

# Study of Facial Expression Recognition using Machine Learning Techniques

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**ABSTRACT--** Human facial expressions convey lots of unsaid details visually instead of articulation. Facial expression repeatedly performs an essential function inside the area of human-device interplay. Automatic facial expression detection gadget has many applications including, but not restricted to, human behavior knowledge, detection of mental problems, and artificial human expressions. Recognition of facial features by means of a computer with high popularity fee remains a difficult undertaking. In this challenge, we analyze numerous deep studying methods (convolutional neural networks) to pick out the key seven human emotions: anger, disgust, worry, happiness, disappointment, wonder, and neutrality.

**KEYWORDS-** Face Expression, Face Recognition, SVM.

## **I. INTRODUCTION**

With the appearance of the current era, our dreams went high and it binds no bounds. In the prevailing generation, large studies work is going on in the field of digital picture and image processing. The manner of development has been exponential and it's far ever increasing. Image Processing is an enormous place of studies in the cutting-edge world and its packages are very widespread.

Image processing is the field of signal processing where both the input and output alerts are images. One of the most vital applications of Image processing is Facial expression popularity. Our emotion is discovered by the expressions in our face. Facial Expressions plays an important function in interpersonal communication. Facial expression is a non-verbal clinical gesture which gets expressed in our face as in step with our feelings. Automatic popularity of facial features plays a crucial role in artificial intelligence and robotics and as a consequence, it is a need of the generation. Some software related to this consists of Personal identification and Access manipulate, Videophone and Teleconferencing, Forensic software, Human-Computer Interaction, Automated Surveillance, Cosmetology and so on.

The goal of this task is to expand an Automatic Facial Expression Recognition System which can take human facial pics containing a few expression as entering and recognize and classify it into seven extraordinary expression magnificence such as :

**I. Anger**

**II. Disgust**

**III. Worry**

**IV. Happiness**

**V. Disappointment**

**VI. Wonder**

**VII. Neutral**

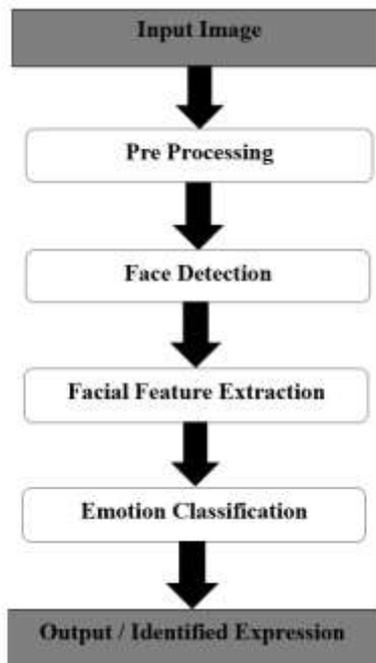


**Figure 1 several facial expressions**

Several Projects have already been completed in these fields and our goal will now not best be to expand an Automatic Facial Expression Recognition System however also enhancing the accuracy of this system in comparison to the opposite to be had systems.

**II. PROBLEEN STATEMENT**

Human facial expressions can be effortlessly categorised into 7 basic emotions: satisfied, unhappy, marvel, fear, anger, disgust, and neutral. Our facial emotions are expressed thru the activation of unique units of facial muscle tissues. These now and again diffused, yet complicated, signals in an expression frequently incorporate an ample amount of records approximately our state of mind. Through facial emotion reputation, we're able to degree the outcomes that content and offerings have on the audience/users through an smooth and coffee-price technique. For instance, retailers may also use those metrics to assess client hobby. Healthcare vendors can provide better carrier by the usage of additional information approximately sufferers' emotional kingdom in the course of treatment.



