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# Facial Emotion Recognition using Convolution Neural Network

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**ABSTRACT**
Facial expression plays a major role in every aspect of human life for communication. It has been a boon for the research in facial emotion with the systems that give rise to the terminology of human-computer interaction in real life. Humans socially interact with each other via emotions. In this research paper, we have proposed an approach of building a system that recognizes facial emotion using a Convolutional Neural Network (CNN) which is one of the most popular Neural Network available. It is said to be a pattern recognition Neural Network. Convolutional Neural Network reduces the dimension for large resolution images and not losing the quality and giving a prediction output what's expected and capturing of the facial expressions even in odd angles makes it stand different from other models also i.e. it works well for non-frontal images. But unfortunately, CNN based detector is computationally heavy and is a challenge for using CNN for a video as an input. We will implement a facial emotion recognition system using a Convolutional Neural Network using a dataset. Our system will predict the output based on the input given to it. This system can be useful for sentimental analysis, can be used for clinical practices, can be useful for getting a person's review on a certain product, and many more.

***KEYWORDS***: *Facial Emotion Recognition, Deep Learning, CNN, Image Processing*

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## I. INTRODUCTION

In this world when a human being becomes speechless due to some reason at that moment his facial expression communicates many things of his state of mind at that particular moment. Humans always had the innate ability to recognize and distinguish between faces (for ex the mother and a child……)[3]. Humans interact socially with the help of emotions, which is considered a universal language. Facial emotions are one of the important aspects of human communication that help us understand the intentions of others [4]. Hence, it is natural that research of facial emotion has been acquiring a lot of attention over the past decades with applications not only in perceptual and cognitive science but also in affective computing and computer animations [24].

Human-Computer Interaction Technology (HCIT) refers to a kind of technology that takes computer equipment as the medium, to realize the interaction between human life and computer systems [15]. In recent years with the rapid growth and progress in pattern recognition and artificial intelligence, and many more new emerging technologies there are many libraries and modules available specifically for image processing in neural networks. Among which one of them is Convolution Neural Network (CNN) best suited for facial emotion recognition and pattern finding.

In this paper, we are going to go through Face Emotion Recognition (FER) using a Convolutional Neural network for a better result outcome. It is also best suited for any angle emotion recognition i.e. it can recognize the face emotion at any odd angle. Facial Expressions are responsible for conveying information that is hard to perceive. It has been applied in the fields of distance education, public security, public review for certain things, and many more. Hence, creating a system that is capable of face detection and emotion recognition has become a crucial area of research.

## II. PRELIMINARIES

### 2.1. Image Processing

In our paper, we are dealing with the concept of Image Processing rigorously for emotion detection from an image. Image Processing is generally known as a methodology of performing some important kind of operation on an image for a certain output. In our paper, during this processing, we have input as an image and output as a characteristic/ features associated with that image in the form of various emotions such as anger, happiness, sadness, neutral, etc. that are expressed by human beings.

#### 2.1.1. Neural Network

Neural Networks are similar to neurons in the human brain and works with concepts of weights, input, activation function, channel, etc. as follows:
The set of elements represented by the set of input(x) in the form of x1,x2,x3…..xn are connected to ut the connection between the input activation function is drawn by the set of weights()which are represented by 1,2,3…..n. Besides this, we have Bayer's letter 'b'.

After applying the output of the activation function represented by (z) which is: y=(i wi*xi +b)

where *xi* is input, i is the weight of *xi*, *a* is the bias added in this neuron, and is the activation function.

This is where we collect the summation of input as a single unit. The other concept that is to be done is convolution operation convolution in images. We have single input in an image and we apply filters to it.

#### 2.1.2. Activation Function

Generally, the Activation Function is used for determination purposes i.e. the output of a neural network. There are quite a lot of commonly used Activation Functions, whereas in our case depending upon the sum of weighted input either it is larger than zero or not it acts as a filter deciding whether the information will be passed on and how strong the signal will be. On the other hand, if the value is equal to or less than zero then the signal will vanish.

#### 2.1.3. Stride

Stride denotes the number of steps to be taken during the traversal of an array during the Pooling. The default value of stride is generally 1 [16].

### 2.2. The algorithm that can be used

#### 2.1.1. CNN

Among the several deep learning models available, Convolutional Neural Network (CNN), in particular, deep learning is one of the most popular neural networks [4]. Convolutional Neural Network is one of the Feed-Forward Network to process and recognize image data with the grid version. Being one of the Neural Network it also consists of an Input layer where the image is input, Hidden layers such as Convolution Layer, ReLu Layer, Pooling Layer, and Fully Connected Network.

Convolutional Layer - Converts images into an array

The size of the feature map is controlled by three variables:

Depth-Number of filters used for the convolution operation [16].

Stride- Number of Pixels by which the filter matrix traverses over the input matrix [16].

Padding-It's good to input matrices with zeros around the bordering matrix [16].

## III. RELATED WORK

**HONGLI ZHANG, ALIREZA JOLFAEI, AND MAMOUN ALAZAB[1].**The authors have proposed a facial expression recognition method using the CNN model which extracts facial features effectively. Supervised deep learning is used as the processing technique in the system. The proposed method can automatically learn pattern features and reduce the incompleteness caused by artificial design features. The proposed method directly inputs the image pixel value through training sample image data. The algorithm used is R-CNN.

**Accuracy:** 85%
**The Datasets** used are:
1. Fer-2013 facial expression database
2. LFW data set.

**Advantages:** Highly Accurate

**Limitations:** Facial expressions, in reality, may vary depending upon various factors that may occur during image capturing such as face posture it can be blurring, occlusion may occur. It can have different noise and many more.

**Zeynab Rzayeva and Emin Alasgarov[2].** The authors have proposed a model based on Convolutional Neural Networks (CNN), which is trained on Cohn-Kanade and RAVDESS datasets. The proposed model gives the expected outcome for the said dataset in detecting macro facial emotions. The algorithm used is RFM technique, clustering algorithms, and multilayer perceptron (MLP) algorithm.

**Accuracy:** 95%

**The Datasets** used are: Cohn-Kanade and RAVDESS datasets

**Advantages:** Distributed platforms allow us to train our model with a higher number of images and do it efficiently and effectively.

**Limitations:** The algorithm is not able to detect features explicitly.

**LehLuoh, Chih-Chang Huang, Hsues Yen Liu[3].** The authors have proposed a system to build an emotion detection system that can analyze basic facial expressions of humans automatically. The experiment result also shows the facial emotion recognition rate is about 90% for the well-known JAFFE database.

**Accuracy:** 90%

**The Dataset** used is the JAFFE dataset.

**Advantages:** Highly Accurate

**Limitations:** It faces problems in image processing, such as detection of landmarks of face and variance of color or light of the environment.

## IV. CONCLUSION

After so much research and working on this proposed system it has been in view that recognizing the emotion of a person and knowing his/her state of mind is essential. The future scope mentioned is endless to the counting and has many effective results in different fields like Medical, Security and Surveillance, Education, Marketing of Products, etc. with more futuristic applications visible on the horizon especially in the field of security and surveillance.

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