A Capacious Review on Human Facial Expression Classification

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Abstract— In order for computers to continue their march into the mainstream of human activity, they must continue to improve their ability to interact with humans. This means that they need to discern human writing, understand human speech, and recognize human faces Facial emotion recognition is significant cognitive functions that our brain performs quite efficiently. Facial expressions are vital reminder for non-verbal communication amongst human beings. This is only possible because humans are able to recognize emotions quite accurately and efficiently. An automatic facial emotion recognition system is an important component inhuman machine interaction. One stage of recognizing a face is to figure out how the face is oriented and to do this one needs to know where the facial features are in the image.

Keywords— Emotion Recognition; Gabor filters; Kernel principal component analysis.

I. Introduction

In this modern era, recognition of face expression becomes an active and popular research area. By facial expression recognition, means finding emotions of human depending on expression. An emotion can be termed as physiological and mental state which is subjective and private; it involves a lot of behaviors, actions, thoughts and feelings. Any facial expression, action, speech, poses, these all are taken as channel which expresses the emotion of human being several researcher research to investigate the relationship among these channels and emotions.

In 1970s, Ekman categorized six emotional expressions to be universal: pleasure, sadness, anger, disgust, shock and fear. From these above factors facial expressions have a greater significance since they are easily perceptible. Pose, speech, facial expressions, behavior and actions are some of them. Facial expression is considered as key for non-verbal communication. The technique emphases on the automatic recovery of points lost between frames. It is dedicated for robust tracking of human facial features. This new method is intended for use in robust recognition of facial information such as the identity or facial expression of a person. Such recognition applications are important components of future computer interfaces, for example. Instead of trying to increase the performance of tracking by using the automatic selection of improved features,

Numerous constraints are applied during the initial selection and tracking of feature points. Moreover, face expression can be taken as natural way of showing the emotions of human. Numerous researches in this field have been carried out in the hope of attaining these developments. A survey on the available face databases was also performed. Due to the approach selected, certain constrains has to be met in selecting a database. The requirements were for the database to have color and frontal facial images. The subject, background variations and other variations like spectacles, beard and hair in images were favorable. After some research we found the Caltech Faces, Georgia Tech Face Database and Facial Expressions and Emotion Database suitable for our study.

A. Gabor Filter

The gabor filter is important tool to extract the meaningful facial features. It is related to the receptive field profile of cortical cells that characterized as frequency selective ,orientation slective. The gabor filter attains a better performance and gabor filter in 2D spatial domain (a,b) is defined by

$$G_{u,v}(a,b) = \frac{f_u^2}{\pi\gamma\alpha} e^{-((a'^2/\gamma^2)+(b'^2/\alpha^2))} e^{j2\pi f u a'^2}$$

Where $a' = a\cos\theta + b\sin\theta, b' = -a\cos\theta + b\cos\theta$

F_u denotes the maximal frequency. U and v define the number of orientation and scales of the filter bank.

B. Kernel Principal Component Analysis

On the other hand, KPCA are useful technique in order to reduce dimensionality of features. Dimensionality reduction helps to create a correlated features reduces computation cost. KPCA can extract nonlinear features and gives better recognition performance. The nonlinear principal component can be extracted implicitly using the kernel function without explicit projection of input vectors to high dimensional space. Kernel function is denoted by

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$$k(x_i, x_j) = \emptyset(x_i).\emptyset(x_j)$$

The fractional power polynomial kernel is defined by

$$k(x_i, x_j) = sgn(x_i', x_j').|x_i'^{x_j'}|$$

The rest of the paper is organized as follows. Section II contains a brief overview of the recent work carried out in the area of facial emotion recognition. Finally the paper is concluded in section III.

II. Related work

In [1] a neural network is trained for the extraction of eyes, nose and mouth. The back propagation algorithm and a training set with 97 images have being used to train the network. Four such neural networks have being trained for each feature (left and right eyes, nose, mouth). For the visualization of the user, the neural network's suggestion for the feature has being mapped in to an image (also called a feature maps). Thus the accuracy of the neural network can be calculated by visual comparison of original image and the above mentioned image.

