International Journal of Advanced Technology in Engineering and Science
Vol. No. 09, Issue No. 04, April 2021
www.ijates.com
ijates
ISSN 2348 - 7550

An Approach to Facial Expression Recognition using Machine Learning Algorithm

Ankita Singh
Department of Computer Science and Engineering
Galgotias University
Greater Noida, India
ankitasgh12@gmail.com

Awinash Jha
Department of Computer Science and Engineering
Galgotias University
Greater Noida, India
awinash1532@gmail.com

Yogesh Yadav
Department of Computer Science and Engineering
Galgotias University
Greater Noida, India
yogeshyadav278@gmail.com

Abstract

Apart from the somatic aspect here is one thing every soul shares fundamentally-emotions. Emotions are exhibited through consistent facial expressions. In recent years, FER technology has gained importance, and this is often justified by the applications in several domains: psychology, engineering, neuroscience, healthcare. The motive of this paper is to spot different approaches for face expression recognition within the past few years. Any system which allows for detection, extraction also as evaluation of those facial expressions does serve for automatic recognition of human emotions.As we individuals interact socially but emotions speaks what lips can't or failed. These human emotions outshine ethnic mosaic and also the origin. Human facial expressions are bound for fetching those necessary knowledge, which is tough to admit by the lips. It provides the psychological state of someone that directly consort to his/her intention or the physical efforts that are needed for performing tasks or what someone wants to do.

Keywords— Facial Expression Recognition System(FER).

I. INTRODUCTION

As we all know countenance is a vital type of emotional additionally to psychological state. Psychologist's research shows that only 7% of the entire information are given language itself, and 38% is transported by language auxiliary, like the rhythm of facial features has reached 55% of the total[1].

Humans interact socially with the assistance of emotions, which are studied as a universal language. These emotions surpass cultural diversities and ethnicity. Facial expressions, especially micro-expressions, are often signs of these emotions and thus the power to detect them could even be important for people working in enforcement, national security, intelligence, or the system.

Individuals and organizations with interests in detecting lies have used programs. People have developed that supported information that has been substantiated in research and informed by enforcement experience observed within the globe by officers and agents who have worked. Many instructor-led training programs which involve those that designed and took part in group-based exercises. Many of them introduce trainees to knowledge about the character of emotion, facial expressions even about the tiny detail like micro-expressions, and other nonverbal behaviors including voice, gesture, gaze, posture likewise because the nature of truth which is convincing and lying about the nonverbal signals related to both.

But Human facial expressions are accountable for delivering the knowledge, which was very difficult to perceive. These expressions provides the psychological state of someone that directly relates to his intentions or

the physical efforts that he must be applying for performing tasks. On a worst level, one can say that there are some components of a face are associated with age, emotion, orientation. Some more components are persist with the person regardless of age, emotion, etc. we've got all seen folks that look alike sideways, but very different otherwise. Or, a toddler within the family reminds people of his parents at that age.

So, it is not very easy to logically identify these individual components. But, one can recite that there are several overlapping components of the face — which are individually liable for the perception of emotion, age of the person himself. Essentially, we all know that there is "some relation which are too complex for logic" — that's where machine learning shows up!

In the 1970s, Paul Ekman and Wallace Friesen[2] made a pioneering work for facial expression recognition that they defined six basic expression categories of human:

1) Surprise
2) Fear
3) Disgust
4) Anger
5) Happiness
6) Sadness

Which provided a way for current expression recognition research. Other factors also contribute to the recognition of a person's emotional state such as voice, body language, gestures even the direction of the gaze. Emotion recognition, therefore, demands a more precise knowledge ofthose factors in conjunction with contextual information to convey more accurate results.

