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Enhanced Facial Expressions Recognition using Modular Equable 2DPCA and Equable 2DPC

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Abstract: Human Face is main part human body can be used for various purposes. Facial expressions, resulting from movements of the facial muscles, are the face changes in response to a person's internal emotional states, intentions, or social communications. Computer recognition of facial expressions has many important applications in intelligent human-computer interaction, awareness systems, surveillance and security, medical diagnosis, law enforcement, automated tutoring systems and many more.

Face detection and Facial expression recognition system can be good source for express recognition activity. It can be used for important information, current state, and user behaviour and expression retrieval. Biometric area of research is well known activity of applications due to human interaction applications. As LBP convert any high definition file to greyscale, it leads to convert this file into low quality work. PCA suffers with the issue of involvement of least important facial part. The dark part of all such technique is lake of efficiency and accuracy due to consideration for least important facial feature during reorganization process. 2DPCA and E2DPCA algorithm can be used as the replacement algorithm to observed better accuracy and feature extraction.

This work proposed to replace LBP with E2DPCA as the advance variant of PCA to get better level of performance. E2DPCA would remove least important part of face by estimating average value for individual classes than whose face. Subsequently, a modular approach will be used to obtain more perfection in extraction process. This work also proposed the use of .Euclidian distance measure for expression classifier. Yale algorithm for auto faces detection purpose. The best part of proposed work is evaluation on user images. The complete work will be evaluated on basis of JAFFE, Cohn-kanade and Self Images.
Keywords: ME2DPCA, Euclidian distance, facial expression, expression reorganization.

I. INTRODUCTION

Facial expressions, resulting from movements of the facial muscles, are the face changes in response to a person's internal emotional states, intentions, or social communications. There is a considerable history associated with the study on facial expressions. Darwin (1872) was the first to describe in details the specific facial expressions associated with emotions in animals and humans, who argued that all mammals show emotions reliably in their faces. Since that, facial expression analysis has been a area of great research interest for behavioral scientists (Ekman, Friesen, and Hager, 2002). Psychological studies (Mehrabian, 1968; Ambady and Rosenthal, 1992) suggest that facial expressions, as the main mode for non-verbal communication, play a vital role in human communication. For illustration, we show some examples of facial expressions in Figure 1.

Figure 1: Facial Expressions of Barak Obama

Computer recognition of facial expressions has many important applications in intelligent human-computer interaction, awareness systems, surveillance and security, medical diagnosis, law enforcement, automated tutoring systems and many more.

In this work, we present our recent work on recognizing facial expressions using discriminative local statistical features. Especially variants of principal component analysis are investigated for facial representation. Finally, the current status, open problems, and research directions are discussed. This study investigated whether facial expressions can be accurately identified using face region only, how much recognition is impaired relative to the facial parts, and what mechanisms account for the recognition advantage of

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some expressions. In most of the prior studies, the facial parts were used but there significance in recognition respective of facial expression was not shown.

expression recognition methods use a combination of geometric and appearance-based features. Spatial features are derived from displacements of facial landmarks, and carry geometric information. These features are either selected based on prior knowledge, or dimension-reduced from a large pool. In this study, we produce a large number of potential spatial features using two combnations of facial landmarks [1].

Facial expressions can be described at different levels. Two mainstream description methods are facial affect (emotion) and facial muscle action (action unit). Psychologists suggest that some basic emotions are universally displayed and recognized from facial expressions , and the most commonly used descriptors are the six basic emotions, which includes anger, disgust, fear, joy, surprise, and sadness. This is also reflected by the research on automatic facial expression analysis; most facial expression analysis systems developed so far target facial affect analysis, and attempt to recognize a set of prototypic emotions.

However, little is known about facial expression processing in the visual aspect based on facial parts. Facial-expression recognition has been active research fields for several years. Several attempts have been made to improve the reliability of these recognition systems. One highly successful approach is based on Principal Component Analysis (PCA), proposed by Matthew Turk and Alex Pentland proposed in 1991. Since then, researchers have been investigating PCA and using it as a basis for developing successful techniques for facial-expression recognition.

