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Emotion Detection using Deep Learning Techniques

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***Abstract*— Identifying human emotions from images is a potent and difficult study task in social communication. Emotion detection based on deep learning (DL) outperforms conventional image processing techniques in terms of performance. In this work, we refined the convolutional neural network approach to discern eight basic emotions and assessed multiple preprocessing techniques to demonstrate the impact on CNN efficacy. Enhancing facial emotions and features through emotional recognition is the aim of this research. Computers might be better able to forecast people's mental states and respond with more tailored replies if they could distinguish or identify the facial expressions that elicit human emotions. Therefore, we investigate the possibility of enhancing the emotion detection performance using a CNN based deep learning (DL) technique. The dataset for testing and training comprises of around 32,290 pictures with multiple face expressions. The pertaining stage helps reveal face detection, including feature extraction, following noise removal from the input image. The preprocessing system helps remove noise from the image. As a result, the proposed article reveals the same eight facial acting coding system emotions as the current work does, even though the latter uses an optimization technique to classify a variety of facial reactions, including the eight FACS emotions.**

***Index Terms*— Facial expression, emotion detection, deep learning, CNN.**

I. INTRODUCTION

Emotion is a mental state associated with the neurological system that is linked to feelings, perceptions, behavioral reactions, and happiness or sadness [1].Due to its ability to comprehend human behavior, emotions, intentions, and other aspects, the human facial expressions and emotion detection system acquires great significance in this day and age. The human facial expressions and emotion detection system that uses deep learning has proven to be superior to the conventional method, which has limited speed and low accuracy[2]. Convolutional neural networks can be used for face unlocking, customer feedback analysis, and other purposes because of their ability to recognize a wide range of human facial emotions.

Without disclosing personal information, facial expressions are essential for identifying human mentalities. Support vector machine algorithm (SVM) and DL are used in multiple studies that combine data from 2016 to 2022 and include most feature extraction and classification, improving classification accuracy and outcomes. In the assessment technique, both the PCA (Principal Component Analysis) and the LBP (Local Binary Pattern) yield good findings [3].

As a result, the suggested work uses an enhanced deep learning method that makes use of ECNN(Enhanced CNN) to identify the same eight emotions as the FACS (facial action coding system). The FACS system was created with the intention of identifying every potential apparent face motion based on anatomy. Numerous applications are

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made possible by the defined nomenclature that FACS provides for the study of face movement. Numerous facial expressions are classified when the optimum technique the eight emotions of the FACS is not used. In comparison to the current method, the suggested system is more accurate.

A. Study Objective

The goal of this work is to distinguish different emotions from face cues using a deep learning system. We achieve this through the use of seven different types of face expressions. This study proposes a feature extraction method that is more accurate than the existing methodology by utilizing holistic approaches, geometric-based techniques, and hybrid approaches.

II. Literature Review

A. Expressions on Human Faces

One important aspect of human connection is the universality of body language and facial expressions. In the 2016s, researchers wrote about the widespread use of facial expressions that are crucial to nonverbal communication [4]. Some studies that certain emotions were reliably connected with certain facial behaviors [5]. It appears that distinct muscular motions are associated with particular mental states in both humans and animals. Some researchers are recommended reading for anyone interested in studying emotion classification through speech recognition research [6].

B. Recognition of Images

The technology that recognizes locations, logos, people, items, buildings, and other things in photos is known as image recognition. A technique that can recognize and detect an object in a digital video or image is called image recognition, and it is a subset of computer vision [7]. The field of computer vision comprises techniques for obtaining, manipulating, and interpreting data from real-world video or still images. Such sources provide high-dimensional data that can yield numerical or symbolic information in the form of judgments. Computer vision encompasses not only image identification but also object recognition, event detection, learning, video tracking, and picture reconstruction [8].

III. Methodology

Convolutional neural network analysis (CNN) is the most used technique for assessing images. CNN features hidden layers known as convolutional layers, in contrast to an MLP (multilayer perceptron). The suggested method is predicated on the two-level CNN architecture. An overview of the suggested strategy shows that the preprocessing procedure is applied to the input image. The image's noise level is reduced with the help of the preprocessing technique &e. In Figure 1, the proposed CNN's summary is displayed.

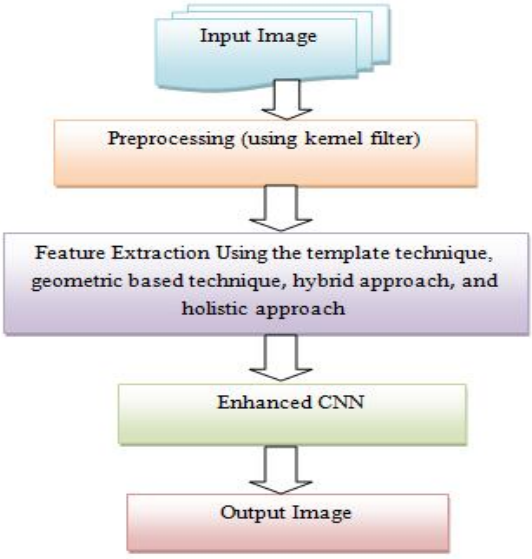

Figure 1: Proposed ECNN approach

C. The suggested approach

The suggested architecture is summarized in Figure 2. The first dataset, which undergoes preprocessing, includes the different face expressions from the image.

E. Preprocessing

One of the most important filters for facial identification in an image is the kernel filter, which also helps to reduce unfocused areas, dimensionality, and smooth edges. The kernel filter for image preprocessing is implemented in this work.

