Human facial expression recognition using deep learning technique

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***Abstract*- The emotion is recognized from facial expression by using static images. It is one of the categories in signal processing which is applied in various fields, similarly for human and computer interaction. Some sources are proposed to automatic emotion recognition, which uses machine learning approach. Many real-time problems have been solved by Deep learning technique. In this work we have defined Convolutional Neural Network (CNN) is used to identify 6 elementary emotions this technique has been implemented in MATLAB.**

Keywords: Facial Expression; Recognition; Deep Learning; CNN Architecture; Classification.

I. INTRODUCTION

Facial emotion recognition has been a progress source area, with application fields like, neuro marketing. Facial expressions are important factors in human communication that help us understand the intentions of others. Even images of same person can vary in many types of variations. Even though it is much studied earlier often, while training and testing few works which showed fair evaluation has been avoided. Facial emotion is the major significant features of recognition of human emotion. The face is always the best sensitive and communicative part of humans [1]. The feature extraction and classification has been successfully identified in Convolution Neural Networks (CNN) architecture.

A. Face recognition system

Identifying an individual's emotion depending on the features of that person is known as the face recognition system. The common approach to facial emotion recognition contains three steps: face detection [3], feature extraction [4] and classification [5, 6]. Face detection processes the facial images, without human intervention to identify the face position from the input images. Once the face is positioned, the facial expressions are extracted. The final stage is to identify the facial emotion. The facial variations can be identified either as emotions or as an action. As we know that humans are filled with various emotions, but basically we assume basics emotion. Facial muscle movements support in identifying human emotions. The features are the key parameters that can be considered for recognizing emotions. The facial parameters include eyebrow, mouth, nose, eyes and cheeks.

B. Facial expression

Once expression of one's emotions. And it is to display messages and signs [2]. Like, happy may cause the eyebrows relaxed, mouth opens and the mouth corners upturned. A process must be able to identify several of emotions. The basic 6 emotions are shown in Fig 1.

Fig 1. Six basic emotions

The description of facial expression is given in Table. 1.

Sr. No.	EMOTION CLASS	Description of Facial expression
1	Happy	The eyebrows are relaxed. The mouth is open and the mouth corners upturned.
2	Sad	The inner eyebrows are bent upward. The eyes are slightly closed. The mouth is usually relaxed.
3	Fear	The eyebrows are raised and pulled together. The inner eyebrows are bent upward. The eyes are open and tense.
4	Anger	The inner eyebrows are pulled downward and together. The eyes are wide open. The lips are tightly closed or opened to expose the teeth.
5	Surprise	The eyebrows are raised. The upper eyelids and the eyes are wide open. The mouth is opened.
6	Disgust	The eyebrows and eyelids are relaxed. The upper lip is raised and curled, often asymmetrically.

Table. 1: Description of facial expression

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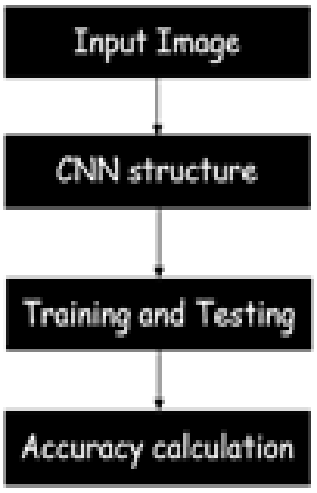
C. *Block diagram*



II. METHODS AND MATERIALS

A. *Datasets*

The process is finished by utilizing JAFFE datasets which has 6 feelings in it. The total images present in this are 213 images with the dimensions of 256x256. The experimental setups are given in Table. 2.

Table. 2: Experimental setups

CATEGORY	JAFFE
Labels	6 Emotions
The number	213
Participants	10(Female)
Resolution	256x256
Format	.tiff

B. *Convolutional Neural Network method (CNN)*

A CNN takes an image as an input and tries to combine the given image and target data in mat lab. The CNN design flow is shown in Fig. 2.

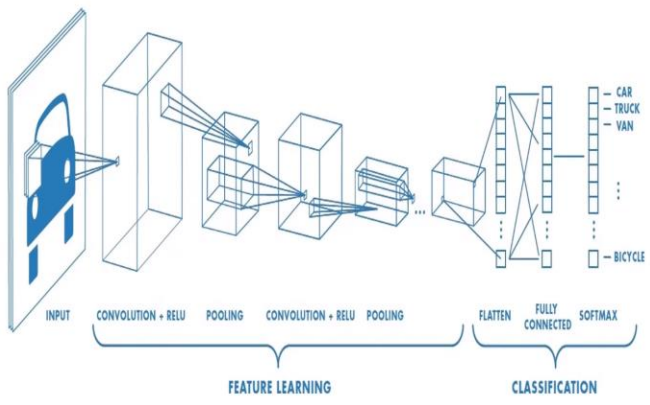


Fig. 2: CNN methods

In CNN the weights will connect small subsections of the input to each of the different neurons in the first layer. These different sets of weights are called 'kernels'. Convolution is something just like a mathematical operation [7]. A kernel is placed in the top-left corner of the input image.

