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Identification of Human Facial Expression using Gabor Filter with Minimum Features

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Abstract—*Facial expression expresses almost complete eternal emotional feelings of a person, hence this is one of the most typical areas in the field of computer science. Emotion recognition usually uses image processing, gesture signal processing and physiological signal processing. This is used in the area of security, entertainment and human machine interface (HMI). Facial expression reflects not only emotions but other mental activities, social interaction and physiological signals. There exist several algorithms to extract features such as principal component analysis (PCA), Fisher linear discrimination analysis (FLDA), Image principal component analysis (IPCA) and various others. Here we will use Gabor filter method due to its powerful representation of the behavior of receptive fields in human visual systems (HVS) for that we have also taken one face database in which the different expressions of facial images are stored. Different facial expressions will be recognized as happy, sad, anger or neutral mood. This will be tested online with the free available Japanese database and the better expression recognition result will be found out.*

Keywords: *Digital image processing, Face recognisition, Human face perception, Gabor filters.*

1. INTRODUCTION

Facial expression is one of the most powerful, natural and immediate means for human beings to communicate their emotions and intensions with another [1-4]. A change that happens on human face and forehead is in response to the human internal emotional states that plays a major role. Major component of human conversation is facial expression which constitutes around 55% of the total conversation. The fundamental of facial expressions categorized by psychologists are neutral, happiness, sadness, anger, fear, surprise and disgust.

Recognizing an effective facial expression from the original face images is a vital step for successful recognisition. There are two common methods to extract facial features one is geometric feature-based methods and another is appearance-based methods [5]. Geometric features represent the shape and locations of facial components, which are extracted to form a feature vector that represents the face geometry. However, the appearance based methods applied to the whole face or specific regions of face to extract the appearance changes of the face. This method is applied with Gabor filter due to their superior performance [8].

There are many methods that has been proposed for the human facial expression recognition from the static images (image database) to image sequence (video) (B. Fasel et al., 2003).

Following are the steps involved in human facial expression recognition systems.

1. **Image acquisition and Processing:** In this after getting the image as input, image scaling, image brightness and contrast adjustment and other image enhancement operations are performed.

Fig. 1: General Structure of Human Facial expression System

This system uses an image database to train and test the performance of the classifier.

2. Feature Extraction: Particular facial expression need to be extracted from the images. These parameters are used to discriminate between expressions.

3. Classification: Fature vector of test image is compared with feature vector of trained database and classify them accordingly (Shishir Bashyal et al., 2008).

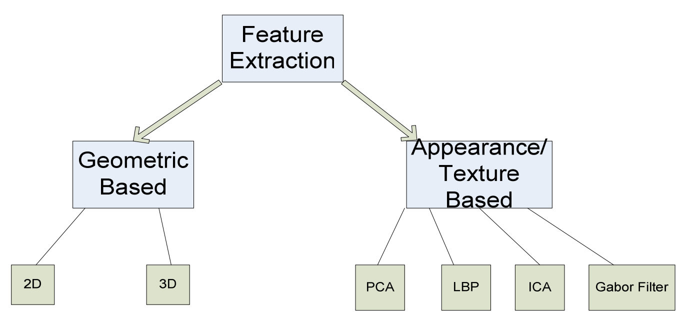


Fig. 2: Techniques for Feature Extraction and Classifier

2. RELATED WORKS

Facial expression recognition has attracted much attention from behavioral scientists since the work of Darwin in 1872 [6]. Suwa et al [7] made the first attempt to automatically analyze facial expressions from image sequences in 1978. Much more progress has been made in the last two decades, and a thorough survey of the exiting work can be found in [1,2]. Here we are briefly review some previous work in order to put our work in context.

Andrew J. Calder et al (2001) used principal component analysis (PCA) and linear discriminant analysis (LDA). After submitting an image to PCA, it converted them into eigenfaces then the output of PCA was submitted to a series of LDA. 4 sets of PCA data showed good categorization rate. Its performance was about 86%.

Hong-Bo Deng et al. (2003) used local Gabor Filter bank and PCA plus LDA. A novel local Gabor filter bank with part of orientation and frequency parameters was proposed. Two stage feature compression method (PCA plus LDA) used to select and compress the Gabor feature. The minimum distance classifier was adopted to recognize facial expression.

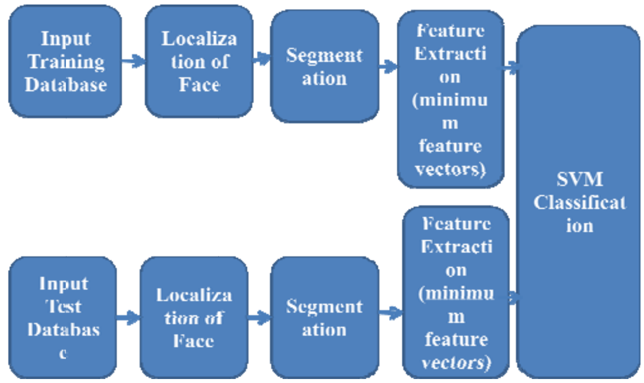
Shishir Bashyal et al (2008) used Gabor filter and learning vector quantization to develop a facial expression recognition system. Gabor filter was used to extract the features from JAFEE database images. This paper proposed that learning vector quantization (LVQ) performs better in recognition of fear expression than multilayer perceptron (MLP). Performance of recognition rate was about 90.22%.

