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A Review on Automatic Heterogeneous Face Recognition

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Abstract: ***Facial recognition has been rapidly growing in areas where real-time challenging and interesting applications. A large number of facial recognition algorithms have been developed for nearly a decade. In this paper, the review of a wide range of methods for facial recognition attempts to be completed. This includes software tools such as PCA, LDA, ICA, SVM, and Gabor wavelet, soft neural networks such as neural networks that recognize and hybridize to these techniques. This review investigates all of these methods with challenging faces to identify lighting parameters, posture changes, and facial expressions.***

Keywords: ***Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Face Recognition, Independent Component Analysis (ICA), Artificial Neural Networks (ANN).***

I. INTRODUCTION

Face recognition is an important part of human perception of the system capacity, is a human task, and facial recognition similar to the computer model of the building. The calculation model not only contributes to theoretical knowledge, but also has many practical applications, such as automated monitoring of population, access control, and interface design team (HCI), management database and criminal identification. The first work on facial recognition can be traced back at least to psychology. Some of the early studies included Darwin's facial expressions of working emotions. But the research in automatic face recognition began in the 1970s and the groundbreaking work. In 1995, a review paper gave a detailed study of facial recognition techniques at that time. At the time, video-based face recognition was still in its infancy. In recent decades, facial recognition has received increasing attention and has advanced technology. Face Recognition Many commercial systems are still available. Recently, significant research work focused on analog face tracking based on video, identification and system integration. They have created new databases and have evaluated the use of these database identification techniques. Now, face recognition has become one of the most active applications for pattern recognition, image analysis and understanding.

II. LITERATURE REVIEW

Changxing Ding et al. Changxing Ding and so on. This paper describes a novel scheme for the extraction of face images from "multi-level multi-level double cross pattern" (MDML-DCP). Specifically, this scheme exploits the DCP MDML Gaussian operator to derive the first derivative of the difference in light intensity, and then calculates the characteristic DCP level as a whole and the components. DCP is a unique face texture inspired by the new facial image descriptor. It is computationally efficient and only doubles the cost of calculating the local binary mode, but it is very robust to pose and expression changes. The MDML-encoded data collection platform and effectively differentiate from multiple levels are highly interpersonal but robust introspection-changing discriminant models complete the invariant feature of a facial image. The results of the FERET, CAS-PERL-R1, FRGC 2.0 and LFW experiments show that DCP is superior to the most advanced local descriptors such as LBP, LTP, LPQ, TLBP and LGXP for ID face and face verification tasks . Even more impressive is the

performance of the LFW based on the best and the challenging FRGC 2.0 data achieved through a simple identification scheme implemented on MDPS-DCP [1].

E Ji1 et al. Determine how much adjuvant therapy with raloxifene alters the activity of abnormal neurons in cognitive processes of anger emotion in schizophrenia. Twenty schizophrenic patients (M12, F8) were enrolled in a 13-week trial of a randomized, double-blind, adjuvant raloxifene (120 mg per day orally), placebo-controlled treatment and were identified for each task emotionally Facial care during functional magnetic resonance imaging after the treatment phase. A two-sample t-test was performed in the region of interest to select the a priori assessed differences between raloxifene and placebo activations for recognition of angry faces. To our knowledge, this study provides the first evidence that neuronal activity in the brain region associated with changes in adjuvant therapy with raloxifene is associated with facial emotion recognition in schizophrenia. These findings support the estrogenic modification of schizophrenia and suggest that raloxifene adjuvant therapy can reverse the recognition of facial sensitivities during which it is related to social function in men with worsening abnormal neural activity and the hypothesis that women with schizophrenia disease. [2]

Tal Hassner et al. Methods Face recognition based on template. The purpose of this is to improve the recognition accuracy and to reduce the cost of matching template calculations and storage. To do this, we take practice in many other areas, but as far as we know, never fully explore the face images: the face of the average of the photo. The images of the space of the template showing how can be divided and grouped according to the quality of the image and the posture of the head and the template with the effect and size of the precision. Perform extensive testing of IJB-A and Janus CS2 template-based face recognition and verification benchmarks. These indicate that our approach not only overcame the fact that although much less cross-comparison template is required to publish the prior art, it can also be surprisingly that the grouping of the images is performed in parallel with the deep features of the pool. [3]