A novel framework of information extraction is developed for facial expression recognition. Facial Expression Recognition system is based on machine learning theory; precisely it is the classification task. The input to the classifier is a set of features, retrieved from face region in the previous stage. The set of features is formed to describe the facial expression. Classification requires supervised training, so the training set should consist of labeled data. There are a lot of different machine learning techniques for classification task, namely: K-Nearest Neighbors, Artificial Neural Networks, Support Vector Machines, Hidden Markov Models, Expert Systems with rule based classifier, Bayesian Networks or Boosting Techniques (Adaboost, Gentleboost). Three principal issues in classification task are: choosing good feature set, efficient machine learning technique and diverse database for training. Feature set should be composed of features that are discriminative and characteristic for particular expression.

II. PROBLEM STATEMENT

The face expression research community is shifting its focus t the recognition of spontaneous expressions. As discussed earlier, the major challenge that the researchers face is the non-availability of spontaneous expression data. Capturing spontaneous expressions on images and video is one of the biggest challenges. If the subjects become aware of the recording and data capture process, their expressions immediately loses its authenticity [2]. To overcome this they used a hidden camera to record the subject’s expressions and later asked for their consents. Although building a truly authentic expression database (one where the subjects are not aware of the fact that their expressions are being recorded) is extremely challenging, a semi-authentic expression database (one where the subjects watch emotion eliciting videos but are aware that they are being recorded) can be built fairly easily. One of the best efforts in recent years in this direction is the creation of the MMI database. Along with posed expressions, spontaneous expressions have also been included. Furthermore, the DB is web-based, searchable and downloadable. Many of the systems still require manual intervention. For the purpose of tracking the face, many systems require facial points to be manually located on the first frame. The challenge is to make the system fully automatic. In recent years, there have been advances in building fully automatic face expression recognizers.

III. PROPOSED SOLUTION

The facial expression recognition system is designed for recognition of facial expression using variants of PCA. We applied Modular Equable Two Dimensional Principal Component Analysis for information extraction .The information extraction is performed on face and facial parts images. While classifications performed using various classifiers and the final classifier chosen are presented in the flow diagram of the proposed system is shown in Figure 2.

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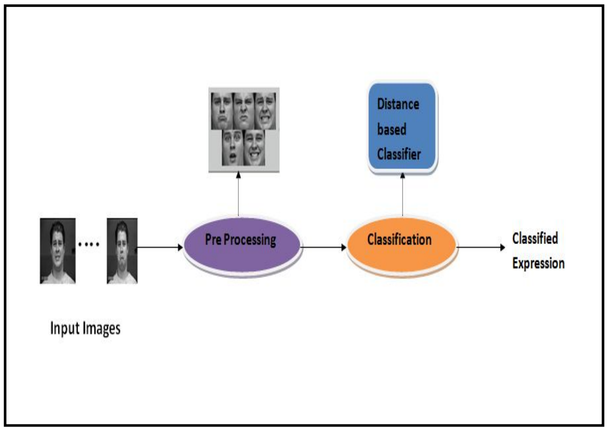
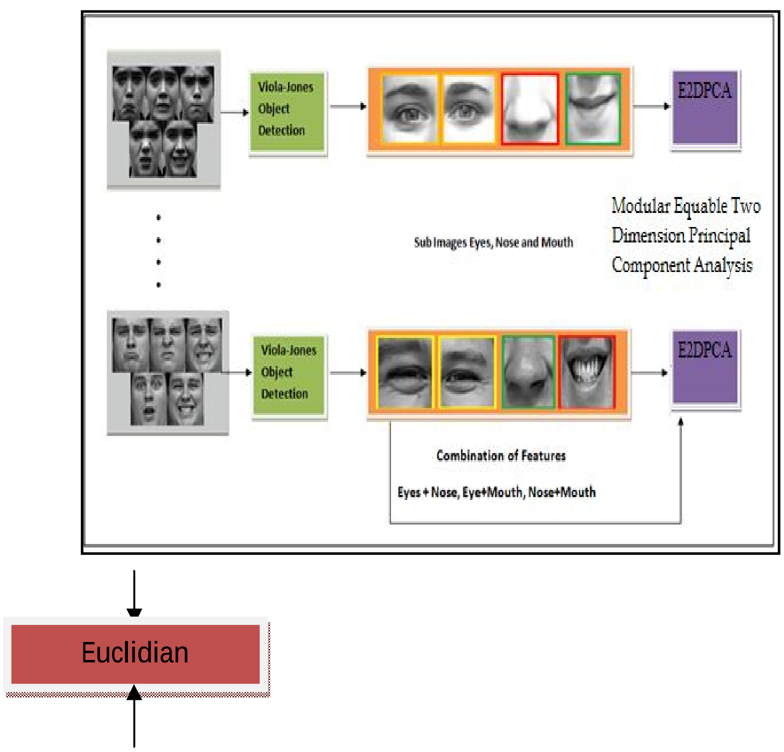


