Effect of Aging on Facial Expression Recognition

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Abstract—Facial expressions recognition is a challenging task. It has applications in many areas like human–computer interaction and data-driven animation. Automatic recognition of facial expressions can also be used in behavioral science and in clinical practice. Because of wide and active applications, Facial Expression recognition is a rapidly growing and ever green research field. Humans recognize facial expressions virtually without effort or delay but reliable expression recognition by machine is still a challenge. This paper presents high-level overview of automatic Facial expression recognition by highlighting effect of age on the recognition process where Gabor filters is used to extract facial features and SVM is applied for classification.

Keywords—Facial Expression, Facial expression Recognition (FER), facial expression recognition rate, State Vector Machine (SVM), Neural Network, Gabor filters.

I. INTRODUCTION

Facial expression is a form of nonverbal communication. It is a natural way of conveying social information between humans. Facial expression recognition is an active research topic in psychology study as well as computer vision research [3], [5], [9], [10]. A facial expression is a visible attestation of state of mind and hence gives idea about intention, personality and psychopathology of that person. As a result of the information carried by facial expressions, they play a key role wherever humans interact with machines.

Automatic facial expressions recognition can be used as a vital component in natural interface between human and machine which can be called as conversational interfaces. This enables the provision of services automatically and gives good appreciation from the service user. In the paper by Mehrarabian [12], he comments that 55% communicative cues can obtained by facial expression. Smart Devices like computer/robots can recognize the expression and hence emotional state of human and efficiency of the system to assist will increase significantly.

In [1], [2], Ebner and Johnson showed that facial expression differs across the age groups. Thus aging has considerable impact on facial expression recognition.

However, there is very little study yet done in computer vision to explore the effect of human aging on facial expression recognition. The knowledge of the effect of aging on expression recognition may help to extract robust facial features and increase the recognition rate.

This paper includes study of 1) Effect of aging on facial expression recognition and 2) Method to overcome aging effect.

In this project we use facial expression database containing large span of ages. Facial expression recognition within and across age groups is performed to discover the effect of aging on facial expression recognition. Then, we present methodology to compensate aging effect.

II. LITERATURE SURVEY

There are two major approaches for Facial Expression Recognition. 1) Appearance based and 2) Model based recognition techniques [13] [14] [15] [16]. Jyh-Yeong et al. proposes automated facial expression recognition system using neural network as a classifiers [17]. In this paper Rough Contour Estimation Routine (RCER) is used for feature extraction. Use of Point Contour Detection Method (PCDM) [18] improves the precision of eye and mouth [18]. They used Action Units (AU) [19] to describe the basic muscles movements of face. By this approach 92.1% recognition rate was achieved.

Manal Abdullah et al. In paper [20] presented optimize approach for Face Recognition using PCA (Principal Component Analysis) by decomposing image into small sets of features images or eigen face. They create training dataset to compare result. Input image is pre-processed and compared with training dataset. Using FACE94 database 35% less time as compared to original PCA is required for computation. 100% recognition rate with this method is achieved for FACE94 database.

Jacob et al. [21] discussed two techniques designed to increase the recognition accuracy of facial expression recognition. Comparison of results for a local segmentation of the face around the mouth, eyes, and brows with global segments of the whole face indicated that classification of the whole face yields greater accuracy.
In the paper [22] Anitha et al. discussed various Facial expression databases. Frank et al. [23] used JAFFE database of facial expression recognition for happy, angry, disgust, sad, fear, surprise and neutral expression. 95.71% recognition rate was obtained using 2D-LDA (Linear Discriminant Analysis) and SVM (Support Vector Machine). It takes 0.0357 second to process one image of size 256 × 256. Wai Kin et al. [24] explain the use of 2-D Gabor filter to obtain palm print and texture feature extraction which can be used for authentication. They describe five modules which are required for satisfactory results. These modules are: Palm print Acquisition, Preprocessing, Textured Feature Extraction, Matching, and Database to store template.

III. EXISTING SYSTEM

Recognition of human facial expression by computer can be done by using a system as shown in fig.1

![Fig 1: Functional block diagram of FER](image)

In the stage of pre-processing, input image is made compatible with the developed code. For instance, conversion of the input colored image into the gray scale values and low pass filtering to avoid the effect of blur and to reduce the noise if any from the input image to get the exact expected results. For Feature extraction certain features of the face to be compared with the existing database are extracted.

The database consists of the training or the reference images. This database could be one of the standard databases or the self prepared database. The functions of pre-processing and feature extraction are also operated on the database images to obtain the average values for the sake of comparison with the values obtained by the input images. Knowledge consists of the required information for the classifier to compare with the training and testing images like some mean values or some thresholds or some standards to be followed while making the comparison.