II. FACIAL RECOGNIZATION

A identity verification system could be a technology able to detect an individual's face from a image or human itself or through a video frame employing a database of faces which contains different features of human faces like lips, cheek, nose eyes, etc,.. through ID verification services for conformation of the proper person, also to spot human emotions. Basically there are two ways to detect human faces:
Geometric which is feature based and photo-metric which is view based. Scientist are still within the process to search out a stronger way.

III. FACIAL DETECTION

Face detection could be a stride towards many face-related technologies, like facial recognition system or verification for various use. The utmost successful application of face detection would apparently be taking photos of an individual.

These facial detection are a sort of computer vision technology that use to spot people's faces within digital images. this is often very obvious for we humans, but computers need aprecise instructions. the pictures might accommodate many objects that are not human faces, like buildings, cars, animals. it's the indispensable step for face recognition and is employed to detect faces within the images. it's a long-established problem for humans to resolve and has been solved sensibly, well by classical feature-based techniques, like the cascade classifier. it's part of object disclosure and may use in many areas like security, biometric, enforcement, entertainment, personal safety. Good usage of face detection/tracking is that the cornerstone of mobile device interaction. With the face region tracked, the system can support applications like a Pong game or map panning and zooming. After the face has been detected, the subsequent is to extract and represent the knowledge about the face expression in order that it might be easier to get identified. The extraction process assemble a high-level

description of the expression as a function of the image pixel data. This description commonly stated as "feature vector" which is employed for consequent expression classification.

Geometric features which extant the form and locations of facial components and spectral-transform-based features which are gained by applying image filters for facial images that are often accustomed to express the knowledge of facial expressions, no matter what the sort of feature extraction is approached. the mandatory information about the displayed expressions should be preserved as a database for further use. The extracted features should comprises high discrimination power and high stability against different expressions.

IV. FEATURE EXTRACTION

Extracting useful information from the image/input signals is named feature extraction. it's a district of the dimensional reduction process, in which, an initial sets of the information and splits, and reduced to more manageable groups. the foremost important characteristic of these large data sets is that they have an outsize the quantity of variables. These variables require a lot of computing resources to process. Gabor feature extraction, local binary pattern, optical flow method feature, point tracking and lots of such techniques are deployed for the identical. These features are easy to process, but still unable to explain the particular data set with accuracy and originality. The feature extraction methods are categorized into five types like texture feature-based method, edge-based method, global and native feature-based method, geometric feature-based method, and patch-based method.

Geometric systems[3] may be a systems that 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.
Some of the important difference between a independent component and appearance-based are:

- Appearance-based which uses the looks and extract the required information of the face as a feature vector. Appearances-based are more popular because they supply a better recognition rate. Whereas within the geometric system, it's difficult in detecting accurate and proper geometric features of the face in real-life settings.

- Independent Component Analysis (ICA)[4] is additionally a feature extraction method that extracts the local features using multichannel observations. Facial movement features are extracted as patches depending upon the space characteristics. These are performed by using two processes as extracting the patches and patch matching. The patch identical is performed by translating extracted patches into distance characteristics.

V. APPEARANCE BASED

The appearance-based approach depends on a collection of delegate training face images to seek out out the higher models. The appearance-based method is best than other ways of performance. These appearance-based methods rely on techniques from statistical analysis and machine learning which detect the relevant characteristics of face images. This method is additionally utilized in feature extraction for face recognition. The appearance-based method is categorized into submethods for the employment of face detection, which are as follows:

1) Eigenfaces Based
2) Distribution Based
3) Neural Networks
4) Support Vector Machine

5) Sparse Networks of Winnows
6) Naive Bayes Classifiers
7) Hidden Markov Model
8) Information Theoretical Approach
9) Inductive Learning

Many methods are proposed within the field of face detection. one in all them relies on the matching of facial template images. However, the scale and pose of the face are limited because it takes terrible computation cost to consider all sizes and poses of the template image. On the other hand is that the methods supported complexion and may detect any size and poses of the face because it's difficult to detect the face from a coloring background. This method use head shape information or hair color information. Moreover, it is necessary to make a face actually within the region detected by the methods to reject the false detection. to create sure whether there's a face actually or not, the approach to withdraw countenance like pupils, a nostril, and a mouth is taken into account. The facial appearance extraction is that the method supported the geometric face model which is proposed. However, the tactic assumes the nearly frontal face.