Figure 2: System Architecture of Facial Expression Recognition System

We consider facial expression classification in the framework of measuring similarities mainly for the reason that it is conceptually simple and does not require direct access to the features of the samples. it only requires the similarity function to be defined for any pair of samples. Thus, a metric structure that adapts to the feature space embeddings is preferred over the default Euclidean metric as a measure of similarity. Inspired by the success of Metric Learning (ML) in learning domain specific distance metrics, we propose an expression classification method based on ME2DPCA. In particular, generalize Euclidian distance matrix is learned that satisfies pair wise similarity/dissimilarity constraints on distance between expression feature vectors. Afterwards, classifiers equipped with this distance metric are used to assign the majority class label to the query expression. Many researcher worked on face recognition and then on facial expression recognition to reduce the unwanted information from an input image. Then the modular E2DPCA is based on dividing the face image into four parts and apply feature extraction on all parts and then apply classifiers. In spite of working on parts of image we chose to work on facial parts which are most significant and important part of a face.



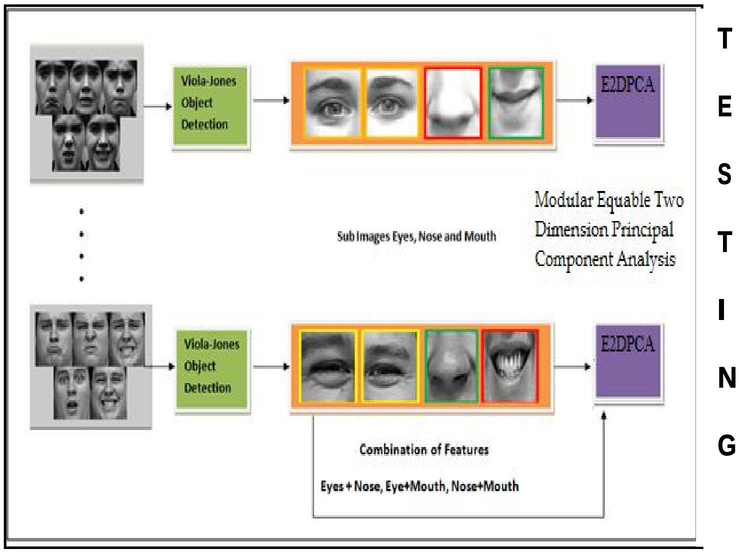


Figure 3: System Architecture of Proposed System

Figure 3 represents the System Architecture of Proposed System. Facial expression recognition has three stages face detection, feature extraction and classification.

IV. EXPERIMENTAL ANALYSIS

In this method we apply E2DPCA on whole image, finally these E2DPCA components are used as input to the classifier. We have used Euclidean distance as a nearest neighbor classifier.

Figure 4: Process Flow for Proposed System

To summarize the experiments and do the comparative analysis of the methods on the basis of recognition accuracy we are presenting the bar graphs for two methods E2DPCA and Modular E2DPCA.

