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Facial & Emotion Detection

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Abstract: **Facial Emotion Detection** *is the process of identifying human emotions from facial expressions. Facial Expression recognition (FER) system is a system to recognize expressions from a person's face. It plays an important part in today's world in fields human physiological interaction detection. The human can recognizes emotions automatically, and many software has now been developed that can recognize emotions as well.*

Keywords: *Facial Expression Recognition, Convoluted Neural Network, Machine Learning.*

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I. INTRODUCTION

Facial expression is an important way of communicating human emotions. Darwin in 1872 proposed that facial expressions of emotion may have a link to evolution of species. Sir Charles Bell and G.B. Duchenne anatomically examined human facial expressions. Mehrabian et al showed that 55% of feelings and attitudes are expressed via the facial features[4]. Facial expression are classified as various states like Happiness, Anger, sadness, surprise, disgust and fear which are given in figure 1.

Fig. 1: Different facial expressions

FER has applications in fields of Human-computer Interaction, Virtual reality, Augmented reality, Education, audience analysis in marketing and entertainment [1]. This review aims to explain the history, importance, and procedures of FER systems.

STEPS OF FACIAL EXPRETION RECOGNATION SYSTEM

FER systems have 4 important steps like signal acquisition, Pre-processing, Extraction of features, selection of features and their classification (Fig 2).

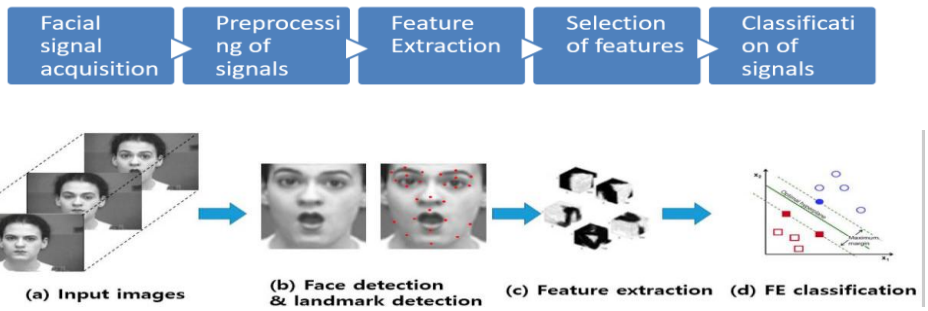


Fig. 2: Steps of FER [2]

[I]INPUTS OF FER SYSTEM

FER can be studied by various input taken by camera, facial action coding etc. But commonly static (frame-based) and dynamic (video-based) inputs are commonly used [3]. Static FER are obtain from images like photos and Dynamic FER are obtained by spatio-temporal features for obtaining dynamic facial expression. Static FER has lower rate than Dynamic FER.

[II]PRE-PROCESSING OF SIGNALS

Facial expressions captured by photos can be studied using facial landmarks namely alae of nose, corner of of eyebrows, mouth corners which are the emotional highlights of the face and varies with six expressions of emotions. Noise reduction using filters; face detection by localising and extracting facial region; Normalisation of colour & size of images; and enhancement of image by Histogram Equalisation are various pre-processing.

[III]FEATURE EXTRACTION

Extracting useful information from the image/input signals is called feature extraction. Gabor feature extraction, local binary pattern, optical flow method, feature point tracking and many such techniques employed for the same. These can be classified as geometric and appearance based. Geometric FER systems extract not only shape and positions but also angles between various face elements like eyes, ears, mouth and nose. Their geometrical relationship illustrates the feature vectors. Appearance based FER uses appearance and employs the texture information of face as feature vector. Appearance based FERs are more popular since they provide higher recognition rate. Another disadvantage of Geometric system is the difficulty in finding accurate and proper geometric features of face in real-life settings [5].

[IV] CLASSIFICATION OF SIGNALS

k-nearest neighbours, Support vector machine, Ada-boost, and Probabilistic neural networks where common classifier used for this purpose. But nowadays, these classifiers are replaced by "Deep Learning" (DL) methods. DL, a branch of Machine learning is widely used in FER systems. Convolutional Neural Network (CNN) among other Neural networks is the most popular among researchers in this field. Here, the input images are convolved through filters in the convolutional layers so by producing a feature map.

