Detecting Dynamic Facial Expression Using EigenFaces

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Abstract

Recognizing a human facial emotion in a facial recognition system is one of major field of research in present era to develop in a human computer interface. Facial expression system is dependent on various parameters for recognizing a human face i.e. orientation, colour, posture, luminous intensity etc. to detect a genuine facial expression. Basically it is done by firstly recognizing movement of eyes, nose, lips and head movement and further it is followed by classifying it by comparing it with the trained data with which is earlier feed into the system. The comparing process is done with the help of suitable classifier for facial expression. The following research paper uses Eigen faces approach for modeling human facial expression recognition system. This approach uses hue - saturation - value colour model to detect a face. High dimensionality Eigen space is reduced by using PCA. The test image is then projected on eigenspace and a euclidean distance is measured between test image and mean value of trained image to get a final outcome. A set of greyscale images including surprise face, sorrow face, anger face, happiness face, fear face etc is used to recognize by comparing to a test image and achieving a final outcome of human emotion. The system used is better in sense of precision and accuracy as compared to earlier system of research. The rate of success of facial expression is higher than earlier method used in the following field.

Keywords: *Dynamic Facial expression recognition; facial expressions; Eigenvectors;Eigenface; Recognition.*

1. Introduction:

It is very important for implementing the facial expression recognition system, it is also important to realize that there are many possible methods that exist to represent facial expression. These facial expression can be represent using, pictures, video, cartoon, smiley, active action and facial characteristic points [1].

A human face carries a lot of important information while interacting to one another. In social interaction, the most common communicative hint is given by one's facial expression. Mainly in psychology, the expressions of facial features have been largely considered. As per the study of Mehrabian, amongst the human communication, facial expressions comprises 55% of the message transmitted in comparison to the 7% of the communication information conveyed by linguistic language and 38% by paralanguage.

This shows that the facial expression forms the major mode of interaction between the man and machine. Since for communicating the non-verbal messages the face forms the basis, the ability to read the facial emotions becomes an important part of emotional intelligence [2].

The human body conveys an abundance of information necessary for mediating socio-emotional communication. Bodily movements, facial expressions and eye gaze shifts allow us to extract information from others. We can then use this to understand their thoughts, intentions and moods. Without the ability to perceive this information, social interaction would be difficult. A Facial expression is defined as final outcome of cumulative motion and position of the muscles as a response to a situation beneath the skin of the face. The person as an observer can find the emotional state of the person by viewing their facial expression.

Facial expression is a kind of sign communication. Recognition of facial expression is one of the major field of research in field of human - computer interaction. Facial expression recognition with a high level of accuracy and precision can bring a major change in the field of human computer interface. Recognition of emotion is one of the new idea which is taking a big pace in the field of research on intelligent systems. Human facial recognition can help us in large number of fields of its applications. It can be among the most promising systems in the field of human-interaction,some of its important applications can be such as patient monitoring, observation of a suspect against any anti-social motives etc. might be other useful areas for emotion recognition. Facial expression recognition system, it's one key advantage is that it does not require the cooperation of the test subject to work. Properly designed systems installed in airports, multiplexes, and other public places can identify individuals among the crowd, without passers-by even being aware of the system. Other biometrics like fingerprints, iris scans, and speech recognition cannot perform this kind of mass identification. In a generalized form of a facial expression recognition system, an input sensing device such as a webcam obtained the input image from a subject and then it communicates with the computer.

After detection of the facial area, representative feature from the emotionally expressive face image are extracted, it is then pre-processed and a classifier is used to classify them into one of the emotion classes such as anger, fear, surprise, happy, neutral etc. There are several detection methods as well as classifier algorithms that can be used in the detection and classification. A dynamic model of emotions is presented in this research based on a comprehensive eigenspace based approach. Eigen space is a feature space that best encodes the variation in the eigenfaces. The eigenfaces is a set of feature space which characterize the overall variations among face images.

2. Literature Survey :

Different Facial Expression Paper Based on PCA, Eigenface, Eigenvector and Atlas Construction

1. D.Gautam et al. (2014)

   Facial Expression Detection Using Implemented (PCA) Algorithm. The author implemented the facial expression recognition system using PCA (eigenfaces) analysis method. This method uses image database system for facilitating results by

comparing it with prototype. Higher level of accuracy has been demonstrated in the experimental results of the following research paper.