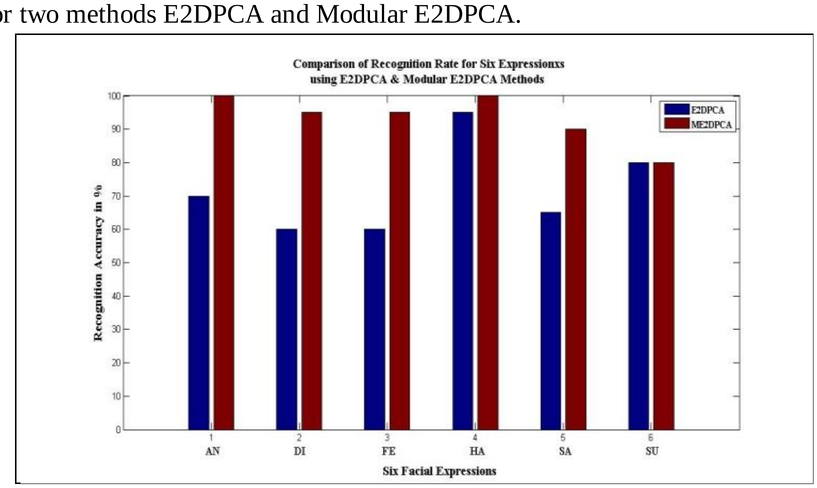


Figure 5: Comparison of Recognition Rate for Six Expressions using E2DPCA & ME2DPCA

Figure 5 shows that the recognition accuracy of Modular E2DPCA method is high for five expressions compared to E2DPCA i.e. Angry, Disgust, Fear, Happy and Sad. The accuracy for Surprise is equivalent in both cases. Table 6.3 represents the recognition rate of E2DPCA& ME2DPCA

Table 1Recognition Rate for Six Expressions using E2DPCA & ME2DPCA

S.no	Dataset	Method Used	Accuracy (%)
1	Cohn-Kanade	PCA+SVM	65.78
2	Cohn-Kanade	PCA+MDA+SVM	81.3
3	Yale-face	EPCA+LRC	86.7
4	Jaffe	EPCA+LRC	91.1
5	Cohn-Kanade	Selected Spatial Features Method	88.71
6	Cohn-Kanade	ME2DPCA+Euclidian Proposed Method	93.33

A. Majumder and co-authors worked on various techniques named as SVM,SOM,RBFN and LBP and the promising results were using PCA with SVM i.e. 65.78 [40]. S. Kumar and co-authors, proposed to align neutral images of different subjects in the feature domain using Procrustes analysis. Subsequently, modelling of shape-free neutral images are done using Principal Component Analysis (PCA).For classification MDA and SVM were used and the accuracy was 81.3% [4]. Y. Zhu, X. Li and G. Wu proposed Face expression recognition based on equable principal component analysis and linear regression classification and the accuracy was 91.11% [32]. C. Gacav, B. Benligiray and C. Topal proposed a Sequential forward feature selection method for facial expression recognition and the accuracy was 88.71% [11].Table 6.4 shows all methods discussed here with their accuracies & datasets used

.

EXPRESSIONS	E2DPCA	ME2DPCA
ANGRY	70	100
DISGUST	60	95
FEAR	60	95
HAPPY	95	100
SAD	65	90
SURPRISE	80	80

Table 2 Methods and Their Recognition Accuracy

V. CONCLUSION

We present a unique expression classification method using Modular Equable Two Dimensional Principal Component Analysis and Euclidian Distance classifier. A modular system for facial expression recognition was developed. Though the goal was to classify Ekman's basic expressions, the modular approach can be expanded to any number of classes. Feature descriptors based on Principal Component Analysis, Equable Two Dimensional Principal Component Analysis were formulated in terms of pixels around key points. This approach can be seen as generalization of the local appearance based approaches often found in literature that divide the image into non-overlapping blocks of the same size. Viola Jones method was used to select significant key point locations. These locations are important facial features like; eyes nose and mouth. Initially these features were manually detected; later Adaboost method was used for automatic detection. To maintain the equilibrium in selecting useful information and reducing unwanted information or less important face regions, we have further applied Adaboost method to get the most important information from a face image i.e. the central region of the face composed of Eyes, Nose and Mouth. To derive the significance of facial parts we have used the most important parts of face as module of ME2PCA. It is not only four parts of face image but these are four identification pillars which are Left and Right Eye, Nose and Mouth. Euclidian classifier + ME2DPCA perform best with overall recognition accuracy of 93.33%.