II. METHODOLOGY

Convolutional Neural Network

Jung and others in 2015, studied two types of CNN for this purpose. One which can extract the temporal appearance of facial features and another for geometric features [6]. This successfully boosted facial expression recognition. Another method is a Deep region and multi-label learning (DRML). This is a deep neural network which uses feed-forward functions. This approach is easily trained and it can also learn automatically [7]. Better than these two a LSTM (long term short memory), a type of RNN (Recurrent Neural Network), which is easy to fine tune when combined with other models such as CNN and it also supports both fixed and variable length inputs and outputs.

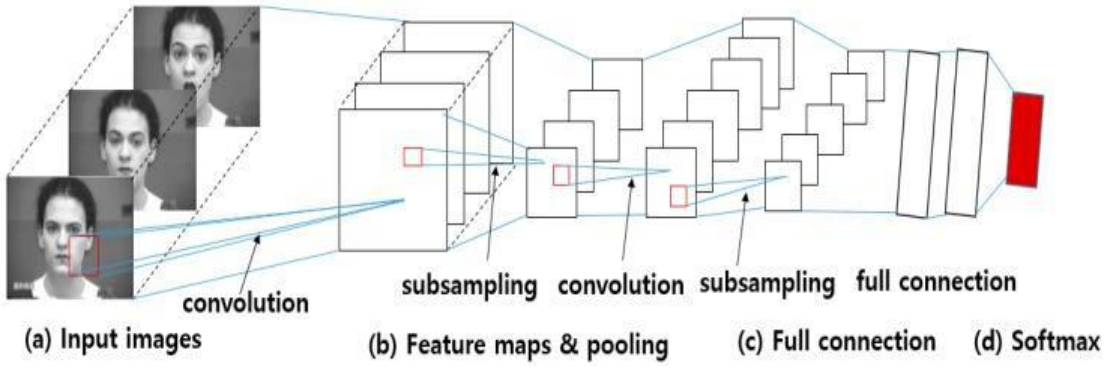
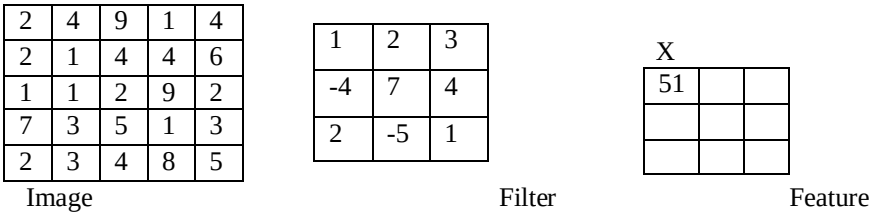


Fig. : CNN in FER [2]

1. Convolutional Layer

Convolutional Layer which is layer which is used to extract features from input image .In this layer operations of convulations are performed between input image and filter in form of size(MXM) and dot product is taken between this 2 with respect to size of filter (MXM)



The output which we get is termed as Feature map which gives us information about image such as conres and edges.

2. Pooling Layer

The main aim of this layer is to decrease the size of feature map to reduce the additional working cost. Pooling refers to a small portion, so we take small portion of input and try to take a maximum value known as Max pooling by which we are not taking all values from image but we are taking max value.

3. Fully Connected Layer

This layer is placed before output layer to form last layer of CNN architecture. It consists of weights and neuron and it is used to connect neurons between two different layers.

4. Activation Functions

It is final and one of the most important function of CNN model. Activation functions are mathematical functions that are added to neural network models to learn complex patterns. There are several commonly used activation functions such as the ReLU, Softmax, tanH and the Sigmoid functions. Each of these functions have a specific usage.

III. CONCLUSION

Even though facial expression recognition has attracted many scientists, real world applications have rarely evolved. This is because these systems have to evolve more and more to provide better accuracy than today's average accuracy of 50%. Since people are from various races, colour, skin textures, they may differ in facial expressions, it is very difficult to create a FER removing all these differences. We hope that further researches in this field may tackle these issues providing us with robust, easy to use and widely applicable facial expression recognition systems.

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