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A Comparative Study between CS-LBP/SVM and CS-LBP/PCA in Facial Expression Recognition

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ABSTRACT

Face plays significant role in social communication. This is a 'window' to human personality, emotions and thoughts. Due to this, face is a subject of study in many areas of science such as psychology, behavioral science, medicine and computer science etc. In this paper, a comparative study is suggested between CS-LBP/SVM and CS-LBP/PCA. These algorithms are used in emotive facial expression recognition. Finally, a comparison is shown between PCA & SVM in terms of Dimension Reduction. The proposed system uses grayscale frontal face images of a Japanese female to classify six basic emotions namely happiness, sadness, disgust, fear, surprise and anger.

***Keywords*:** Center symmetric local binary patterns (CS-LBP), Principal Component Analysis 9PCA), Support Vector Machine (SVM), Facial Expression Analysis

1. INTRODUCTION

According to the psychological research conducted non verbal part is the most informative channel in social communication. Verbal part contributes about 7% of the message, vocal 34% and facial expression about 55%. So, it is considered important tool for individual identification. Biometrics can neither be replaced nor faked [1]. To identify a person, biometrics such as iris, fingerprints, retina etc. are used [2]. Face recognition system is very powerful method for authentification of a person. Basic human facial expression can be classified into seven categories i.e., happiness, surprise, sadness, fear, anger, disgust and neutral [3].

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A facial expression recognition system represented in figure1 is a three step process which includes face detection, feature extraction and expression classification.

Figure 1. Facial Expression Recognition Steps.

Facial recognition process is divided into three processes. First is the face detection in which an input is in the form of an image and the facial region is detected. Face alignment is included in this step. After the detection of the face from an image or video frame, the most informative items are extracted [4].

This step is called feature extraction. Here, in this process, the redundant information is removed. Feature vectors are subsequently formed. A local feature extraction method uses neighbourhood, region, and facial point or patches to derive the required features. Now, third step is matching the test image with each extracted feature vector.

This gives distance representing the similarity between the test image and database image. Label is given to the image, most similar to the template of the trained data. The classification unit provides best match of image with database images [5].

2. SUPPORT VECTOR MACHINE (SVM)

SVM is a useful technique for face recognition and image compression. It is useful in finding patterns in case of high dimensional data. It is a discriminative classifier formally defined by a separating hyper plane. It finds a hyper plane i.e. in multi-dimensional space it separates out classes [6].

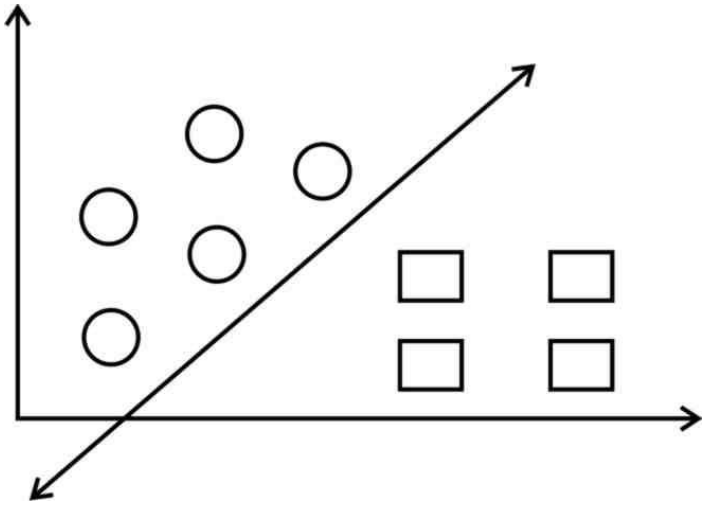

Figure 2. SVM Sample.