VI. CLASSIFICATION

Classification is that the ending of the facial features recognition system within which the classifier categorizes the expression sort of a surprise, sad, smile, anger, disgust, fear, and neutral. Common classifiers used for this purpose are k-nearest neighbors, Support vector machine, Ada-boost, and Probabilistic neural networks. The KNN (k – Nearest Neighbors) algorithm is also a classification method during which the connection among the assessment models but as of the opposite models are estimated during the training stage. Convolution Neural Network (CNN) among other neural networks is that the hottest among researchers during this field. Jung et al. in 2015[5] studied two sorts of CNN for this purpose. One which might be excerpt within the temporal appearance of face expression and another for geometric features. However, this successfully boosted facial features recognition has another method in Deep region and multi-label learning (DRML). This deep neural network that uses feed-forward functions. This approach is definitely trained and it may also learn automatically.

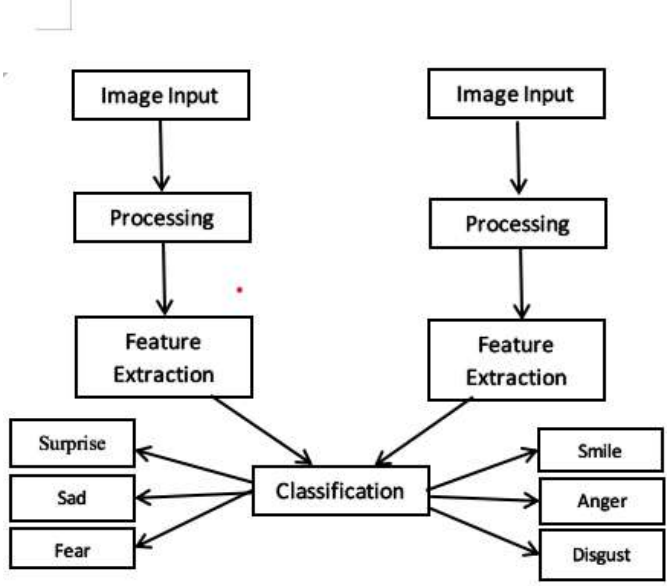

Fig: Architecture of facial expression recognition system

VII. FRAMEWORK

Generally, countenance recognition use systems for feature extraction, analysis of countenance information, analyzing and understanding human emotions like happiness, fear, surprise, anger, sadness, disgust. countenance recognition is split into phases which are training phase and testingphase[6].

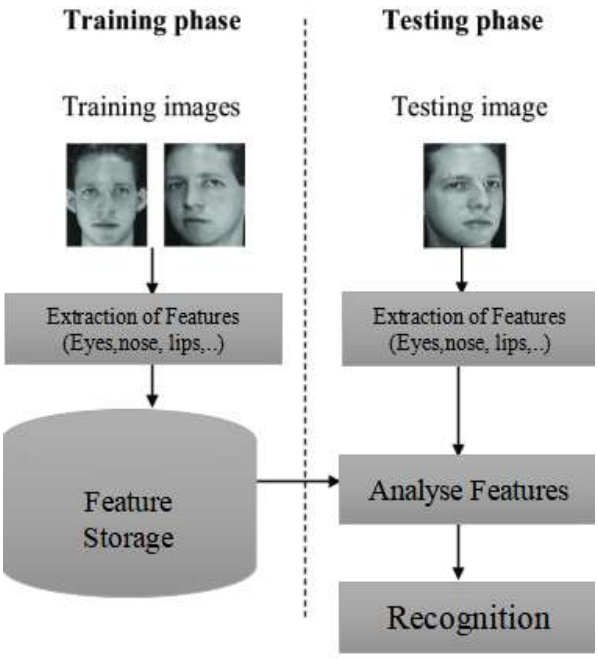

Fig: Facial Expression Recognition System Framework

Training Phase::In these phases, the researchers ought to extract features within the sample images, initially the feature classification then get the feature classifier.