In [2] a approach based on MLP and RBF networks which classify the seven basic types of emotions: Neutral, Happiness, Sadness, Anger, Fear, Surprise and Disgust. The geometric coordinates of the Facial Characteristic Points (FCPs) for the image, Euclidean distances for the contour points for the image and the differences in inter-feature distances are the only data fed into the neural network. Since the classification is done from the given image and the neutral face, the approach is based on the assumption that the neutral face image corresponding to each image is available to the system. This approach has shown 73% accuracy with the JAFFE database

In [3] a human skin detection and face recognition using fuzzy logic and Eigen face .In this paper human presence and face is recognized using fuzzy approach. This fuzzy approach is used to abstract the skin region. Human skin detection for face recognition is a very dynamic area for research in the field of image processing. It is used to prevent much misconduct and helps to provide public security. In this work, face is detected from an image by segmenting the skin region (if present). Since human skin can be found in a diverse color, fuzzy approach is used to segment the skin region. After that separate faces are detected. Eigen face is used to recognize different faces. [3] Face recognition using eigen values. In most of the cases face recognition using Eigen space systems require proper views of a person from front. But if the face to be recognized does not face the camera properly then these system will not work .In this paper, they find the face detecting and storing the database. Face recognition system is insensitive to observing directions hence it requires only single sample view for each person. The presented approach utilizes the similarities of face amongst set of faces from the training set. [4].

In [5] a growth of face recognition based on a mixture of traditional eigen face with (ANN), having the face identification performance increased by the classification of differentiated vectors. The differentiated vectors on behalf of intra-subject and inter-subject variations are trained depending on the same pairs of general samples that are utilized to categorized inter and intra subject pairs from training data sets. After that, the resultant classification is used to recognize faces by combining it with the communicative ability of eigen face through a voting procedure. The proposed method when tried with FERET and YALE datasets indicates that in recognition within the SSPP restraints, the performance of the proposed method is improved than some state-of-the-art methods.

In [6] hybrid system has been presented which uses the skin color for enhancing precision for tracking and detection. In this approach, an image is divided into different part depending on their skin color and also image is rescaled. The portioned skin color image is united with the edges before applying the morphological operations. The result indicated that proposed hybrid system outperforms as compared with other traditional system.

In [7] 3 dimensional images has been used that may encode many information related to face. But, 3 dimensional images are costly to capture because of the sensor cost. In RGB-D images can be acquired using consumer level devices like Kinect that gives pseudo-depth data. Moreover in this paper, RGB-D face tracking algorithm has been proposed which is depending on extracting biased features using entropy and saliency from RGB-D images. The result demonstrates that proposed algorithm is very efficient and understands the several facets of RGB-D face recognition.

In [8] An adaptive biometric system. This architecture have one detector per target and for every detector, face model is being produced within the face images. Sequential Karhunen-Loeve technique is used to update the face model using representative face captures that are choosing for operating data by utilizing reliable tracking trajectories. This method is used to produce the intra-class variation of face appearance and improve representativeness of the face models. The effectiveness of proposed approach provides security surveillance. The analysis indicates that the proposed biometric system is very efficient

In [18] Automatic facial expression recognition has been proposed in this paper which is using the features of salient facial patches. Emotion recognition is still a difficult and a complex problem in computer science. Most researches have tried to address this problem in various ways. Emotions are expressed by humans in different ways and we chose facial expressions for the recognition of emotions in humans. Based on the feature points within the face a neural network was trained to identify the emotions contained.

III. APPROACH

A. Emotion Recognition system

The emotion recognition system is classified into 3 steps:

- Face location determination.
- Feature extraction and
- Emotion classification.