3. PRINCIPAL COMPONENT ANALYSES (PCA)

It is a dimensional reduction tool that can be used to reduce large set of variables to a small set that still contains most of the information in the large set [7]. There are various approaches to face recognition ranging from PCA approach or Eigen faces. It has been called one of the most valuable results from applied linear algebra [8]. Face recognition system consists of two phases [9-10]:

- ❖ Training Phase (Feature extraction)
- ❖ Recognition Phase (Feature matching)

4. LOCAL BINARY PATTERN (LBP)

LBP operator is a non-parametric 3×3 Kernel which summaries the local special structure of an image [11]. At a given pixel position (x_c, y_c), LBP is defined as an ordered set of binary comparisons of pixel intensities between the center pixel and its eight surrounding pixels.

$$\text{LBP}\ (x_c, y_c) = \sum_{n=0}^{7} s_n \left(i_n - i_c 2^n \right),$$

This is the decimal form of 8-bit word (LBP code) where, i_c corresponds to the grey value of center pixel (x_c, y_c), in to the grey value of the 8 surrounding pixels.

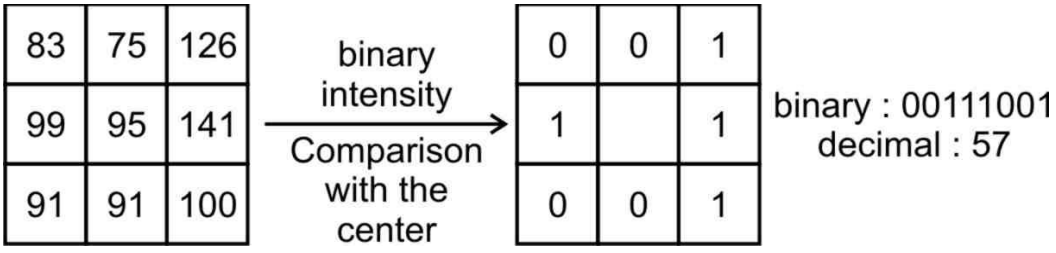

Figure 3. LBP Operator.

5. CS-LBP FEATURE EXTRACTION

With the help of CS-LBP operator features of every pixel of the desired input area or say region is extracted. There are total three different parameters of CS-LBP operator i.e., total number of neighborhood pixels P, and radius R, and threshold on the gray level difference H. Experiments results that good values of the above parameters are (1, 2) for R, (0 .....0, 02) for H and (6, 8) for P.

6. PROPOSED DESIGN METHOD

The first proposed algorithm consists of following: feature extraction using CS-LBP, PCA & SVM for dimension reduction and facial expression classification using Euclidian distance.

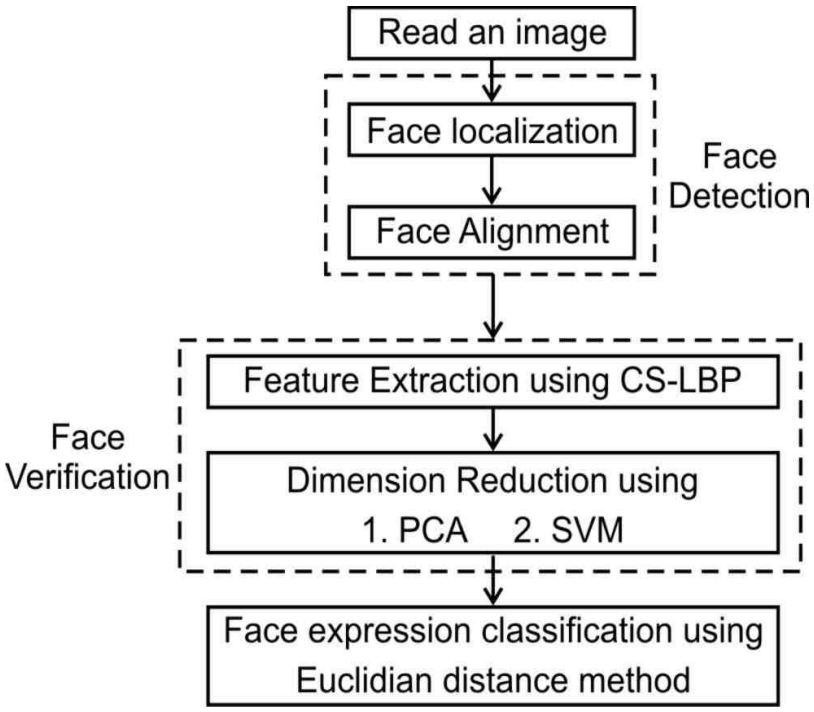

Figure 4. Proposed system for Expression Recognition.