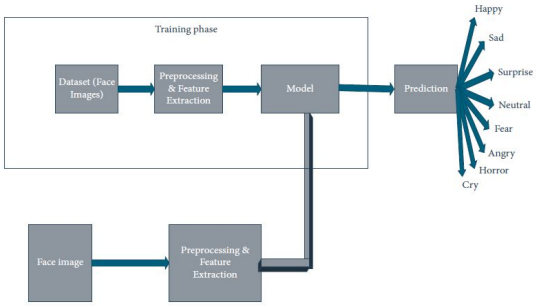

Figure 2: Proposed Framework

F. Extraction of Feature

Feature extraction is a crucial technique in image processing. The three stages of face recognition include face detection, which is basically the identification of the input image, face extraction, which happens after picture identification. The accuracy of an image's classification is increased by the feature extraction procedure.

Reducing the dimensionality of the input images and their dimensional bounds is the primary goal of feature extraction once feature recognition is complete. Feature recognition is regarded as the image's identification. The four forms of feature recognition [9] are implemented in this paper, specifically:

- Template-based technique
- Hybrid Approach
- Holistic approach
- Geometric approach

G. Neural Convolutional Network

Convolutional neural networks are one example of this kind of deep learning technique. In essence, CNN function as integral layer networks. Figure 3 shows how the CNN completes the multilayer-specific task using a classification method. The input picture is passed via the convolutional RELU layer by the convolutional neural network and then sent to the maxpooling algorithm. The output image is passed via the completely linked layer after this process is repeated once. It facilitates the correct output's separation. Classifying the image is also aided by the completely connected layer.

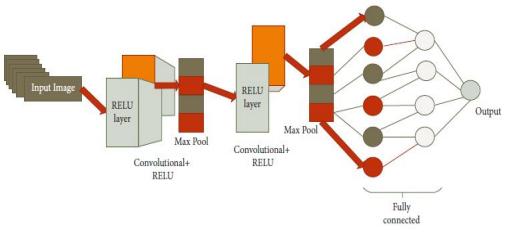

Figure 3: CNN model

H. Data Collection

The approximately 32,290 photos in this dataset are each individually labeled. For further analysis, the FER2013 dataset was used because the images have $48 * 48$ size pixels. This dataset is divided into two columns, emotional and pixels, respectively. The code values, which go from 0 to 7, are examined in connection to the emotional activities, and the pixel value is shown in the pixel column.

I. Model for Testing and Training

The preprocessing technique helps to reduce the noise level in the filter because the training stages require 80% of the data as input. The high dimensionality of the space inside the filter is lessened with the aid of feature extraction. This work reduces the dimensional space and enhances edge recognition through a range of feature extraction techniques. As a result, it generates output images with exact dimensional quality. In the data, feature extraction and categorization are done simultaneously. Following categorization, the features from the testing and training stages are transferred. Three training iteration models, like 20, 200, and 600, are gathered.

IV. Results And Discussion

The comparison results indicate that both the SVM approach and the current CNN. The set of templates is extracted using a support vector machine-based method that makes use of the Monto Carlo algorithm and the Gabor filter [10, 11]. The current method's feature extraction does not always produce flawless outcomes. The dataset for classifying emotions using different feature extraction techniques is displayed in Table 1.

TABLE I: DATASET FOR EMOTIONS TABULATIONS

Emotion	Code
Happy	0
Surprise	1
Sad	2
Fear	3
Cry	4
Neutral	5
Horror	6
Anger	7

The accuracy rate for the data obtained is shown in Table 2. It demonstrates that, in comparison to the current strategy, our suggested method utilizing the CNN technique yields more accurate findings.

TABLE II: RATE OF ACCURACY

Epoch	Accuracy rate	Hour
20	81	5
200	94	15
600	98	100

The comparison findings for face feature identification are displayed in Table 3. Our study outperforms other methods already in use, especially a variety of feature extraction strategies that aid in the correct extraction of features.

TABLE III: COMPARISON TABLE FOR FEATURE IDENTIFICATION

Algorithm	Emotion	Accuracy rate
ECNN	6	98
CNN	6	78
SVM	7	86

The accuracy results for both the suggested and the current strategy are displayed in Figure 4. Thus, when compared to the current procedure, our suggested approach yields better outcomes.

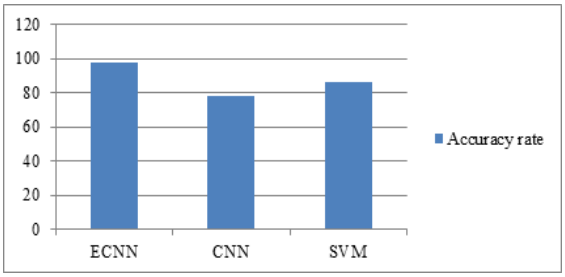

Figure 4: Accuracy rate of methods

V. Conclusion

In this work, we suggested a CNN and DL algorithm-based facial feature for emotional identification. Several face characteristics with appropriate dimensions space reduction were used, and as a preprocessing technique, we sharpened the edges using a kernel filter. The results demonstrate that, in comparison to the existing approach, the convolutional neural network improves both the classification process and accuracy. The results are superior when contrasting the present method with our recommended strategy. The capacity of the model seems to meet the difficulty of complex facial expression recognition at those resolutions. The research's future depends on including additional information, classifying facial emotions into ten categories, and investigating automatic facial emotion detection. This highlighted study looks at picture synthesis methods that could be viewed as a deep learning augmentation data solution. It aims to prevent data hunger and over fitting for tiny amounts of data. Our study's future depends on including additional information, classifying facial emotions into ten categories, and investigating automatic facial emotion detection.

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