

# Facial Emotion Detection using Convolutional Neural Network

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**Abstract** - In today's world, there is a tremendous increase in usage of machinery. The world needs machines to understand humans and interpret accordingly. The perception of machines helps them to understand their surroundings, thus facial emotion identification helps in finding this perception. Since emotion contains an abundant amount of information about our state of mind, a system is developed to detect facial emotion using neural network and image processing techniques.

**Key Words:** Neural Network, Convolution neural network, Tensor Flow, Haar cascade classifier, FER 2013 image database.

## 1. INTRODUCTION

In any human communication, Facial expression plays an important role. As now a day, the world seems to depend mostly on machines, it becomes important that a machine should be able to analyze and understand a human emotion. Though there are several ways to detect emotion, the more practical and easier method is via facial expression. There are seven universally recognized facial emotions: (1) Happiness (2) Sadness (3) Anger (4) Fear (5) Disgust (6) Surprise (7) Contempt. The main difficulty is classifying emotion depending on whether the input image is static or in a transition frame. Also, since the emotions change frequently the real challenge exists in detecting the emotions in dynamic cases. Since convolutional neural network can achieve greater performance on visual recognition tasks, we have implemented convolutional

neural network for face detection. In the past two decades, the research on emotion detection has increased significantly the areas contributing include psychology, sociology, business etc. It's always better to have a safer world if we have an auto-scanning system for signs of terrorism in terms of facial emotion detection. The facial expression recognition system had four important steps: Input image given to the system, Face Detection, Emotion Recognition, Output image indicating emotion of the human.

## 2. RELATED WORK

### A. A comprehensive study on techniques for facial emotion recognition.

The various emotion classification problems are discussed and to overcome certain emotion recognition methods are proposed. Haar function has been discussed for feature extraction where in bazier curve is applied in order to approximate extracting regions. The distance of each feature has been calculated and the relationships between these features are found. A two layered feed forward neural network has been used as classifying tool. Various Techniques are discussed with their predicted accuracy of result for facial emotion recognition.

### B. Real Time Facial Emotion Recognition based on Image Processing and Machine Learning.

A neural network based prototype system has been proposed in this paper for different human emotions. Image processing techniques are used to process the input image given by the user. The universal emotions are considered

and image processing techniques combined with machine learning algorithms help classify these emotions to find different features. After the feature extraction, the features are given as an input to the neural network in order to classify these emotions to the six universal emotions.

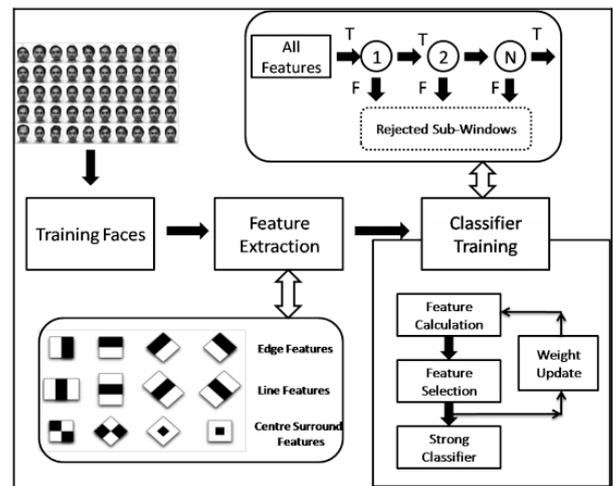
### 3. METHODOLOGY

The identification of human facial expressions is determined using facial muscles movements. There are various methods used in recognition of facial expressions. Before recognizing facial expression, it is important to detect faces. Since there are numerous variations in faces, detecting the face is a challenging task. Even in facial detection there are various methods, one such method used is Haar classifier. Haar function can be used for face, eyes and mouth detection. Edge detection method is the basic approach used for sharpening and detecting boundaries of the image.

#### 1. Face Detection

Basically, for facial detection the Haar cascade classifier is used. The Haar Cascade is a classifier which is used to detect the object for which it has been trained using the source. It is an approach used in machine learning where both positive and negative images are considered to train the cascade function. The algorithm is fed with both positive and negative images. Negative images are those images without a face. Later features are extracted to train the classifier. There are basically three Haar features: 1. Edge feature 2. Line feature 3. Four rectangle features. Firstly, find the sum of pixels and later find the difference with respect to specific sum of pixels in the given image. Integral images are introduced to simplify the calculation by reducing the number of pixels if it is too large. The irrelevant features which are calculated will be removed using Adaboost methodology. A threshold will be set for each feature which will classify the input image face to either positive or negative. Also features with minimum error rate will be given more priority. A strong classifier will be considered as the final classifier as it is the sum of all

classifiers. This classifier is specially introduced to reduce number of steps in classification process by dividing it into several stages and eliminating in each stage.