**Figure 2 Project Formulation**

Entertainment manufacturers can display target market engagement in events to constantly create desired content material. Humans are well-trained in analyzing the feelings of others, in reality, at just 14 months vintage, babies can already tell the distinction among glad and unhappy. But can computers do a higher job than us in having access to emotional states? To solution the query, We designed a deep mastering neural network that gives

machines the capacity to make inferences about our emotional states. In other words, we supply their eyes to see what we can see.

**III. PROCESS**

As per various literature surveys it is found that for implementing this project four basic steps are required to be performed.

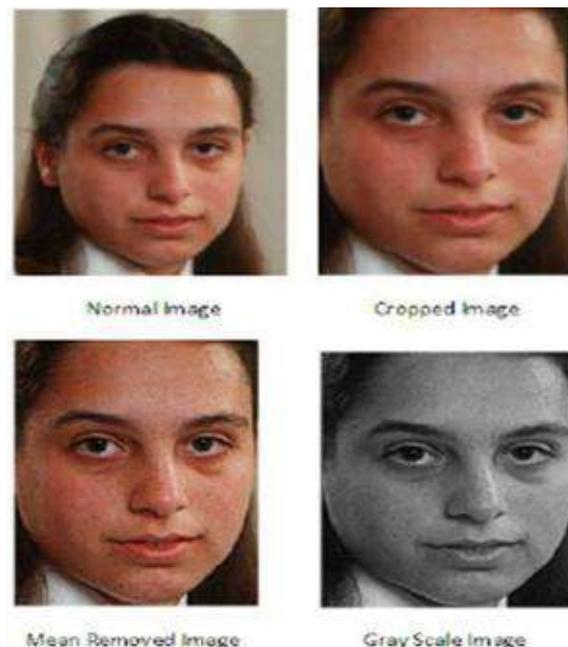
- i. Preprocessing
- ii. Face registration
- iii. Facial feature extraction
- iv. Emotion classification

Description about all these processes are given below-

□ Preprocessing :

Preprocessing is a not unusual call for operations with photos at the bottom degree of abstraction each input and output are depth photos. Most preprocessing steps which can be implemented are –

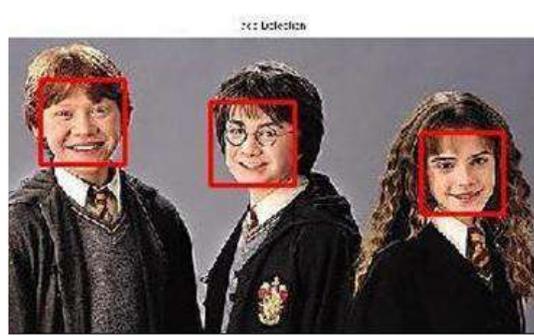
- a. Reduce the noise
- b. Convert The Image To Binary/Grayscale.
- c. Pixel Brightness Transformation.
- d. Geometric Transformation.



**Figure 3 Preprocessing**

□ Face Registration :

Face Registration is a pc era being used in a ramification of packages that identifies human faces in digital pictures. In this face registration step, faces are first placed inside the picture using some set of landmark points known as “face localization” or “face detection”. These detected faces are then geometrically normalized to suit some template picture in a procedure referred to as “face registration”.

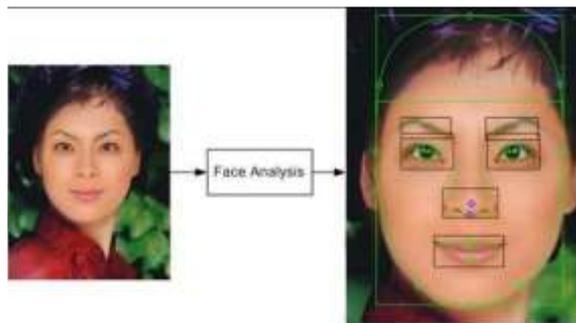


**Figure 4 Face Registration**

□ Facial Feature Extraction :

