Global Journal of Computer Science and Technology
Volume 12 Issue 7 Version 1.0 April 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Empirical Analysis for Recognition of Facial Expression the State of the Art

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Abstract - facial expression recognition is limited to six basic expression and several combination.The expression are classified into emotion categories rather than another technique..It is difficult task to show all facial expressions because in everyday life six basic expression occur so frequently.Emotion is often communicated by small changes in one or two facial features,on the other hand the same facial expression may occured in more than one emotions.The presence or absence of one or more facial actions value may change its prediction.One man can show their facial expression in different manner than expressing the same facial expression by other person.The facial features value changes person to person for the same facial expression.

GJCST Classification: *I.4.8*

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Empirical Analysis for Recognition of Facial Expression the State of the Art

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Abstract - facial expression recognition is limited to six basic expression and several combination.The expression are classified into emotion categories rather than another technique..It is difficult task to show all facial expressions because in everyday life six basic expression occur so frequently.Emotion is often communicated by small changes in one or two facial features,on the other hand the same facial expression may occured in more than one emotions.The presence or absence of one or more facial actions value may change its prediction.One man can show their facial expression in different manner than expressing the same facial expression by other person.The facial features value changes person to person for the same facial expression.

I. Introduction

Human computer interaction is an upcoming valuable field of science and engineering that provides such a platform or environment so that a machine can interact with human in natural ways. Computer will interact with human only if they will have communication skills like human. Emotion is pioneer communication skills. The very authentic way of expressing emotional state is through facial expression. Emotions are shown by some visual, vocal and other physiological means. The research on recognizing emotion through facial expression was pioneered by Ekman and Friesen [1]. Facial expression plays vital role to show the emotion and that be unique component to deliver the communication skills. Facial expression analysis has wide range of application in area such as Security and surveillance system, Gaming, Human behavior recognition, intelligent human computer interfacing, user behavior analysis. six type of facial expression happy(1), angry(2), surprise(3), disgust(4), fear(5), sad(6). The face expression recognition Problem is tough because different person display the same expression in different manner. Selecting the most important feature and ignoring unimportant feature is a main concept to solve this problem. In Automatic Facial Expression Recognition System face is first detected and localized than facial feature is extracted from the detected Face Region. finally the facial expression are classified based on the extracted feature. Sometimes the facial expression analysis has been confused with emotion analysis in the computer vision domain. For emotion analysis higher knowledge is required. Darwin (1872) is the first to point out the importance of facial expressions as powerful and immediate means for human beings to communicate their emotions and Tomkins (1963) reaches the same conclusion and reports that affect (or emotion) is always represented by visual sign. Though facial expression can convey emotion and can also express intention, cognitive processes, physical effort or other interpersonal meanings. Human face is the richest source of nonverbal communication and the most accessible interface displaying human emotions. To recognize the facial expressions using computer is a revolutionary work which rely on human-computer interaction so that computer will be able to understand whether users feel excited or bored, agrees or disagrees.

It will be a great challenge and a practical significance to develop a computer vision system which can recognize a variety of facial expressions and estimate expression intensity.

Facial expression analysis basically depends on the facial feature like eye, nose, mouth, eyebrow which play an important role to detect human emotions because these positions are changed when a human expression changes. So these are the important features to display the emotions .So these are the key point in facial expression analysis. The face model features are the feature used to represent (model) the face. The face can be represented in various way e.g., as a whole unit (holistic representation), as a set of features (analytic representation) or as a combination of these (hybrid approach).

II. Literature Review

In this work the facial expression is based on the attributes of facial muscle that is hidden state of a HMM for individual image. Probability of the state is changed on the behalf of the feature vector obtained from image processing.[2]

Optical flow algorithm is used for the evaluation of velocity vector of two successive frames. After that FFT is applied to a velocity vector around the region of mouth and eye. The selection of feature vector is lower frequencies value and a mixture density is applied to scaled the output probability of HMM to detect the variation in human facial expression. Mixture density is very useful to enhance the accuracy as the mixture increases. Facial expression recognition is done by using the Support Vector Machine by modifying Kernels.[1] Facial expression is also recognized with the

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help of brain activity that is governed by the EEG signal.[3]

In this there is a proposed system that analyzes EEG system and classify them into 5 classes on the two emotional dimensions name like valance and arousal. However after using the 3-fold cross validation method the recognition rate for the valence dimension is 32% and for the 37% for the arousal and overall rate is approx 71%.

Facial expression recognition is also detected with the help Markov random Field.[4] In this the main concept is the essential factor that helpful for the expression detection is Eye and mouth expression. In this the first step is done image segmentation and skin detection for the Markov random field .second step is done for the eye and mouth feature extraction. The set of different color image is used as a training set.HLV color space that is responsible for the detection of the eyes and mouth region.3rd step module is in accordance with the detection of emotions in images with the help of edge detection and measurement of gradient of eye and mouth region.