Classifier uses the knowledge set which help in comparison of the vales obtained from the input images and that obtained by the database already stored and gives the recognized expression to the recognizer block to be displayed in the result.

Recognized expression that is results from the classifier can be displayed into the require GUI format.

IV. PROPOSED WORK

Above mentioned system has limitation that it do not take into account effect of aging. Thus above system should be modified to system as shown in fig 2.

![Fig 1: Modified Functional block diagram of FER considering aging factor](image)

To find aging effect on facial expression recognition, we study FER in two groups: 1) within each age group 2) across age groups. By comparing the expression recognition accuracies, we can understand the effect of aging on FER if exists. If results vary by large amount we may conclude that the aging effect is significant on FER on the other hand the aging influence can be ignored if it vary by small amount.

FER task can be divided into two subtasks: Facial feature extraction and classification. The Gabor filters is used to extract facial features as in the [11], [7], [8]. The features are then normalized and inputted to the SVM classifier [23]. The radial basis kernel (RBF) is used for the SVM.

Through examining the face images, it can be observe that old person perform facial expressions differently from young. The expressions of young people are little exaggerated as compared to old people. From Fig. 3, we can say old adults perform the expression very subtly which even cannot be noticed clearly sometimes. This observation interprets that aging puts limitation on performing facial expressions.
Due to reduction in facial muscle elasticity, wrinkles are formed that may lead to different appearance of expression from original one. For example, the nasolabial fold separating the upper lip from the cheek can be noticed in happy expressions for the young person, but it is also noticed from the old adult even when he is performing a neutral expression, as shown in Fig. 3.

Thus, there are at least two reasons to interpret the aging effect on facial expression recognition: 1) Facial expressions performed by elderly people are implicit. 2) Aging causes different appearance of facial expression, causing effect on the extracted features for facial expression classification.

To overcome the problem we can use two approaches: 1) age group classification, and FER within the classified group. 2) Consideration of each expression in each age group as one separate class, and performing multiclass classification in a single step. For example, database that contains two expressions and two age groups will have 4 classes. For the FACES database, if we consider six basic expressions there are 24 generated classes as it is divided into four age groups.

The result of the classification will contain the information of the age group as well as expression category. 3) Aging detail removal. Aging detail removal includes removal of aging details like wrinkles, nasolabial folds etc. without removal of facial features like eyebrows, chin, nose point etc. which is a very challenging.

Thus we need edge-preserving image smoothing technique for facial feature extraction without losing useful information. The technique that can be used is weighted least squares (WLS) [4].

Let $l$ represent a gray-level face image. The WLS method decomposes it into two layers 1) base layer $b$ and 2) detail layer $d$. In this WLS method $b$ is brought as close as possible to $l$. It is made smooth everywhere except across significant gradients in

Thus we need to minimize expression of an energy function

$$\sum_p \left( (b_p - l_p)^2 + \lambda \left( a_{x,p}(l) \left( \frac{\partial b}{\partial x} \right)_p^2 + a_{y,p}(l) \left( \frac{\partial b}{\partial y} \right)_p^2 \right) \right)$$

where $p$ = spatial location of a pixel.

$ax$ = smoothness weights in $x$ direction

$ay$ = smoothness weights in $y$ direction

$\lambda$ = balancing terms; increasing the value of $\lambda$ results in smoother base layer $b$.

Smoothness weights $ax$ and $ay$ are determined by

$$a_{x,p}(l) = \left( \left| \frac{\partial l}{\partial x} (p) \right| + \epsilon \right)^{-1} , a_{y,p}(l) = \left( \left| \frac{\partial l}{\partial y} (p) \right| + \epsilon \right)^{-1}$$

where $\alpha$ is a constant. In the experiments, we set $\alpha=1.2$, $\epsilon=0.001$ to avoid dividing by zero, and $\lambda=0.2$.

Use of only the edge-preserving smoothing technique [4] cannot preserve the facial features. In [4] a method is proposed in which mask called $\beta$ is used to remove aging details in faces adaptively [6], as degree of facial wrinkles and other aging details may vary in different regions. For example, some facial regions may have deeper wrinkles, while other regions may have finer wrinkles. Our aim is to evaluate if removal of aging details the facial expression recognition robust to aging variations within each age group.

V. CONCLUSION

In this project we have proposed a method for automatic facial expression recognition in which aging factor is also taken into consideration.
We analyzed the reasons for studying aging effect on FER. First we find out the features and aging factor and then facial expression is recognized. We have then proposed two approaches which are age group constrained and aging details removal. Thus facial expression recognition rate improves by considering aging effect.

REFERENCES