Caifeng Shan et al. (2009) used Linear Binary Pattern for feature extraction and Support Vector Machine (SVM) for classification. Developed a system that works against illumination changes and take less time as others existing system. Linear Binary Pattern (LBP) tolerant illumination and takes less time in computation. The performance of the system was about 89% for sadness. Some expressions were not classified correctly.

Wenfei Gu. Et al (2012) used Gabor filter for feature extraction and classifier synthesis. The system supports person independent expression recognition and variation in illumination. Gabor filters have the useful property of robustness against slight object rotation, distortion and variation in illumination. The performance of the system was 91.5%.

The techniques used by researchers previously had some certain problem. Some of them only give good result for person dependent test. If the test input was not from the trained database then the result were different.

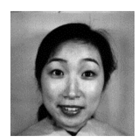
3. PROPOSED SYSTEM ARCHITECTURE



Above Fig. shows the architecture of the proposed facial expression system that will run in the following phases.

1. Input Training database
Trained the system with different images to provide the desired results on input image while it was photographed,

2. Input Test database
Input the image to get the expression by comparing it with trained data.



3. Localization of Face and segmentation:
The properties of the images, the size of the face space in comparison to total image dimensions, and the low lighting conditions. These factors affect the facial expression recognition process.

4. Feature extraction on minimum feature vectors:
Mood detection like Happy, Sad, Neutral, Anger and Disgust etc from discriminates from two classes

5. Support Vector Machine (SVM) Classification:
Multi SVM features is used to classify all categories of mood. Multisvm function uses svmtrain and svmclassify function in loop for the large database of image.

4. FEATURE EXTRACTION AND CLASSIFICATION

SVM convert Gabor feature into vector form. Whenever a test image is input, first of all Gabor is created for that input image and this is converted into vector. In SVM the data is divided into two parts one is known as training set and other is known as testing set and each have the instances of the attributes. The goal of the SVM is to produce the model which predicts the target value of instances in the testing set. This one is based on the supervised learning methods. Support vector machine has a unique property that it creates a hyperplane which has taken into the consideration for the classification. Greater the margin it is easy to find better accuracy and minimal errors has found.

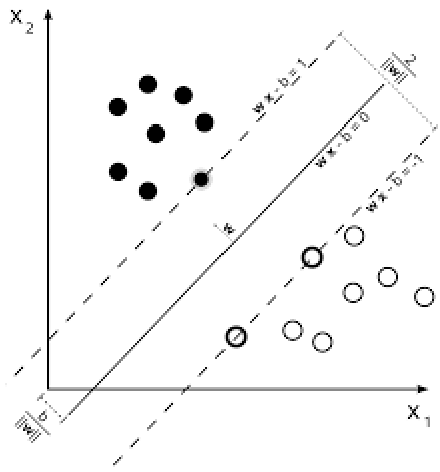


Fig. 3: Hyperplane that discriminates between two classes.

5. RESULTS AND CONFUSION MATRIX

The developed system produces the result in the form like, "Provided image shows the anger" or "Provided image shows happiness" or "Provided image shows the sadness" or "Provided image shows disgust" or "Provided image shows the neutral expression". Performance for accuracy is measured through confusion matrix which is shown in below figure.

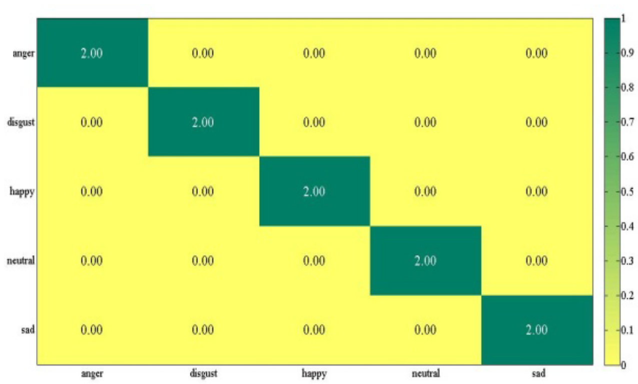


Fig. 4: Confusion matrix for single image

Confusion matrix is used to show the accuracy of a classification of result by comparing the classification result with ground truth information. This is also known as performance matrix. Here if the matrix produces diagonally same or approximately same data then the performance is considered as very good otherwise quality needs to be improved. In above Fig. it shows 2.00 diagonally and rest is zero.

6. CONCLUSION

In this proposed model we have created three modules image acquisition, feature extraction and SVM classification using an appearance based algorithm. Here selection of best Gabor feature reduces the system complexity. The output of Gabor works as input to SVM Classifier. SVM compares the test data with trained data and classify the expression accordingly.

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