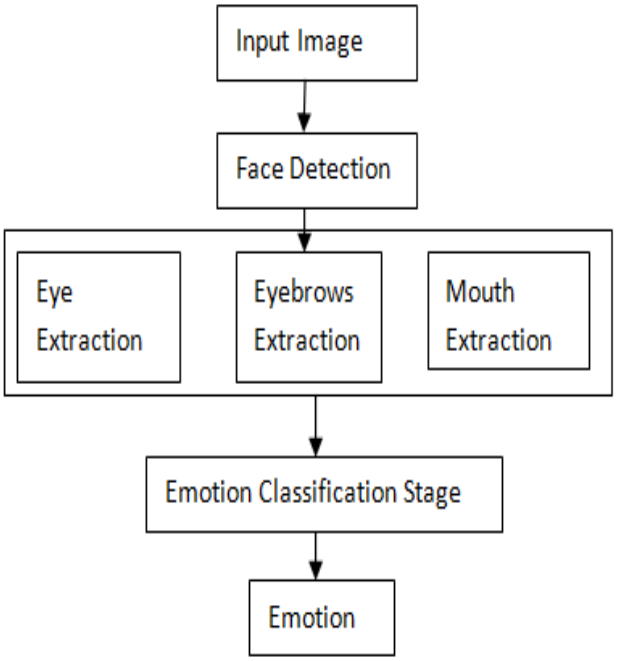

Figure 1. Emotion Recognition System

1) **Face Detection/ location determination**

In this system, face is located by using Face detection algorithm. Identifying the human face is difficult task because of the possible variation of face. The main reason of variation of face is different size, poses and angles. Furthermore, face appearances may be affected by different imaging conditions like occlusion and illumination, beard, presence of spectacles and makeup. There are four type of approaches in face detection. These are: knowledge-based approach, feature invariant approach, template- based approach and appearance-based approach. Knowledge-based approach is relying on rules derived from the knowledge on the face geometry. Commonly, rules may be defined by the relative distances and positions of facial features. Face is detected by applying these rules, and then a verification process is used to dapper the incorrect detections. In feature invariant approach, initially face features are identified and then they are grouped according to the geometry of the face. Selecting a set of appropriate features is very crucial [1]. This approach is not suitable for images with noise, illuminations and occlusions since they can weaken the feature boundaries. A standard pattern of a human face is used as the base in the template-based approach. The pixels within an image window are compared with the standard pattern to detect the presence of a human face within that window. In Appearance-based approach considers the human face in terms of a pattern of pixel intensities. Since non face pattern are not used in the training process of this approach it is not robust enough. Even the time taken is lengthy, as the number of patterns which needs to be tested is large.

Once the face is located, the formation of the face combined with image processing techniques is utilized to process the region of face in order to recognize the feature locations.

2) **Feature extraction**

By using a corner point detection algorithm, feature points are extracted from the selected feature regions. Feature extraction stage can be separated into two sections: Feature region extraction, Feature point extraction. Human face detection is an important research topic for many applications in computer vision. Thus, face detection of human is a challenging task because of high variety of configurations of the scenario, such as changes in the point of view, different illumination, and background complexity. The facial features are used as main anchor points. In addition, constraints imposed by the configuration of human faces, are exploited during tracking. In the main, the recovery of lost points is based on determining a search window around the region of interest. There are many recent methodologies from an extensive research on this topic. Most of these works focus on the extraction and analysis of visual features. The method described here is concerned with several issues that are considered to be important for robust recognition of facial features. These issues are rigid and non- rigid motion, variation of lighting conditions, head orientation, head tilting etc. The established point tracking scheme aims to tackle all those issues.

3) **Emotion Classification**

After feature extraction is performed a neural network approach is used to identify the emotions enclosed within the face. And then, from extracted feature points, distances among the features are determined. The neural network has been trained to recognize the 6 universal emotions. New developments in this field give confidence to the researchers to create enhance the applicability of facial emotion recognition to areas like chat room avatars, video conferencing avatars. The capability to identify emotions can be important in face recognition application, intelligence improvement systems and suspect detection systems and some other beneficiaries. Though numerous approaches have been taken on this topic, some limitations still exist. To obtain better results, many investigators have constrained their approaches by either using less feature points or by using a neutral image of the person in the emotion classification phase. If we may address this problem from an identified set of critical feature points and use straightforward feature detection techniques the overall performance can be augmented.

In the face recognition system, feature extraction is one of the significant components. By feature extraction means, to find the most suitable representation of face images for the recognition. In this system Gabor filter and kernel principal component analysis are used to extract feature.

IV. Conclusion

This paper has briefly overviewed facial emotion recognition System. In field of image processing it is very interesting to recognize the human gesture by observing different movement of eyes, mouth, nose etc .Facial expression are vital cues about human emotion. Automatic recognition of facial expression can be important component of human machine interface. Expression recognition can be done us using neural networks. Neural network are invaluable for applications where formal analysis would be different or impossible such as pattern recognition. Therefore we can conclude that face expression can be recognized using various algorithms like corner point algorithm, face detection algorithm in 3 basic steps as follow –

- Face location determination is a difficult task because of possible variation of face .It is done using face detection algorithm.
- Feature extraction refers to features from selected feature region using corner point detectional algorithm.
- Emotion classification refers to identify the emotion enclosed within the face using neural network approach.

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