Facial Features extraction is a crucial step in face recognition and is defined because of the manner of locating specific areas, points, landmarks, or curves/contours in a given 2-D picture or a 3-d range image. In this option extraction step, a numerical feature Sector is generated from the ensuing registered image. Common capabilities that can be extracted are:

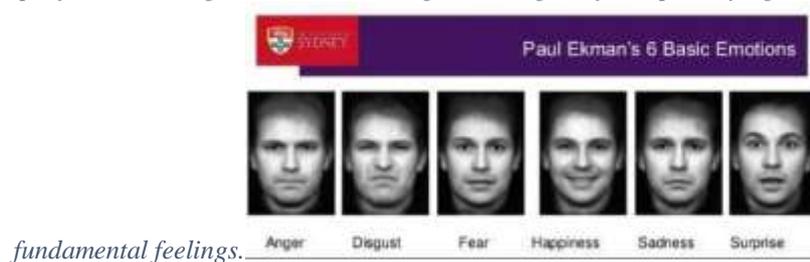
- a. Lips
- b. Eyes
- c. Eyebrows
- d. Nose tip



**Figure 5 Facial Feature Extraction**

□ Emotion Classification :

*In the 1/3 step, of class, the algorithm tries to categorize the given faces portraying one of the seven*



**Figure 6 Emotion Classification**

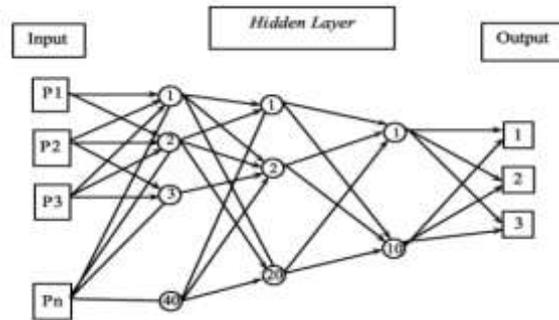
Paul Ekman (born February 15, 1934) is an American psychologist and a pioneer in the take a look at of emotions and their relation to facial expressions. He has created an "atlas of emotions" with greater than 10000 facial expressions.

**IV. TYPES OF APPROACH**

Different approaches which are followed for Facial Expression Recognition:

□ Neural Network Approach :

The neural community contained a hidden layer with neurons. The method is based on the idea that an impartial face photo similar to each photo is available to the device. Each neural community is trained independently with using on line backpropagation. Neural Network could be discussed later.

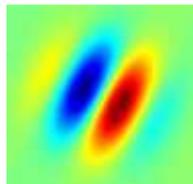


□ Principal of Component Analysis :

Principal thing analysis (PCA) is a statistical manner that uses an orthogonal transformation to convert a hard and fast of observations of in all likelihood correlated variables right into a difficult and fast of values of the linearly uncorrelated variable called Principal Components.

□ Gabor Filter:

In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter out used for texture analysis, because of this that it essentially analyses whether or not there is any unique frequency content within the picture in unique guidelines in a localized area around the factor or location of evaluation. Frequency and orientation representations of Gabor filters are claimed by way of many modern imaginative and prescient scientists to be just like the ones of the human visible system, although there may be no empirical proof and no useful reason to help the concept. They have been found to be in particular suitable for texture illustration and discrimination. In the spatial domain, a 2D Gabor clear out is a Gaussian kernel feature modulated by a sinusoidal plane wave.



Gabor filters are directly related to Gabor wavelets considering that they can be designed for some of dilations and rotations. Nevertheless, in desired, progress is not applied for Gabor wavelets, because this requires computation of bi-orthogonal wavelets, which may also be very time-ingesting. Hence, quite often, a filter economic institution including Gabor filters with various scales and rotations is created. The filters are convolved with the sign, ensuing in a so-known as Gabor field. This method is closely concerning approaches within the in, particularly seen cortex. Jones and Palmer tested that the real part of the intricate Gabor function is a superb match to the receptive subject weight aspects located in convenient cells in a cat's striate cortex.