7. ALGORITHM WORKING

The algorithm has training phase and testing phase. The following steps can be taken into account.

(1) Training phase
- (a) Read an image
- (b) Preprocessing
- (c) Sub regions are extracted
- (d) Feature extraction methods over each region is applied using CS-LBP
- (e) (i) PCA for dimension reduction
  (ii) SVM for dimension reduction
- (f) Repeat steps from (a) to (e) for all images

(2) Testing phase
- (a) Read an image
- (b) preprocessing
- (c) Sub regions are extracted
- (d) Feature extraction using CS-LBP
- (e) (i) PCA for dimension reduction
  (ii) SVM for dimension reduction
- (f) Distances between each training vector's with test vector are obtained
- (g) Finally best match is obtained

8. RESULTS & DISCUSSION

Evaluation of six basic universal facial expressions by extracting features through CS-LBP/PCA and CS-LBP/SVM [12], is used for dimension reduction and classification. The Japanese Female Facial expression (JAFFE) Database Contains 213 gray images of 7 facial expressions including neutral posed by 10 Japanese female models. Each image has four frontal face images for each expression. The image of 10 subjects in the database is classified in 6 different expression classes.

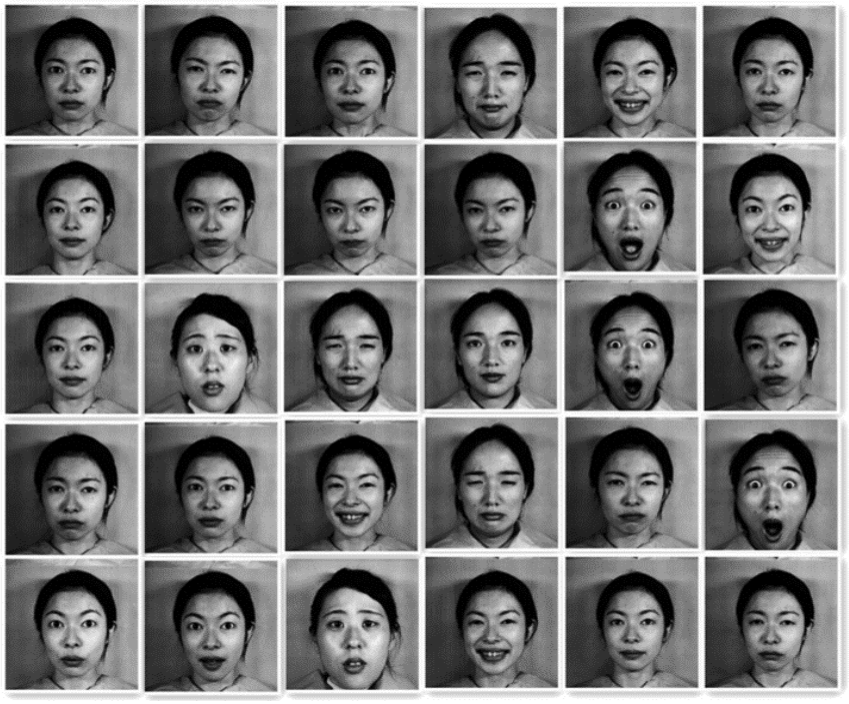

Figure 5. JAFFE Image Database

Table 1. Recognition rate (%) comparison of CS-LBP/PCA and CS-LBP/SVM.