Jun Lee et al. Face recognition is performed by a DB-related multi-pose surface between a set of facial images between a set of facial images that are matched by applying a template to a matching template. [4]

Yang Libo et al. Feature plane method based on support vector machine and method of recognizing multi - classifier fusion. The combination of multi-classifier methods not only makes full use of SVM and high recognition rate and distance measurement, but also uses distance measurement results to guide the support vector machine (SVM), speed, training and testing. [5]

Shrutika Shukla at al. Reducing to such an extent as face detection and dynamic video noise should not be able to affect system performance. Other areas of improvement may be neural networks and a combination for calculating soft fuzzy logic. [6]

III. FACE RECOGNITION ALGORITHM

A. Principal Component Analysis (PCA)

PCA is also known as the Kahenan-Lovi method. For the feature selection and dimensionality reduction of the popular method. Face recognition The use of PCA was first done by the Turks and Puntland [9] and the reconstruction of the face is made. The method of recognition, called the eigenface, defines a feature space Reduce the original dimension Data space [7]. This space is used to reduce the data Recognized. But, discriminatory power Classes and computations are well known frequently asked questions in the PCA Method. This limitation is transcended by Linear Discriminant Analysis (LDA). LDA is the most dominant algorithm for feature selection based on the appearance [8]. However, many face recognition systems based on the PCA LDA are used to reduce the size, and then the LDA is used to maximize the discriminatory feature selection of the power suppl.[9]

The reason for this is that the LDA has a small sample problem where the selected data set must be extracted for a larger sample size for a good discriminant feature. Therefore, an LDA implementation lead directly to the discriminatory feature extraction is poor. In the proposed method [10], the Gabor filter is used to filter the image frontal plane and the PCA is used to reduce the dimensionality of the filtered feature vector, and then the LDA is used for feature extraction. The performance of the PCA, LDA, and ICA methods based on statistical appearance was tested and compared in color images to identify faces [11]. PCA is better than LDA and ICA in different light changes, but LDA is better than ICA. LDA is more sensitive than partial occlusion of PCA and ICA, but PCA is less sensitive to partial occlusion than LDA and ICA. PCA is used as a dimensionality reduction technique and modeling deformation expression.

The recursive algorithm used to compute the discriminant features of the PCA-LDA method was introduced in [12]. This method concentrates on the computation of the flow of high-dimensional data by challenging the identification of the vector increments to arrive without calculation without knowing the corresponding data covariance matrix. The incremental PCA-LDA algorithm is very efficient in memory usage and is very efficient in computing vectors. It recognizes the algorithm's very famous face like PCA and LDA, giving a face recognition acceptable success rate. Based on the appearance of the modified PCA (MPCA) and the Bureau of Protection Projection (LPP) two technologies combined to the face recognition rate is high. PCA is used as a feature extraction technique. These feature vectors are compared using the Mahalanobis distance of the decision. Proposed a multi-linear sheet based on principal component analysis, extracted directly from the screw buckle representation instead of the vector representation function. This method shows a better performance than the well-known method of distance measurement of the environment.

PCA can go beyond many other technologies When the size of the database is small. The algorithm [13] uses a subset of the database some features of interest in the face. only one Subgroups are recognized by PCA. Despite the PCA, so good results There is the disadvantage of being computationally expensive and complex with increasing the size of the database, since in all pixels, the representations necessary for the image to match the input image with others in the database.

They are in the process of selecting and applying different techniques for dimensionality reduction, such as PCA, nuclear PCA, LDA, town and street preservation predictive preservation, to reduce yield loss due to facial classification changes. While PCA and LDA appear to be equal in terms of accuracy for dimensionality reduction. However, it has been observed that the LDA takes a lot of time to process the number of images that are more multifaced, even for small databases. In the case of the Town Protected Protrusion (LPP) and NPE methods, the recognition rate is much lower if there is a growing number of facial images compared to the PCA and KPCA methods used. The proposed method [14] provides a significant improvement in the case of illumination variations, PCA and nuclear PCA are the best.