□ Support Vector Machine :

In gadget mastering, help vector machines are supervised studying fashions with related mastering algorithms that analyze facts used for type and regression evaluation. Given a collection of education examples, each marked as belonging to 1 or the other of classes, an SVM schooling algorithm builds a variation that assigns new examples to 1 category or the substitute, making it a non-probabilistic binary mannequin. An SVM version is an illustration of the examples as factors in space, mapped so that the examples of the separate classes are divided by means of a clean hole that is as broad as practicable. New examples are then mapped into that equal discipline and expected to belong to a class-based absolutely on which side of the hole they fall.

In addition to acting linear class, SVMs can successfully perform a nonlinear type the use of what is called the kernel trick implicitly mapping their inputs into excessive-dimensional characteristic spaces. When information isn't classified, supervised learning isn't always feasible, and unmonitored gaining knowledge of approach is required, which tries to discover natural clustering of the statistics to companies, and then map new data to those formed companies. The aid vector clustering algorithm created by means of Hava Siegelmann and Vladimir Vapnik applies the information of assist vectors, advanced within the help vector machines algorithm, to categorize unlabeled facts, and is one of the maximum widely used clustering algorithms in industrial packages.

Various facial datasets available online are:

1. Japanese Female Facial Expression (JAFFE)
2. FER
3. CMU MultiPIE
4. Lifespan
5. MMI
6. FEED
7. CK

**TABLE I: COMPARISON OF FACE DETECTION OF EXISTING TECHNIQUE**

Ref	Segmentation Techniques	Dataset	Performance
[12]	RGB Colour Space	Self-prepared 120 Images	Detection Rate = 80%
[16]	YcbCr + RGB + Canny Edge	FRGC 302 Images	Detection Rate = 82.7%
[17]	Skin Colour	Self-prepared	Detection Rate = 88.9%
[18]	Adaboost & SVM	MIT + CMU (2500 Images)	Detection Rate = 94.5%
[19]	RGB-H-CbCr	Self-prepared	Detection Rate = 90%

**TABLE II: COMPARISON OF FACE FEATURE EXTRACTION OF EXISTING TECHNIQUES**

Ref	Segmentation Techniques	Feature Extraction	Dataset	Performance
[20]	Haar Features and Adaboost	LBP	CK+ and JAFFE	Accuracy=89.64%
[21]	Adaboost	LBP and MCT	FDDB and MIT + CMU	Accuracy=91%
[22]	Skin Color	ANN	LFW and PEAL	Accuracy= 89.5%
[23]	Viola-Jones	SVM	Self- prepared 300 Images	Training time period 60% increases
[24]	Hough Transform	SVM	AR database	FR rate increased by 7.7%
LBP: Local Binary Pattern, ANN: Artificial Neural Network, SVM: Support Vector Machine, MCT: Modified Census Transform				