Facial Expression	Recognition Rate using CS-LBP/SVM	Recognition Rate using CS-LBP/PCA
Happy	97	96.23
Disgust	77	76
Surprise	96	87
Sad	92	91.36
Anger	71	70
Fear	87	86.24

In PCA, we project all data points to an n-1 dimension plane preserving the variance and in SVM with hyper plane that is also n-1 dimension plane. But this is only the case for a linear SVM. Combination of two algorithms is implemented and method proposed is effective in recognizing the different expressions as compared conventional methods. In future, research will be extended to 3-D face modeling.

References

[1] M. Hassaballah and Saleh Aly, Face Recognition: Challenges, Achievements and Future Directions. *IET Journals of Computer Vision,* Vol. 9, No. 4, pp. 614-626, 2015.

[2] S. Tolba, A. H. El-Baz, and A. A. El-Harby, Face Recognition: A Literature Review. *International Journal of Computer, Electrical, Automation, Control and Information Engineering,* Vol. 2, No. 7, pp. 2556-2571, 2008.

[3] T. Ojala, M. Pietikäinen and T. Mäenpää, "Multiresolution Gray-scale and Rotation Invariant Texture Classification with Local Binary Patterns. *IEEE Transactions on Pattern Analysis and Machine Intelligence* Vol. 24, No. 7, pp. 971–987, 2002.

[4] K. Meena, A. Suruliandi and R. Reena Rose. Face Recognition Based on Local Derivative Ternary Pattern. *IETE Journal of Research,* Vol. 60, No. 1, pp. 20-32, Feb. 2014.

[5] Shashi Kant Sharma, Maitreyee Dutta and Kota Solomon Raju, Comparative Study of Efficient Face Recognition Methods: A Literature Survey, in *Proceedings of International Conference on Communication, Computing and Networking* (ICCCN), Vol. 2, pp. 554-559, 2017. ISBN: 978-8-193-38970-6

[6] Shashi Kant Sharma, Maitreyee Dutta and Kota Solomon Raju, Comparative Study of Efficient Face Recognition Methods: A Literature Survey, in *Proceedings of International Conference on Communication, Computing and Networking* (ICCCN), Vol. 2, pp. 554-559, 201. ISBN: 978-8-193-38970-6

[7] Solomon Raju Kota, J.L.Raheja, Archana Rathi, Shashi Kant Sharma, Principal Component Analysis for Gesture Recognition using SystemC. *International Conference on Advances in Recent Technologies in Communication and Computing* 2009 IEEE pp.732-737. DOI: 10.1109/ARTCom.2009.177

[8] Tofighi, N. Khairdoost, S. A. Monadjemi and K. Jamshidi, A Robust Face Recognition System in Image and Video. I. *J. Image, Graphics and Signal Processing,* Vol. 8, pp. 1-11, 2014.

[9] Mahesh Kumar Sharma, Shashikant Sharma, NopbhornLeeprechanon, and AashishRanjan. Wavelet decomposition based principal component analysis for face recognition using MATLAB. Advancement in Science and Technology AIP Conf. Proc. 1715, 020055-1–020055-10; pp. 1-10. doi:10.1063/1.4942737

[10] Shashi Kant Sharma, Kota Solomon Raju, Application of Gaussian Filter with Principal Component Analysis Algorithm for the Efficient Face Recognition. *International*

Journal of Electronics and Communication Engineering & Technology Volume 4, Issue 7 (2013) pp. 244-251.

[11] Wiskott, L., Fellous, J. M., Kuiger, N. and Von Der Malsburg, C. Face recognition by Elastic Bunch Graph Matching. Pattern Analysis and Machine Intelligence. *IEEE Transaction on Pattern Analysis and Machine Intelligence,* 19(7), pp. 775-779, 1997.

[12] Manish Shankar Kaushik and Aditya Bihar Kandali, Recognition of Facial Expression extracting Salient Features using Local Binary Pattens and Histogram of Oriented Gradients, in *IEEE International conference on Energy, Communication, Data Analytic and Soft Computing* (ICECDS), pp. 1201-1205, 2017.