Testing Phases::In these researchers need to detect human faces from the sample images then extract countenance features, then to rearrange countenance features with the trained classifier. Ultimately they get the output of recognition result.

Also, The working of the proposed framework predicated on dual-feature fusion. For dual-feature fusion, firstly they detect the facial landmark like points on the face image then the important local regions are located. The Weber local descriptor excitation and orientation image are also generated from the input imageswithin the following step, a discrete cosine transform to choose the high variance features from local regions along the side excitation and orientation image of Weber local descriptor excitation to reinforce the performance into both forms of features then fused using the score-level fusion.

VIII. TRADITIONAL METHOLODY

Previously face expression recognition system was utilized in various ways, those are:

Classical face recognition algorithms:

There has been a rapid development of reliable face recognition algorithms within the far-off centuries[7]. the normal face recognition algorithms is categorized into two categories. These are as follows:

a) **Holistic features:** The motive is to style a low-dimensional set of features that are quick to compute and capture sufficient information about the objects occupation a picture and to permit straight discrimination between normal and abnormal events. Four features that later may be used effectively to detect abnormal events. Two of those features are crowd collectives and crowd conflict.

In crowd collectives, the try and model the interaction of objects in crowded scenes..

In crowd conflict, these will model crowd density and motion, which we found significantly which can the improve classification performance without requiring significant additional computation.

b) **Local Feature Approach:** The kernels of LFA are derived by enforcing topology into eigenvectors of PCA. Then selection, or scarification. These steps are wont to reduce and decor associated with the outputs.

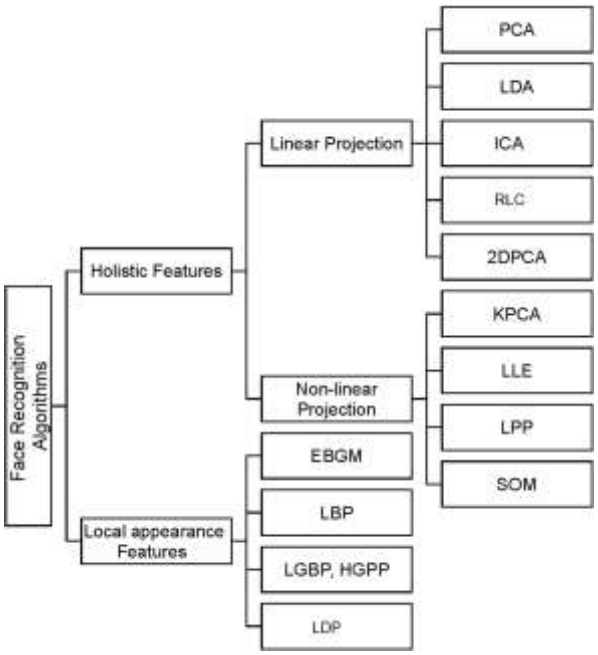

Fig: Traditional Algorithm

EBGM: It stands for Elastic Bunch Graph Matching. EBGM is an algorithm in computer vision for recognizing anyobjects or detects human faces.

LBP: It stands for Local Binary Pattern. LBP could be a simple but quality operator which labels the pixels of a picture through threshold the region of every pixel and study the result as a binary number.

HGPP: It stands for Histogram of Gabor Phase Patterns. it's the mixture of spatial histogram and Gabor phase information.

LDP:It stands for Local Directional Pattern. It is a feature used for face recognition that assigns a code for each pixel in the image, andgenerate a code from the relative strength magnitude.

