracy
	Angry	Disgust	Fear	Happy	Sad	Surprise	Neutral	
Angry	0.58	0.01	0.11	0.03	0.14	0.02	0.11	58%
Disgust	0.24	0.64	0.04	0.04	0.01	0.02	0.01	64%
Fear	0.13	0.01	0.42	0.05	0.18	0.12	0.09	42%
Happy	0.02	0.00	0.02	0.87	0.03	0.02	0.04	87%
Sad	0.11	0.01	0.09	0.05	0.51	0.01	0.22	51%
Surprise	0.02	0.00	0.13	0.06	0.02	0.74	0.03	74%
Neutral	0.04	0.01	0.05	0.06	0.13	0.02	0.69	69%

1(a)

Figure 1 (a): Confusion matrix of the model showing ratio 1



1(b)

Figure 1(b): Confusion matrix of the model showing numbers

VI. CONCLUSION

Facial emotion recognition or computer-based facial emotion recognition system is important because of its ability to mimic human coding skills. Advantages of face detection include better security, easy integration, and automated identification; Disadvantages include huge storage requirements, vulnerable detection, and potential privacy issues. Facial recognition could keep unauthorized or criminal activity in check. But it's not a perfect form of security. The software relies on a database of images, and it's only as accurate as the data it's fed. Due to the variety of commercial and law enforcement uses, face recognition (FR) is becoming one of the most important study areas. conventional FR techniques based on The drawbacks of this approach include the need to manually adjust the contours of these features and components in this frame, robustness issues that arise when tracking is applied to images with changing pose or illumination, and the difficulty of estimating general parameters for movement and displacement due to the tendency of actions and expressions to change both morphologically and dynamically.

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