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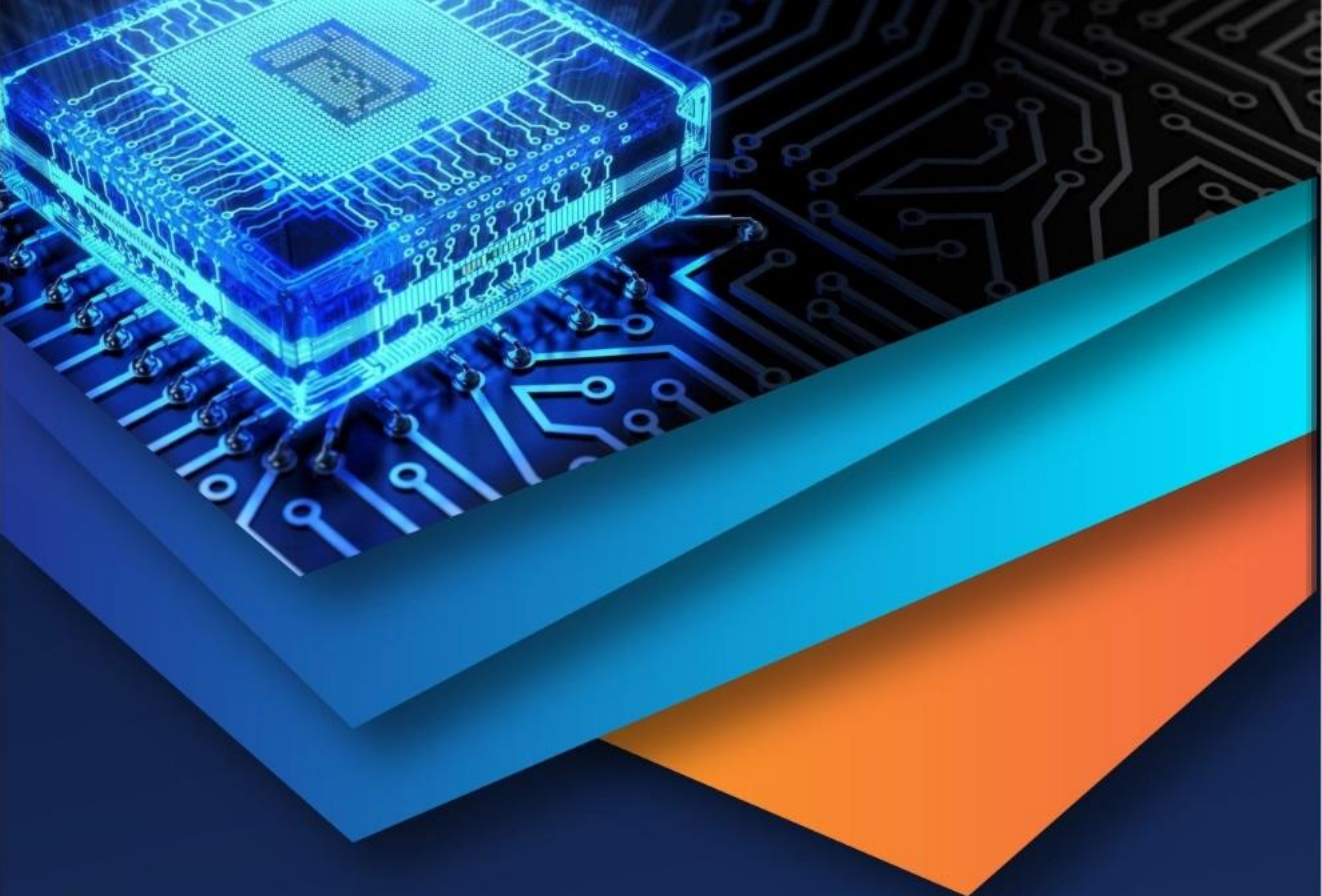

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