The PCA algorithm for face recognition modification has been proposed in [15], which is based on the idea of reducing the influence of the eigenvectors associated with the normalized deviations of vector elements from the normalized large eigenvalues. The simulation results show that the results of the method are still much the same as those of PCA and LDA and the traditional method of calculating costs much better than LDA.

A new method based on facial recognition PCA and LDA neural network [16]. The method comprises four steps: i) pretreatment ii) using the LDA characteristics of PCA iii) to extract the reduced size and iv) the classification using Neural network combining PCA and LDA was used to improve the LDA capacity of certain samples when the images were available and the neural lassifier was used to reduce the number of classified errors due to non linearity. The method is in the database Yale face detection. The experimental results in this database have fewer error categories showing the effectiveness of the proposed face recognition compared to the previous method approach.

The face detection method differs from the method in which the minimum computational time is simultaneously achieved by detección.PCA of higher accuracy is used to reduce the dimension of the extracted feature vector [17]. GRNN is used as a

method of the network function to detect whether an input face contains a face or not and its orientation report if present. The proposed system shows that GRNN can perform better than BP algorithms, giving some solutions to better tuning.

B. Support Vector Machine (SVM)

Support vector machine (SVM) is one of the most useful techniques in classification problem. An obvious example is facial recognition. However, the SVM cannot be defined when the feature vector of the sample is missing an item application. In this framework, the support vector machine (SVM) has been successfully used in the classification algorithm [18], which can be applied to the spatial original appearance or the applied extraction method after the subspace feature . The advantage of traditional neural network SVM classifier is that SVM can realize the better performance of generalization.

C. K-Nearest Neighbor

The simple classification of the program is the classification of the spatial image of the neighborhood. According to this scheme, the group of images in the test group is identified by a label in the learning set, where the distance is measured in the image space in the nearest point of the assignment. If all the images have been normalized to zero mean and unit variance, then this process is equivalent to selecting the image that is most relevant to the test image in the training set. As a result of the standardization process, the result is independent of the intensity of the light source and the effect of the automatic gain control of the camera. The feature selection implementation uses this learning algorithm by restricting each classification to depend on only a single function [19]. The Euclidean distance metric is usually chosen to determine the proximity of the KNN data points. The distance between all the pixels in a data set is assigned. It defined as the Euclidean distance between two pixels. The Euclidean metric is the point Rn in Rn of the function d: Rn and is used to assign N × = (X1, ..., XN) and Y = any two vectors (γ1, ..., n) This gives the "standard" between the two vectors Rn, from which the distances are made up of the matrices of x, y, x, ..., The distance between all possible pairs of points (X, Y).

KNN prediction is based on the closure of distant objects may be similar to the intuitive assumption that it makes sense that the k nearest neighbor divisions make the prediction that the nearest neighbor between K nearest neighbors has a greater impact on the results of the query point . This process has several well-known shortcomings. First, if the images in the training set and the test set are grouped under varying lighting conditions, then the corresponding points in the image space are not tightly grouped [20]. Therefore, this method works reliably under illumination variations, requiring a dense set of learning samples under the continuum of possible lighting conditions. Second, the correlation is computationally expensive. To be recognized, we must correlate the image with the face of each image in the training set to reduce the computational time. Third, it requires a lot of storage space: that is, the training set must contain a large number of images per person.

D. Naïve Bayes

For a given input window, a vector x is extracted from the entity. The eigenvectors are classified into classes or non-faces according to Bayesian decision rules. Let P (X | ω face) and P (X | ωnonface) classes and nonface, respectively, face the class condition in PDF. If the following fractional number likelihood exceeds the threshold, the feature vector x belongs to a face pattern:

$$\mathcal{L}(\mathbf{x}) = \log\left(p(\mathbf{x} \mid \omega_{face})\right) - \log\left(p(\mathbf{x} \mid \omega_{nonface})\right).$$

In our approach, conditional pdf conditional Bayesian use of the naive model, which has been found to work well in practice, is computed. The Naive Bayes model assumes the statistical independence of the elements of the eigenvector x. Under this assumption, we get:

$$p\left(\mathbf{x} \mid \omega_{face}\right) = \prod_{i=1}^{N} p\left(x_i \mid \omega_{face}\right),$$

$$p\left(\mathbf{x} \mid \omega_{nonface}\right) = \prod_{i=1}^{N} p\left(x_i \mid \omega_{nonface}\right).$$

The marginal probability density functions P (p) and P (n) are calculated using the technique of histograms. Naive Bayes classifier has been used and played by Schneider. In its approach, the input window size 64 x 64 is divided into overlapping sub-regions, where the extracted feature vectors; the sub-region appearance and location. In our work, we try to extract the various features of the technology.

