Performance Evaluation and Implementation of Facial Expression and Emotion Recognition System using Principal Component Analysis

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Abstract – Facial expression is primary part to understand the human fillings and emotions. Outward appearance is movements or positions of the muscles underneath the skin of the face. Though nothing is said verbally, there is much to be understood about the messages we send and receive through the use of nonverbal communication, such our expressions. Such as communication is two types Verbal and Non-Verbal in this two kind of correspondence (contact) outward appearance is sort of non-verbal correspondence yet it expects critical part. The feelings expressed on a person's face; a sad expression, a look of triumph, an angry face .This paper incorporates presentation of facial feeling acknowledgment framework, Application, relative investigation of well known face look acknowledgment methods and periods of programmed outward appearance acknowledgment framework. Facial expression plays a principal role in human interaction and communication since it contains critical and necessary information regarding emotion. This paper goal is to present needs and utilizations of outward appearance acknowledgment.

Key Words: Emotion recognition, PCA, Facial expression, Image processing, Human Machine Interface.

1. Introduction: Face recognition technique is becoming one of the most important interesting and challenging in technology to identifying image in several areas. Facial expression is one of the most powerful, natural and immediate for the human beans to communicate and express their emotion and intention. Through the emotion of human being we easily identify the personality of human. Automatic facial expression analysis more interesting and challenging problem and it impact important application in many areas such as human computer interaction and data driven animation. Facial expression are play very important role to communicate between human being to see find out his/her mind set or expression For more than a century expressions have been approached as by dimensional, static, instantaneous, self-contained, well-defined, and universal signals When we can text and message to our friends we use some symbolic diagram to express our filling so facial expressions is most important in our communications. Face recognition is one of the most challenging research areas in the field of computer vision. Even though face exhibits

different facial features, which can be instantly recognized by human eyes, it is very difficult for a computer to extract and use the information content from these features. Communication between human been are done by verbal and non-verbal, facial expression is the part of non-verbal communication to communicate human been. Human face consists of main sensory inputs and sensory outputs. It is used to identify gender, ethnicity, attractiveness, personality, information about age etc.

In pattern reorganization and computer vision PCA (Principal Component Analysis) classical feature extraction and data representation technique are widely used. The main purpose of PCA is shortening the huge amount of dimensional data space into the smallest dimensional data economically.

Table -1: Comparative Study

S.No.	Title	Technique	Database	Performance (%)	Remarks
	Comparative Study				
1	Natural Face Classification Using Personalized Appearance Mode For Fast And Robust Emotion Detection	The Proposed Method is Made Rohust to Various type of user head Motions	CK+,ISL and Internal Database are used	With low Complexity Pre-Processer having a Pre-processing Accuracy of 66%	This Approch May not handle talking Face
2	Multimode Emotion Recognition(MER) System	The use Microsoft XBOX KINECT Sensor, The data include 2D facial images,3D face Feature	MER fusion Recognition part and new database		There is 25 feature in 2D data,32 feature in 3D data an 13 feature in audio data
3	An Efficient Algorithm for Motion Detection Based Facial Expression Recognition using Optical Flow	Infra-Red(IR) illumination used for facial feature approximately localization. Source Vector (SV) used for vector collection and identificatio	Approximately 1000 images sequences of Cohn-Kanada Facial Expression Database with 65% female facial image used for experiment	94% recognition rate	Only three frames are sufficient to detect facial expression.

		n of emotion is based on highest degree of similarity between source vector and execution motion vector		
4	Emotion Recognition System Using Open Web Platform	Facial Action Coding System(FACS) and Facial Action Coding System Affect Interpretation Dictionary		Accuracy of 76.6% for Determining exact emotion	Classification of Emotion id Made Based in the Movement of Reading Point
5	Facial expression recognition with Auto-Illumination correction	Expressions on the face are determined with Action Units (AU's)	Single and Multiple face image	60% recognition rate for multiple face image	Illumination image plays vital role.
6	The application study of learner's face detection and location in the teaching network system based on emotion recognition	SVM(Support Vector Machine) classifier based Adaboost algorithm used	PIE face image database used	Detection and Correction rate 95% or more.	Presents application of face emotion recognition. With application of E-learning system.
7	Identification-driven Emotion recognition system for a Social Robot	Hybrid approach used for personalized emotion recognition,	MUG facial expression database used. More than 50 people frontal face database used aged between 20-25 years.	82% performance achieved with KNN Classifiers.	3D model facial image used.KNN classifier gives good performance for emotion recognition.
8	Cognitive Face Analysis System for Future Interactive TV	Ada-LDA learning algorithm and MspLBP features used for effective multi-class pattern classifier	JAFFE and MIT+CMU database	Recognition rate of over 15 frames per second	Real time performance with high recognition rate
9	Rodust Facial Expression Recognition Using Spatially Localized Geometric Model	For Feature Extraction The Algorithm Uses Edge Projection Analysis	The Cohn Kanade database consists of Grayscale image sequence	The Algorithm Achieves an Accuracy of 90% for Facial Expression Recognition	A Lip-enhancement Transform for Better Segmentation of Lip-region in color image was Proposed
10	Statistical Moments based Facial expression Analysis	Feature Extraction: Zernike moments Classification: Naive Bayesian classifier	JAFFE (Japanese Female Facial expression) database 60 images used for experiment.	Average accuracy for six emotions are 81.66% in time less than 2 seconds.	Emotion accuracy graph shows highest recognition rate of happiness and lowest recognition rate of sadness.