**TABLE III: COMPARISON OF FACE DATABASE**

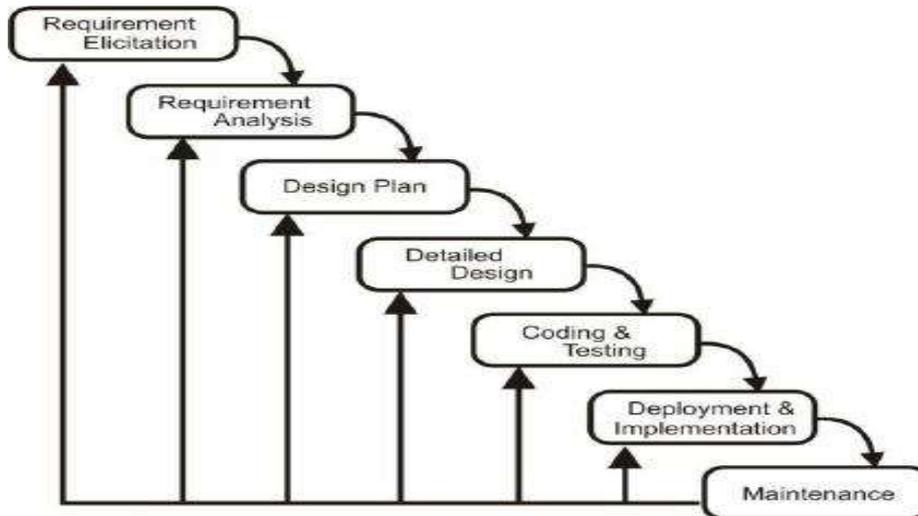
<b>Database</b>	<b>Description</b>
AT & T Database	40 people with 10 images of each (different lighting conditions).
AR Database	4,000 color images of 70 men's and 56 women's.
CAS-PEAL Face Database	99,594 images of 1040 people are in different Pose, Expression, Accessory, and Lighting conditions.
CMU Multi-PIE	750,000 images of 337 people.
CK	486 images of 97 people's
FERET	1000 people of images
Kinect Face Database	52 people in different lighting and occlusion conditions.
Georgia Tech	50 people of images.
Indian Movie database	34512 images of 100 Indian actors are in different age, pose, gender, expression, and occlusion.
JAFFE	213 images of 7 facial expressions each female
Labeled Wikipedia faces	8,500 faces (taken from Wikipedia).
LDHF Database	100 people's images at different distances of 60m, 100m, and 150m from the subject's.
MIT-CBCL database	200 images are in different illumination, pose, and complex background.
YouTube	604 images of 151 subjects
MORPH Database	55,134 images of 13,000 people's. This database describes gender, date of birth, and date of acquisition.
3D face	1149 of the facial color of 105 adults.
Oulu Face Database	125 different faces are in different illuminant conditions.
Yale face Database	165 greyscale images of 15 individuals - 11 images per subject.
YouTube Faces	3,425 videos of 1,595 different people's.
The PUT Face	9971 images of 100 people's.

## V. PLANNING

The steps we observed while developing this mission are:

1. Analysis of the problem announcement.
2. Gathering of the requirement specification
3. Analyzation of the feasibility of the undertaking.
4. Development of a widespread format.
5. Going through the journals regarding the previous associated works on this discipline.
6. Choosing the technique for growing the set of rules.
7. Analyzing the numerous execs and cons.
8. Starting the improvement of the undertaking.
9. Installation of software program like ANACONDA.
10. Developing an algorithm.
11. Analysation of the set of rules by way of the manual.
12. Coding as in keeping with the evolved algorithm in PYTHON.

We developed this project as per the iterative waterfall model



**TABLE IV: COMPARISON OF DIFFERENT FACE DATABASE**

<i>Traing</i>	<i>Testing</i>	<i>Accu</i>
FER2013	CK+	76.05
FER2013	CK+	73.38
JAFFE	CK+	54.05
MMI	CK+	66.20
FEED	CK+	56.60
FER2013	JAFFE	50.70
FER2013	JAFFE	45.07
CK+	JAFFE	55.87
BU-3DFE	JAFFE	41.96
CK	JAFFE	45.71
CK	JAFEE	41.30
FEED	JAFFE	46.48
FEED	JAFFE	60.09

**VI. CONCLUSION**

**THIS PAPER GIVES** a comprehensive survey of face popularity and numerous demanding situations in the closing fifty one years. This literature evaluation confirmed constantly growing hobby inside the discipline of face reputation. During face recognition some well-known problems consisting of pose, facial expression, illumination, occlusion, different facial functions, etc. Have attained a whole lot of interest in the research network of laptop vision and pattern popularity. Various varieties of techniques were proposed to compensate for most of these challenges but nevertheless, there are a few unsolved challenges, so there's a scope of optimization. All those analyses will deliver the right route to the researcher inside the future to clear up the unsolved challenges.

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