#### 2. Emotion Recognition

After the recognition of face next comes the recognition of emotion. Here we have used the Convolution Neural Network to recognize the emotion.

##### Convolution Neural Network:

Convolution Neural Network is a type of artificial Neural Network used in image processing that is specifically designed to process Pixel data. The layers of a CNN consist of an Input Layer, an Output Layer and a Hidden Layer that includes 1. Multiple Convolutional Layers, 2. ReLU Layer, 3. Pooling Layer and 4. Fully Connected Layer.

Convolutional Layer is an initial layer which uses mathematical operations by taking two input matrices. i.e., image matrix and filter matrix. Input matrix is multiplied with the filter matrix to produce feature map as Output. Mainly it helps in performing operations such as edge detection and sharpening by applying filters.

ReLU (Rectified Linear Unit) layer introduces non-linearity in the Convolution Network. The rectifier is an activation function defined as the positive part of its arguments:

$$f(x) = x^+ = \max(0, x)$$

Where  $x$  is the input to a neuron. Rectifying activation functions were used to separate specific excitation and unspecific inhibition in the Neural Abstraction pyramid, which was trained in a supervised way to learn several computer vision tasks.

Pooling layer helps to reduce the number of parameters when the images are too large. The main of this layer is to reduce the dimensionality of each map by retaining the important information. It operates on each feature map independently. The most common approach used in pooling is max pooling. Max pooling takes the largest element from the rectified feature map and reduces it.

Fully Connected Layers are used to detect specific global configurations of the features detected by the lower layers in the Network. Neurons in a Fully Connected Layer have full connections to all activations in the previous layer. Matrix gets reduced into a vector and then fed into a Fully Connected Layer. Here features are combined to create a model. After feature extraction we need to classify the data into various classes, this can be done using a Fully Connected Neural Network.

## FUTURE WORK

The automated framework can be improved efficiently by including more emotions to the system. The accuracy can be improved by considering the individual portions of the face comparing with the individual components of the input image. The system can be implemented in a particular application by considering only one emotion. It can be implemented to driver management system by alerting the driver by monitoring his emotions. It can be included in a security system in order to alert about different crimes by observing the emotion of a particular criminal.

## CONCLUSION

In present era, since the humans tend to depend more on machines, there is an urge necessity to include machines in the everyday life. A good emotional classifier should be able to classify the emotions independent of other factors like age, gender, styles, etc. Though there are several applications to classify emotions, Convolutional neural network has been implemented in our system as it improves the efficiency and simplify the classification process and it uses relatively little pre-processing compared to other image classification algorithms. The Haar classifier has been used in our system for facial detection as it has the at most speed calculation compared to other detection frameworks. Our system can be implemented in many applications which could be used in real time. The emotion can also be detected in a video sequence and also in live video streaming applications. The objective of the research paper is to give brief overview of the project, the various technologies used, and their implementation.

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## REFERENCES

The various references helped our system to explore different concepts used in facial emotion detection and choose appropriate technique to minimize the errors and limitations.

- [1] Rituparna Halder, Sushmit Sengupta, Arnab Pal, Sudipta Ghosh, Debashish Kundu, "Real Time Facial Emotion Recognition based on Image Processing and Machine

Learning”, International Journal of Computer applications, April 2016.

- [2] Renuka Deshmukh, Vandana Jagtap “A Comprehensive Survey on Techniques for Facial Emotion Recognition” International Journal of Computer Science and Information Security, March 2017.
- [3] Kudiri M. Krishna, Said Abas Md, Nayan M Yunus, "Emotion Detection Using Sub-image Based Features Through Human Facial Expressions" in International on Computer & Information Science (ICCIS), IEEE.
- [4] D. Anurag, S. Ashim, "A Comparative Study on different approaches of Real Time Human Emotion Recognition based on Facial Expression Detection", *International Conference on Advances in Computer Engineering and Applications*, 2015.
- [5] Pal Pritam, N. Iyer Ananth, E. Yantorno Robert, "Emotion Detection From Infant Facial Expression", *International Conference on Acoustics Speech and Signal Processing*, 2016.
- [6] S L Happy, Routray Aurobinda, "Automatic facial Expression Recognition Using Features Salient Facial Patterns" in IEEE Transactions on Affective Computing, IEEE, 2014.