There is also a facial expression detection is done by the using of coded form that consists of multiorientation ,multiresolution of the Gabor filters in which region of surface space and precise description of the place or region are mentions and that is aligned along the human face.[12] In this paper the similarity space is matched with the result obtained from the applying the Gabor filter and the result that is semantic value that obtained on the human observations. There is concepts that terminology is known as rank correlation which emphasize the semantic similarity and facial expression image similarity that is obtained after the applying the Gabor coding. The facial expression classification is also achieved of the frontal image by using of Eigen face [21].

In this paper whole face is not taken in consideration rather than classify the face in the regions that is beneficial for the facial expression classification and projecting that faces with the Eigen face and try to train with different types of facial expressions.Than taking the average of all different region faces showing different facial expression and after that making a mask. The important thing is that this masks fading the miss region and try to highlight the region that are changing during the different facial expression. For the recognition of the facial expression The new technique active appearance model (AAM) is used to trained the faces that is available in database that is used to represent the shape and texture variation that plays an important role in facial expression recognition. The features are those that are extracted from the parameter obtained from the AMM and is used to discriminate among the classification of different expression. The feature extraction with the help of AMM better than a simple classifier like Euclidean distance. The AMM makes a efficient method for the texture and shape to model such that It plays an important role and it is thoughtful like (SVM) support vector machine.

Facial expression has also detected with the accuracy of 85% with the help of facial feature vectors obtained with the help of Gabor filter and that feature value is convolved with the Log Gabor filter.[1]

In this whole face is taken into consideration and than its accuracy is tested over the classification with PCA principle component analysis and LDA liner discriminate analysis and the result are quite good .The result is achieved on low reso0lution image without specifying the fiducially points. Facial expression recognition is also achieved with the histogram sequence of the Local Gabor binary pattern.[17] Firstly the face image is convolved with multi orientation with the help of Gabor filter than after that Gabor coefficients map are extracted. Than after local binary pattern is applied on GCM to obtain the local Gabor binary pattern. Finally the SVM is used for the classification and the result of recognition rate is quite appreciable.

III. Facial Emotion Recognition System

Fig1 : block diagram

a) Preprocessing

In the preprocessing step the environmental and other variations that are present in different images are minimized. The operation that is performed is contrast adjustment, image scaling, image brightness and other image enhancement method has done. Sometimes noise is associated with images with the variation in signaling and pixel variation so removal of this factor has become essential to achieving the better result.

b) Segmentation

As we know that in many images processing the input is image and output is image. But for the facial expression analysis there is need of feature that is extracted from the input image. In other words we can say that input should be an image but output should be the feature value that has obtained from that input image.Segmentaion plays a major role in that direction.

Segmentation basically divides an image into its regions or objects. The subdivision depends on the level of problem solving. That is the Segmentation will stop when the the objects or the regions of interest in an application has been detected. The successes or failure of the any image processing or computer vision process depends on the Segmentations accuracy. So there is proper concentration is taken place in the finding the

probability of accurate Segmentation. Most of the Segmentation algorithm basically depends on the two main properties of intensities values.

a) Discontinuity
b) Similarity.

The first category of Segmentation is taking place when the abrupt changes in the intensity such as Edge is found in an image. so In this case image is partitioned into regions.

In the second case of Segmentation an Image is partitioned into the regions that are similar for particular predefined criteria.

In my approach a facial image is segmented into 4 region means 2×2 grid of 128×128 size.

256×256

Fig 2 : Before Segmentation

128×128

Fig 3 : After Segmentation

c) Feature Extraction

Is the important method to define the any recognition System. Without extracting the key feature point it is not feasible to define the facial expression recognition System. In feature extraction method I have applied the Gabor filter on the four segmented region of the face. There is 68×68 features are coming outside from the one face region but due to application of absolute and scaling method we evaluate the major four prominent features like Gabor real part, imaginary part, magnitude and angle are evaluated. These extracted feature value is in the range of 0 and 1.so from the one face we calculates the 16 features that is defined by the Gabor filter outcome. We use the frontal face for the facial expression analysis. There is need to define such an unique parameter that can be differentiate between different facial expression of expressers. The set of parameter that can be extracted is known as feature vector and the information achieving from the feature vector is defines an uniqueness as aspect with the extraction technique. If the feature value extracted from the one expression matches with the feature extracted with the expressions of other faces than it is not known as a good feature extraction technique and it is known as feature overlap. The feature extraction should be different in comparison with the other so there is made a correlation and on behalf of this next procedure be implemented. so there is several method adopted for feature extraction and among these the Gabor filter bank based method is good. So we can say that Gabor based feature extraction technique is excellent for facial expression analysis and avoid the feature overlap condition.

d) Support Vector Machine

SVM is a useful method for the data classification. It is easier than using the Neutral Networks.SVM provides the accuracy and fast result for the data to be classified and belongs to the particular class. In SVM the data is partitioned into the two parts that one is called Training set and other is known as the testing set and each having the instances of the attributes. Each instances having one target means class labels and several attribute. The goal of the SVM is that to produce the model which predicts the target value of instances in the testing set which are given by only attributes value. It is based on the supervised learning methods. Support vector machine has a unique property that it creates the hyperplane or a set of hyperplane which has taken into the consideration for the classification. It defines the functional margin means a good separation is achieved by the hyperplane that has the largest distance to the nearest data points of any class. Greater the margin it is easy to find better accuracy and minimal errors has found.