2. Objective:-

❖ Real time based system

❖ To recognize facial emotion of human

❖ Working with human computer interface

3. Methodology:-

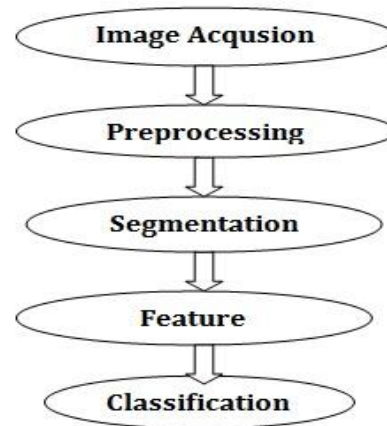Face recognition system can be formulated as following Phases:

Fig. 1: Face Expression Recognition System

Many factors supply in conveying emotions of personality. Pose, speech, facial expressions, activities and actions are some of them. Outward appearance assumes an important part in human connection and correspondence since it contains basic and essential data in regards to feeling. The assignment of naturally perceiving diverse outward appearances in human-PC environment is critical and testing. As we have seen picture pre-processing and division is essential stride for acknowledgment thus it is fundamental to put some proficient procedure for the same to improve the efficiency of system we need an efficient segmentation technique. Efficient preprocessing technique so that classification can be performed in efficient manner.
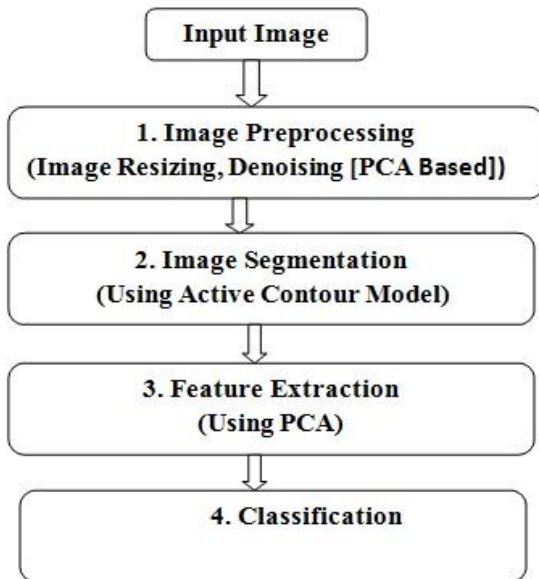
Fig. 2: Main Parts of Face Expression Recognition System

3.1. Image Pre-Processing: In this module, the image pre-processing will be preformed which will convert the image into the desired resolution.

Fig. 3: Image Pre-Processing

3.2. Segmentation: We have used Active Contour based segmentation of face. Active contour model represents an object boundary or some other salient image feature as a parametric curve and energy functional E is associated with the curve. The problem of finding object boundary is cast as an energy minimization problem. Segmentation techniques are either Contextual or Noncontextual. Thresholding is the simplest Nocontextual segmentation technique. With a single threshold, it transforms a grayscale or color image into a binary image considered as a binary region map. Noncontextual thresholding groups pixels with no account of their relative locations in the image plane. Contextual segmentation can be more successful in separating individual objects because it accounts for closeness of pixels that belong to an individual object
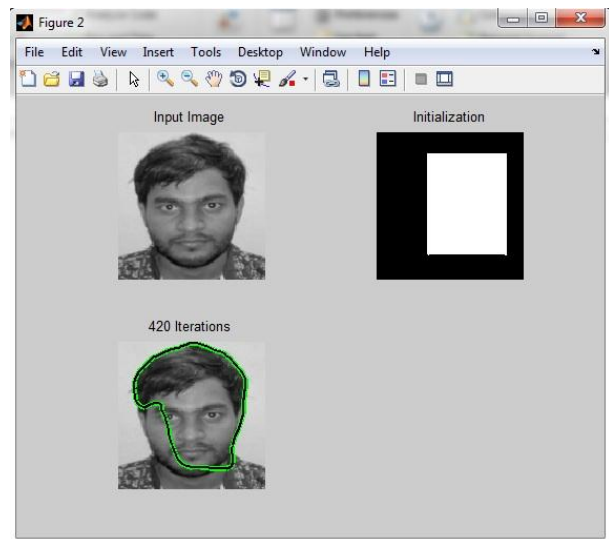

