Analysis of Facial Detection and Classification Using Various Approaches

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Abstract: *This paper proposes a system which automatically recognizes the emotion represented on a face. Initially the face image has been captured and the image is analyzed according to the skin color. After the color image is transmitted to the grey scale image and the noise present image is eliminated with the help of the non-local median filtering approach. From the preprocessed image different features are extracted by using the progression invariant sub space learning method. Then the optimized features are selected and trained for improving the classification rate which is done by using the back propagation neural networks . Finally, the face related features are classified using Support Vector Machine. There are different seven facial expressions considered over here: happy, angry, surprise, disgust, fear, sad and neutral. The system was tested on the Japanese Female Facial Expression (JAFFE) dataset .*

Keywords: Facial Expression Detection, Feature Extraction, Expression classification, Support Vector Machine, Neural Network

1. Introduction

The main goal of the HCI system to improve the interaction between users and computers. The human face is important role in communication. There are two way of communication (i) Verbal communication (ii)Non verbal communication. Facial expression is the one of the non verbal communication. The facial expression can be divided into three major components. (i) Face detection (ii) Feature extraction (iii) Classification.
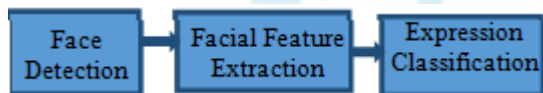

Figure 1: Facial expression classification block diagram

Face detection
Face detection is the extracting the face region from the input images Itfollows two different approaches: Emotion detection from still images and Emotion detection from a video.Firststep in face detection is preprossesing this steps involved in convetinga image to a normalized pure facial image for future extraction.

Facial Feature Extraction
Facial feature extraction is the process of translating input data into set of feature.

Feature extraction mean to reduce the large data to small data for computer. There are two types of feature extraction. (1) Geometric features , (2) Appearance features

Geometric features
Measure the certain parts of face position and size of features are measured by movement of facial parts. Geomentric feature measurement is usually connected with face region.

Appearance features
The charge is face texture when particular action is performed image filter are used. Appearance based algorithm are wide range.

Feature extraction algorithms
The facial feature extraction algorithms can be classified into two main categories. 1) Image based methods 2) Model based methods. In image based method the input is the set of images and output is the corresponding expression. Image based methods are less accurate compare to model based methods but they require less time for feature extraction and they also reduces the high dimensional features .

Some of the image based algorithms are 1) FER using Gabor filter, 2) FER using target oriented approach. Model based methods require more time for feature extraction but they are more accurate compare to image based methods

Some of the model based algorithms are 1) FER .The next task is to recognize the expression using any one of the known classifier. System is trained in such a way that when any unknown image is given as an input it will automatically identify the corresponding facial expression. Some known classifiers are 1) neural network, 2) support vector machine 3) Linear Discriminate Analysis (LDA) 4) Hidden Markov Model (HMM)

2. Feature Extraction Using Gabor Filter

Gabor filter have received the considerable attention in image processing during the last decade. It is extensively used in image processing for the purpose of feature extraction. Gabor filters are well suited for facial expression recognition because these filters have been shown to possess optimal localization properties in both spatial and frequency domain . Multiresolution analysis is possible with Gabor filter by giving a coefficient matrices and Gabor filter are also found to be unaffected by illumination changes and noise . Here 2D Gabor filter is used for the purpose of feature extraction.

Steps for feature extraction are shown below
1) Each image is normalized into a gray scale image of size 140 x 140.
2) The two sets of the Gabor filter are applied on the image, filter of fixed orientation and filter of fixed scale.
3) One of the following special faces is obtained from those filter output faces.

(1) Min face
(2) Max face
(3) (Min+Max)/2

3. Classification

After the set of features are extracted from the face region are used in classification stage.Theset of feature are used to describe the facial expression. Classification requires supervised training , so the training set should consists of labelled data. Once the classifier is trained, itcan recognize input images by assigning them a particular classlabel.There are various types of Classification technique are used.

JAFFE standard database has been used for training and testing the proposed method. For the purpose of classification two widely known classifiers support vector machine and neural network are trained for seven different facial expressions Angry, Disgust, Fear, Happy, Neutral, Sad and Surprise. The Algorithm is implemented in MATLAB.

Sample dataset for JAFFE

Happy   Neutral   Angry   Disgust   Fear   Sad   Surprise

Classification Using Support Vector Machine
SVM is powerful tool used for classification and regression. SVMs are a set of related supervised learning methods used for classification. There are two basic approaches 1) Maximum margin classification (linear) and 2) Non linear classification

Maximum Margin Classifications
SVM construct a hyper plane that classifies the data. The best hyper plane is the one that represents the largest separation, or margin, between the two classes . So we choose the hyper plane so that the distance from it to the nearest data point on each side is maximized. If such a hyper plane exists, it is known as the maximum margin hyper plane and the linear classifier it defines is known as a maximum margin classifier.**.**

Classification Using Neural Network
Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements.

Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. The network is adjusted, based on a comparison of the output and the target, until the network output matches the target pairs are used, in this supervised learning, to train a network

4. Implementation and Results

Gabor filter is widely used for the purpose of feature extraction. The response of the Gabor filter is defined by the harmonic function multiplied by the Gaussian function. Those faces are shown in the Figure

Figure 2: Gabor faces

Those faces are not directly considered as an input to the SVM. Rather than those faces some special faces are obtained .JAFFE standard database has been used for training and testing the proposed method. For the purpose of classification two widely known classifiers support vector machine and neural network are trained for seven different facial expressions Angry, Disgust, Fear, Happy, Neutral, Sad and Surprise. The Algorithm is implemented in MATLAB. For the purpose of the classification open source tool SVM-light is used.. For the test examples prediction is done using this models and stored in the output file. Classification rate is calculated using those predictions.

Table 1: Results obtained using SVM

S. No	Expression	Classification rate
1	Angry	90.89%
2	Disgust	84.67%
3	Fear	89.89%
4	Happy	93.80%
5	Neutral	88.09%
6	Sad	85.18%
7	Surprise	93.78%

Average 89.47%

Table 2: Results obtained using Neural Network

S. No	Expression	Classification rate
1	Angry	100%
2	Disgust	90.89%
3	Fear	100%
4	Happy	100%
5	Neutral	88.78%
6	Sad	87.98%
7	Surprise	80.78%

Average 92.63%

5. Conclusion

Good accuracy is achieved for all seven basic expressions using this method. In SVM implementation complexity is reduced by minimizing the number of support vectors. SVM is a powerful tool used for classification which does not depend on heuristics. It is superior to neural networks as its formulation is in such a way that there is only one minima and it is the global minima. Also SVM has a high generalization capability. A neural network is a supervised learning method used for classifications. Good results are achieved using faces. According to this problem compare to support vector machine good recognition rate is achieved using neural network**.** .In future work researcher can combine the two algorithm for human facial recognition for produce a best Result and high accuracy

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