Convolution is powerful in finding the features of an input image if we already know the right kernel to use. Kernel design is an art form and has been refined over the last few decades to do some pretty amazing things with images each convolution result is placed into the next layer in a hidden node**.** Each feature of the convolved image is a node in the hidden layer.

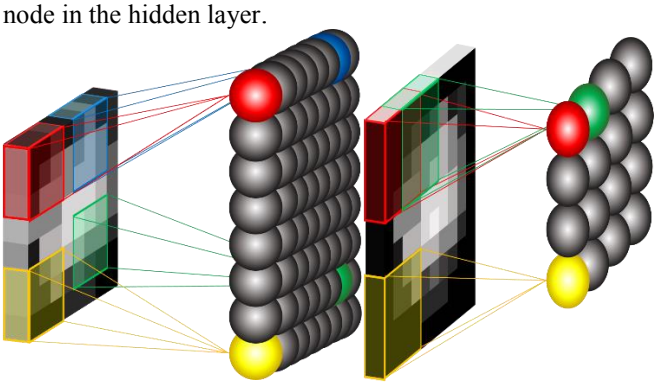


Fig. 3. Hidden layer nodes in NN

TYPES OF LAYERS:

1. *Input Layer*

In this layer the given input image is in 2D, greyscale. This input image is converted into pattern. Kernel is a set of weights which is multiplies with the input image pattern. This dot product method starts from the corner edge of the input image Patten. The taken input images dimension is 256 x 256 x 1 for greyscale image. For certain dimension Inputs to a CNN works best.

2. *Convolution layer*

It takes in an image by using stride and zero-padding, which gives an output if kernels are ready to use. The order of input image dimensions is mainly considered to implement CNN in mat lab. The convolution process is shown in Fig. 4.

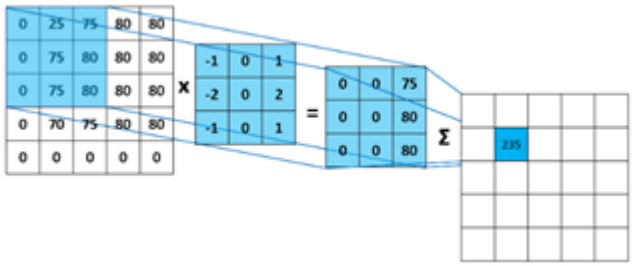
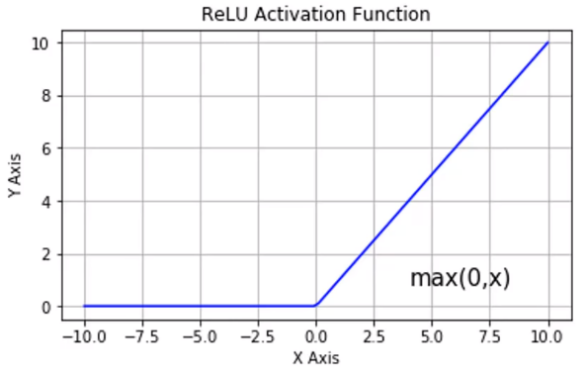


Fig. 4. Convolution process

3. *Activation function*

It maps the resulting values in between 0 to 1 or -1to 1 depending upon the function.



4. *Pooling layer*

The layer after convolutional layer is mostly pooling layer in CNN architecture. It divides the input image into a set of rectangles and, for each such sub-region, outputs a value. The process of pooling layer is shown in Fig. 5.

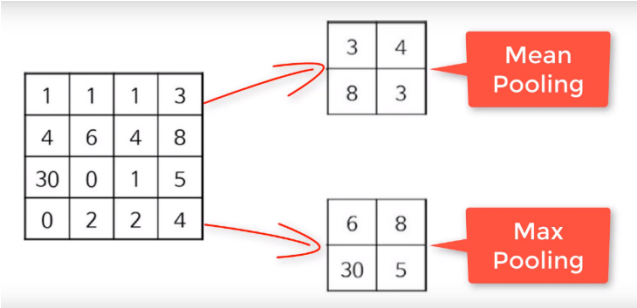


Fig.5: Pooling Layer

5. *Fully Connected layer*

Fully Connected layers are 1D vectors and each neurons in this layer will be connected to the previous volume.

C. *CNN Configuration*

Table.3: Layers used

LAYERS	No of layers used
Convolution layer	2 layers
Pooling layer	2 layers
Activation function	Happens in all layers
Fully connected layer	2 layers

D. *Performance metrics*

The Accuracy is proposed by number of correct prediction by total number of test images with multiples of 100.

Accuracy (Acc) = no of correct prediction / total no of test images x 100 (1)

III. RESULTS AND DISCUSSION

In this work a CNN method for emotion recognition from static images of facial expression were explored. An accuracy of 91.6 % has been achieved by the test result. Training and testing sample images are shown in Fig.6.

(a)

(b)

Fig. 6. (a) Training & (b) Testing

IV. CONCLUSION

Now a days computers are widely used in various fields of human computer interactions in order to recognize human expressions. As the facial expression recognition systems are becoming vigorous and effective in communications, many other innovative applications and uses are yet to be seen. This paper gives a complete view of facial emotion recognition system.

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