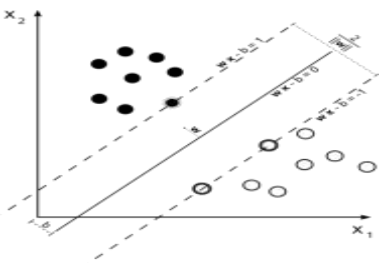

Fig 4: Hyperplane that discriminates between two classes

Lets us assume that we have Data sets of having n features of the form

$$\mathcal{D} = \{(\mathbf{x}_i, c_i) \mid \mathbf{x}_i \in \mathbb{R}^p,\ c_i \in \{-1, 1\}\}_{i=1}^{n}$$

Where C_i belongs to either -1 and +1 value indicates the which class the point X_i belongs.the equation of the hyper plane is given by in such a way

$$W \cdot X - b = 0$$

There is two cases to defining hyperplane

$$W \cdot X - b \geq 1\text{------}$$

it indicates for class one

$$W \cdot X - b \leq -1\text{-----}$$

it indicates for the class others.

Here the training vectors X_i are projected into the higher dimensional space by the function ø. the main important characteristic property of SVM is that it works on the linear separable hyperplane with the minimal margin in the high dimensional space.

C>0 is the main term to define the error parameter. The kernel function is defined as $K(\mathbf{x}_i, \mathbf{x}_j) \equiv \phi(\mathbf{x}_i)^T \phi(\mathbf{x}_j)$.

There is four basic kernels that is defined as follows:-

linear: $K(\mathbf{x}_i, \mathbf{x}_j) = \mathbf{x}_i^T \mathbf{x}_j$.

polynomial: $K(\mathbf{x}_i, \mathbf{x}_j) = (\gamma \mathbf{x}_i^T \mathbf{x}_j + r)^d,\ \gamma > 0$.

radial basis function (RBF): $K(\mathbf{x}_i, \mathbf{x}_j) = \exp(-\gamma \|\mathbf{x}_i - \mathbf{x}_j\|^2),\ \gamma > 0$.

sigmoid: $K(\mathbf{x}_i, \mathbf{x}_j) = \tanh(\gamma \mathbf{x}_i^T \mathbf{x}_j + r)$.

Where γ, r.and d are kernel parameters.

IV. Results

Facial Expression or Facial emotion detection through image database has been proposed: Basically Image Database is Japanese Female Faces and assumed to be frontal and preprocessed and some Indian database also has been used to evaluated the accuracy, After applying Gabor Filter on the four segmented facial region we extract the Features value that is fully defined by Gabor response, The main features that are extracted known as Gabor Real part, Imaginary part, Magnitude and lastly Phase .Basically all these features value are coming out from the segmented Face region under the response of Gabor Filter, After the feature extraction maximum of absolute of Gabor filter responses on the faces are evaluated, After the feature extraction rescaling is done so that all features value are lie between the range of 0 and 1, When the features of all the classes are extracted than finally classifier Support Vector Machine (SVM) applied for labels classification, Extracted Features are arranged into the SVM format means all the value should be written in a single row and showing the name of their respective classes, Than features value of different classes is divided into two domain one for the Training set and the second one for the Testing And in last the accuracy is calculated, accuracy is above 80%.

V. Conclusion and Future Perspective

In this dissertation, we have made a facial expression recognition System that can detects the Facial Expressions like Happy, Sad, Angry, Disgust, Surprise and Fear. We have used a still images that is frontal and preprocessed. The Facial Expression analysis plays a key role in the human Machine interaction. Our approach is different to previous work done and my accuracy is above 81%.Due to segmentation and rescaling the Gabor filter output response is remarkably good. So the extracted feature detection is lie in the range of [0,+1].

This range is essential when we are going to use SVM for the classification. After using the SVM the results obtained is satisfactory. In our future perspective we will try to enhance the accuracy up to 100% and try to make a robust system that can be applied to any database whatever the alignment of the Face. In future we will develop my work for the real time system that can be utilized in any sensitive area and surveillance system. Also the Facial expression analysis is useful for the security, Gaming, Intelligent tutoring system and human behavior recognition.

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