Fig. 4: Segmentation

3.3.Feature Extraction: For extraction the PCA algorithm will be used. The PCA algorithm will generate the Eigen faces for each of the image and through these Eigen faces; the system will generated the Eigenvectors.
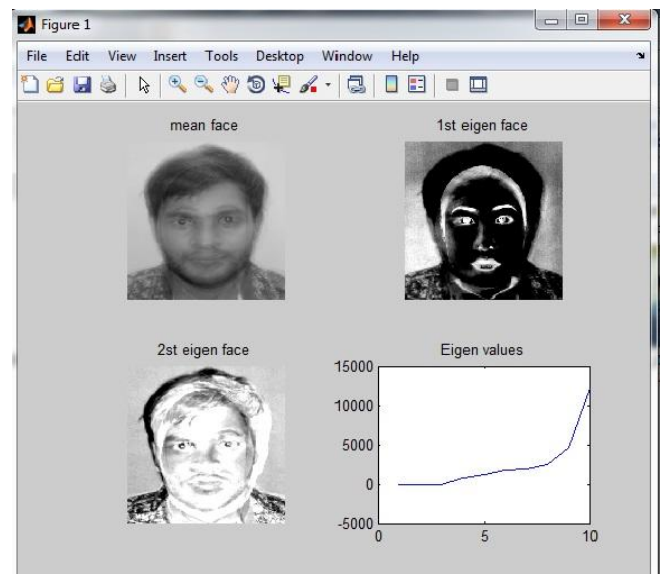

Fig. 5: Feature Extraction

Classification: The task was to classify each of the images into one of the six standard expressions

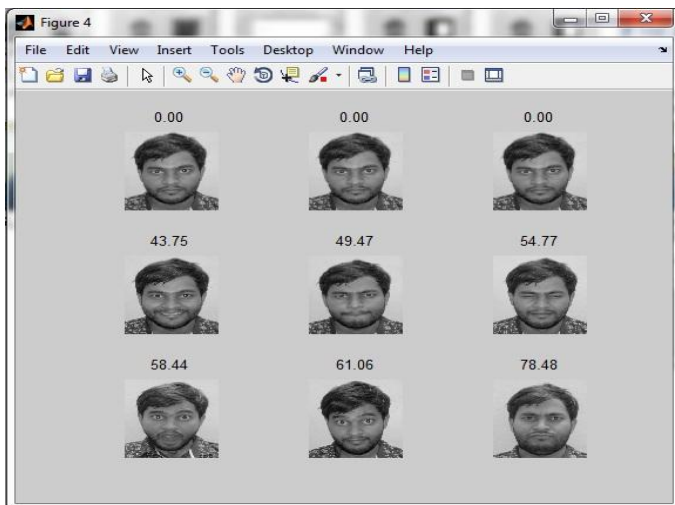**Classes:** happiness, anger, disgust, sadness, fear and surprise
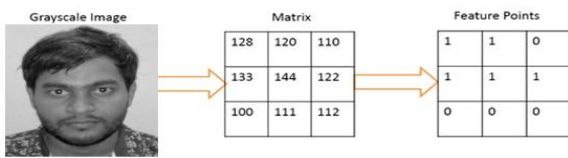
Fig. 6: Classification

Fig. 7: Feature Vector

Calculating Feature Vector (FV) for calculating feature vector, An N*N matrix is said to have the feature values xi and corresponding the feature vector is

$$F_v = \begin{cases} 1 & xi < xthresold \\ 0 & otherwise \end{cases}$$

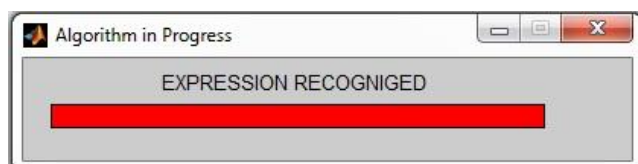Note: X threshold can be taken from the user.

4. Result:-

Fig. 8: Result

Fig. 9: Final Result

5. ADVANTAGES:

❖ Robust system.

❖ Real time based system.

❖ Works with different types of faces.

❖ Easy to work.

6. APPLICATION AREA:

With the quick headway of advancements it is required to gather a watchful structure that can appreciate human feeling. Facial feeling affirmation is a dynamic zone of investigation with a couple fields of employments. A segment of the gigantic applications are:

i)   Alert framework for driving.
ii) Social Robot feeling acknowledgment framework.
iii) Medical Practices.
iv) Feedback framework for e-learning.
v)   The intelligent TV applications empower the client to effectively give criticism on TV Program.
vi) Mental state ID.
vii) Automatic advising framework.
viii)Face expression combination.
ix) Music according to temperament.
x)   In research identified with brain science.
xi) In understanding human conduct.
xii) In meeting

7. CONCLUSION: Broad endeavors have been made in the course of recent decades in the educated community, industry, and government to find more powerful techniques for surveying honesty, duplicity, and validity amid human cooperation. Efforts have been made to catch human expressions of anyone. Emotions are due to any activity in brain and it is known through face, as face has maximum sense organs. Hence human facial activity is considered. The objective of this research paper is to give brief introduction towards techniques, application and challenges of automatic emotion recognition system

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