2. Karen Das, JeemoniKalita et al.(2013)
   Recognition of Facial Expression Using Eigenvector Based Distributed Features and Euclidean Distance Based Decision Making Technique. The previous work on Eigen face features considered the Eigen space of the whole face. In this paper, the objective was to amend the facial expression recognition system using the Eigenvector method, creating different Eigen subspace for a distinct expression.This method uses the trained images to compares with the test images and finding the euclidean distance between them to find the perfect result.

3. Vijay Kumar, Subham Sharma, Razz Verma, Manish Kumar Sharma et al. (2016)
   Human Facial Expression Recognition using Principal Component Analysis. In this paper the authors are system implemented for the recognition of facial expression automatically. In this paper, first of all they extract the face region then extracted the features like lips, nose, eyes, and eye brow etc using PCA algorithm. Then the authors are calculate the Eigen vectors and compare with the real database as well as standard database. The experimental results show the accuracy of the system on different expressions using PCA(Eigenface) algorithm.

4. Anurag De, AshimSaha, Dr. M.C Pal et al. (2015)
   The authors made a approach towards the "Human Facial Expression Recognition Model based on Eigen Face Approach". This paper proposed to recognize various emotions are done by calculating the Euclidean distance between the input test image and the mean of the eigenfaces of the training dataset. The training dataset contains images of different people which gives good results but there exists a resemblance between some emotions some extent such as sorrow and fear which can be thought of as a future work for some improvisation through some more extensive training. The field of research in expression recognition is an area which can be further explored and improved.

5. YimoGuo, Guoying Zhao et al. (2016)
   The authors have used method named "Dynamic facial expression recognition with Atlas construction and Sparse representation". The authors have formulized a better way to tackle the problem of facial expression recognition. It is formulated as a longitudinal atlas construction and diffeomorphic image registration problem. In the paper, the author uses LDDMM registration algorithm. The LDDMM registration algorithm is used to design map, to manipulate and transfer information for providing a larger scope of results.

6. B.Fasel, JuergenLuettinet al. (2002)
   Automatic facial expression analysis.The author made a survey for their research and formulated a system that should work automatically to tackle changes human comes across periodic. The authors finds the great need to work on facial analysis system to

work autonomously as well as it should be improved enough to tackle with natural and manual changes that comes across through human faces in daily life.

7. M.Pantic and I. Patraset al. (2006)
   Dynamics of facial expression: Recognition of facial actions and their temporal segments form face profile image sequences. The authors try to make a new facial expression recognition method which depends on facial muscle action that produces expressions.

8. P. Viola and M.Jones et al. (2002)
   Robust real-time object detection. The authors in this method user rapid image processing to achieve high detection rate. This paper brings together new algorithms, representations, and insights which are quite generic and may well have broader application in computer vision and image processing.

9. M.Yeasin, B. Bullot and R. Sharma et al. (2004)
   From facial expression to level of interests: A spatio-temporal approach. The authors in this paper performed a set of experiment with the proposed classification strategy and was tested on a number of data set with different lighting environments, subjects, and expressions. The authors are analysis of TV broadcast data. TV broadcast analysis and emotion elicitation were conducted. The main aim of the experiments was to understand the effects of a number of factors that are detrimental to the recognition of facial expression recognition using visual data. Emotion elicitation experiment was conducted on 21 subjects by showing the subjects six different clips of movies carefully chosen in a manner to arouse spontaneous emotional reactions that would produce natural facial expression.

10. S. Yang and B. Bhanuet al. (2011)
    The concept proposed in this is Facial expression recognition using emotion avatar image. In this paper, the authors proposed a new concept of condensing a video sequence to be a single EAI representation. The author adopted SIFT flow for aligning the face images which is able to compensate for large global motion and maintain facial feature motion detail. Then, an iterative algorithm is used to generate an Avatar reference face model onto which we align each face image. They feature extract the face from the raw data using the Viola and Jones face detector which achieved almost perfect results on GEMEP-FERA dataset.

11. T.Jeslin, R.Raviet al. (2016)
    Atlas construction and sparse representation method is used for the recognition of facial expression. The authors analyzed many experimental results and came to the conclusion that this system is capable of giving higher recognition rate which is enhanced by its 3D facial expression image recognizing feature. The SIFT and SURF algorithm can be used.