PCA: It stands for Principal Component Analysis. it's an oldest method of face recognition which relies on the Karhunen-Loeve Transform (KLT) as Hotelling Transform and Eigenvector Transform which works on dimensional reduction in biometric authentication.

LDA: It stands for Linear Discriminant Analysis. LDA is another dimensional reduction technique also known as Fisher's Discriminant Analysis.

ICA:It stands for Independent Component Analysis. BasicallyICA is nothing but ageneralizedview of the PCA.

LLE: It stands for Locally Linear Embedding. It is an algorithm in which nonlinear dimensional reduction method is used.

LPP: It stands for Locality Preserving Projection. LPP is an algorithm for learning a local preserving subspace.

SOM: It stands for Self-Organizing Map which locale and extract the face region from the background.

Artificial Neural Networks (ANNs):

Artificial neural networks are wont to solve a nonlinear problem. the substitute neural networks procure a general practical method for real-valued, discrete-valued, and vector-valued functions.

A radial basis functions neural network-integrated with a non- negative matrix factorization to perceive faces. Non- negative sparse coding method to learning countenance using different distance metrics and normalized cross- correlation for face recognition.

An artificial neural network could be a shared computing scheme supported the structure of the system of humans. The architecture of a neural network is organized by connecting multiple elementary processors, this being an adaptive system that has an algorithm to regulate its weights to realize the performance requirements of the matter.

IX. PROCESS

This follows the process of characteristic completely different part of human faces like lips, cheek, nose eyes, etc.. to detect facial marks even the smallest detail about the face and stores features of humans in a feature database and later analyse the face using information saved in the feature database. It is very important to place the human image or human face in perfect alignment so that the feature database can detect or analyse the face quickly using feature database.

Contextually, face recognition often described as processes that are:

Face Detection: This locates one or more (multiple) faces within the image and marks with a bounding box.

Face Alignment: This normalizes the face to be in step with the database, like geometry and photo-metric.

Feature Extraction: This extracts features from the face which can be used as a database to the features and use them whenever needed.

Face Recognition: This performs matching of the face against one or more face during analyzing or detecting the face using database.

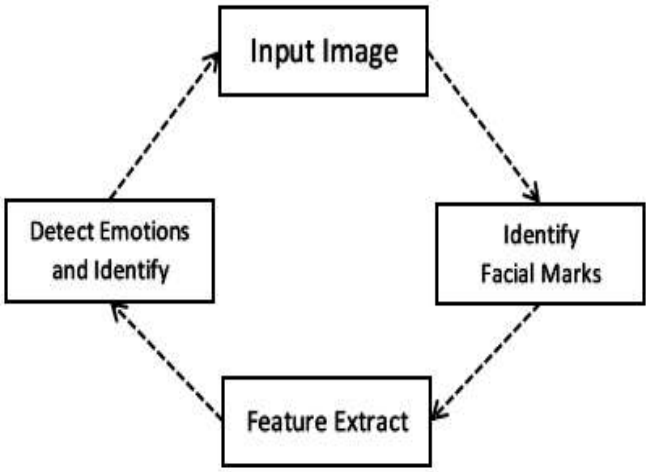

Fig: Processes in Facial recognition process

X. ANALYSIS

The methodology used in this model isn't a rocket science to understand. We have tried to explain lucidly in every point which has been used in developing this model I.e, facial expression recognition system.. We have explained the importance of this emotions because human emotions are the way to understand we humans better. Human often speaks more truth by his emotions then words could ever speak. Scientists are still in a way to understand these concept more specifically and clearly. Most of them have tried to explain their concepts regarding the topic. I've read many of them analyze that in order to under these emotions more clearly there are mainly two types of facial recognition methods and has its own advantages and disadvantages as explained in feature extraction. How well we extract the details from the image and then analyse them matters a lot in facial expression recognition. There are various traditional approaches like Classical face recognition analysis and Artificial Neural Network. However, many improvements are still needed in order to successfully make this working.

XI. PROBLEMS FACED

Usually problem/difficulties faced by most of the peoples while developing this model facial features recognition system are:

- **Subject-dependence:** it's a problem that none of the assorted sensors can solve. A facial recognition system might require a substantial datasets to be told each expression. However, the classifier is probably going to over-fit and consequently needs more attention within the future to seek out an improved solution for reaching to the matter.
- **Large Pose Variations:**3D models may be considered as a correct method to handle large pose variations. Achieving the polarizationstate andrepresenting of faces within the thermal spectrum are often engaged to clarify the countenance that provides more options to add textual and geometric information rather than thermal face imagery.
- **General Multi-modal Sensor Data Fusion:** This facial recognition systemsbenefits fusion technology and find the appropriate method which is tougher than the issue provoked by illumination variation, head pose, and background variability. Researchers have alsoworked on late fusion which is decision-level fusion while previous fusion like feature-level fusion needs more support in comparison to others.

CONCLUSION

This facial features recognition continues to be a really demanding and hard to know after the decades of exploration. although face expression recognition has attracted many scientists, real-world applications have rarely evolved. this is often because these systems needs more and detailed information associated with each facial marks to produce better accuracy than today's average accuracy.. face expression Recognition is employed in real-time applications like driver state surveillance, medical, robotics interaction, forensic section, detecting deceptions. This survey paper is helpful for all who wants to grasp and gain knowledge even for the software developers. This paper holds a close survey of the assorted framework, processes, detection, methods including traditional methods with classification for those approaches which are wont to detect human facial expressions for the identification of emotions. We also realized the most problems during this area which will inspire new approaches to beat and improve the facial features Recognition systems more better within the coming future.

REFERENCES

[1] Huang, Yunxin, et al. "Facial expression recognition: A survey." *Symmetry* 11.10 (2019): 1189.

[2] Gauthier, Isabel, Marlene Behrmann, and Michael J. Tarr. "Can face recognition really be dissociated from object recognition?." *Journal of Cognitive Neuroscience* 11.4 (1999): 349-370.

[3] Hammed, S. Shaul, A. Sabanayagam, and E. Ramakalaivani. "A Review On Facial Expression Recognition Systems." *Journal of Critical Reviews* 7.4 (2020): 903-905.

[4] Revina, I. Michael, and WR Sam Emmanuel. "A survey on human face expression recognition techniques." *Journal of King Saud University-Computer and Information Sciences* (2018).

[5] Chokkadi, Sukhada, and Abhir Bhandary. "A Study on various state of the art of the Art Face Recognition System using Deep Learning Techniques." *arXiv preprint arXiv:1911.08426* (2019).

[6] Balasuriya, Lalendra Sumitha, and N. D. Kodikara. "Frontal view human face detection and recognition." *B. Sc.(Hons) Thesis, Department of Statistics and Computer Science, University of Colombo* (2000).

[7] Wójcik, Waldemar, Konrad Gromaszek, and Muhtar Junisbekov. "Face recognition: Issues, methods and alternative applications." *Face Recognition-Semisupervised Classification, Subspace Projection and Evaluation Methods* (2016): 7-28.

[8] Beymer, David, and Tomaso Poggio. "Face recognition from one example view." *Proceedings of IEEE International Conference on Computer Vision*. IEEE, 1995.

[9] Kadiya, Hardik, and Jayesh Mevada Sir. "COMPARITIVE STUDY ON FACE RECOGNITION USING HGPP, PCA, LDA, ICAAND SVM." (2012).

[10] Brunelli, Roberto, and Tomaso Poggio. "Face recognition: Features versus templates." *IEEE transactions on pattern analysis and machine intelligence* 15.10 (1993): 1042-1052.

[11] Dunteman, George H. "Uses of principal components in regression analysis." *Principal components analysis* (1989): 65-74.