3. Problem Identification :

a. Automatic recognition of emotion from human facial expression image has still challenging problem.
b. It is not robust enough to overcome challenges of strong illumination changes.
c. The recognition of facial expression in image sequences with significant head motion is also a major problem.
d. One of the major problem in designing a robust facial expression classifier is not being able to the effective use of non-rigid complex motion pattern.

4. Methodology :

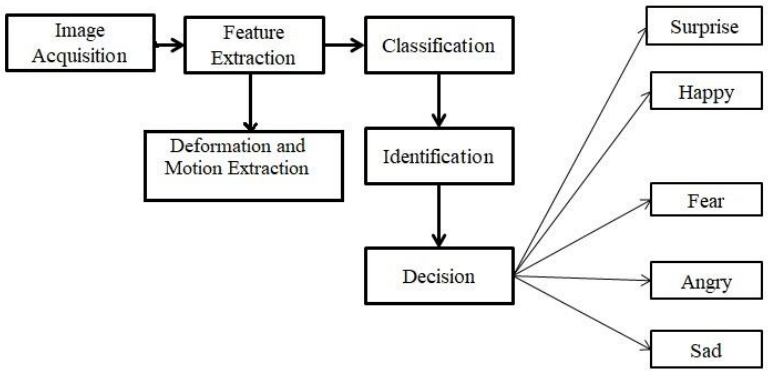


Figure: Block Diagram of Proposed System

[1] **Image Acquisition:** The images used for facial expression can be used as static as well as dynamic (i.e. images are present in sequences). An image sequence contains potentially more information than a still image.

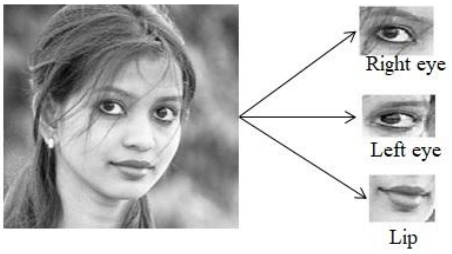
Image Read :

A= imread (filename,fmt) It reads a gray scale or color image from the file specified by the string filename. If the file is not in the current directory, or in a directory on the MATLAB path, specify the full pathname.

Display Image :

B= imshow (I) It display the grayscale image I.

Cropping: Each and every emotions on human face make different shapes of eyes, nose and lips etc and each shapes of these parts carry significant information. So, instead of processing entire face, five different portions are cropped which are also called "feature image".



Feature Extraction: The cropped images we have received from the test image is resized to the given value and the eigen value is extracted from it. Facial feature extraction in two sub parts: deformation and motion.

Classification: In this method, the emotion of the test image is classified to which emotion it may belong. The Euclidean distance between test image and trained image and minimum distance is calculated from the set of values of eigen vector and eigen values and hence facial expression is recognized.

Identification:in this module, the system is used to identify or recognize the person whoever is standing in front of the system. The system uses the images in the database which are earlier being saved in the database to recognize the person. This module plays to is related to identification of test images.

5. Result:

We have implemented the algorithm and tested dynamic facial expression recognition using Eigenface. In this process, Euclidean distance is taken between test

image and trained image to find the degree of emotion. The experimental results show that accuracy of the recognition is higher than other research done in this field.

Inputs:

Training image set.

Label File for information about training images.

Testing image set.

Output:

Result file with

Expression for the test images

Best match

Distance from Neutral

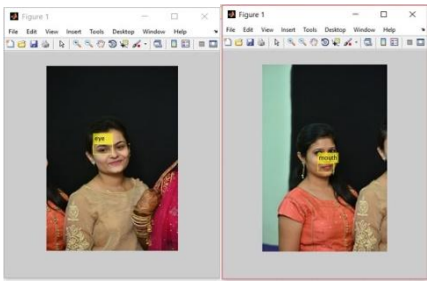


Figure: Basic Experimental result

Conclusion:

This system is automatically implemented for the recognition of the facial expression. In this method, first of all we extract the facial region in which some features are extracted such as lips, nose, eyes, and eyebrows etc using Eigenfaces algorithm. ThenEigen vectors are calculated and eyclidean distance is compared with the trained images present in the real database as well as standard database. The experimental results show the higher accuracy of the system on different expressions using Eigenfaces algorithm as compared to other systems of research on the same field.

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6.2 Conference Proceeding

Anurag De, AshimSaha, Dr. M.C Pal, "A Human Facial Expression Recognition Model based on Eigen Face Approach" in ICACTA **(2015)**.