E. Independent Component Analysis (ICA)

Independent Component Analysis (ICA) is a method for finding latent factors or components from multivariate statistical data (multidimensional). It is necessary to realize a face image for use with the face direction and different lighting conditions using the ICA, which will provide a better result than the existing system [21]. The other method of distinguishing ICA is that finding components is statistically independent and non-Gaussian. In ICA is similar to the problem of blind source separation, it is reduced to finding that the components in it are statistically independent of the linear representation. A comparison of PCA and ICA with different classification-based FERET data for face recognition was discussed and found that the ICA has a statistically independent basis with PCA and is also better for image recognition rates Independent coefficient. I was confronted with the use of ICA in presenting the rotational position of the large angle and varying illumination conditions identified. A new subspace-independent component analysis method named Face Recognition Sequential Subspace is proposed [22]. The vector that is transformed into the ICA prior to the calculation of the independent component for each face image. RC_ICA reduces the error of facial recognition and recognition subspace dimension. Facial recognition has an independent analytical model omponents (ICA) combined with the literature presented by the optical correlation technique of the new technology. This method is based on an optical correlation of the robustness of the ICA model to highly discriminate methods. Independent Component Analysis (ICA) models have been generated to find linear transformations to express a set of random variables that are statistically independent of the source of the linear combination of interest. The ICA provides a more powerful representation of the data PCA because its purpose is to provide an unrelated representation of the decomposition and irrelevant image. This algorithm computes the major component increments of a vector image sequence without estimating the covariance matrix and, at the same time, transforms the main components in a separate address to maximize the source of non-guassianidad. IPCA_ICA is very efficient in calculating the first basis vector. PCA_ICA is higher Average Signed Eigenface, Fisherface's that and FastICA.

F. Gabor wavelet

In order to improve the facial recognition function, the high intensity vector extraction is combined with the ICA image of the front face of the Gabor wavelet transform [23]. The Gabor feature has been identified as one of the best performances for facial recognition. In recent years, wavelet Gabor has been widely used in the face recognition of researchers. Because Gabor wavelet is similar to two-dimensional contours of simple cortical mammalian cells Domain, with the desired properties of spatial locality and orientation selectivity. Previous work on Gabor features has also shown that facial recognition results are impressive. Typical methods include the dynamic, Gabor Fisher classification (GFC) [24], and AdaBoosted GFC (AGFC) of the Linked Architecture (DLA), Elastic Graph Communication Group (EBGM). The Gabor feature is also used to identify gait and sex recognition recently. In this paper, it is noted that although Gabor is sensitive to local variations, similar magnitudes, i.e., the distinction between patterns, may be used, which provide detailed information about the characteristics of the local image. Therefore, the Gabor phase can be well compensated for operation with a magnitude as long as their misalignment and localized sensitivity can be carefully compensated. In previous work, authors have proposed the use of local Gabor binary mode (LGBP), the Gabor amplitude with local binary pattern (LBP) operator [25] to represent the combined face image. Compared to LBP and GFC to get the best results. Since the local LGBP histogram based on the representation of the face is insensitive to local variations, the local histogram LGBP can also be used to suppress the sensitivity of local changes in the Gabor phase. When coding through the local histogram and the Gabor phase of the LBP, a very observable rate comparable to those based on the Gabor amplitude recognition method is achieved, indicating the effectiveness of the Gabor phase in different discriminative

faces. A new method for face feature extraction in face and core least squares discriminant algorithm is proposed based on the Gabor wavelet representation [26]. The experimental results of XM2VTS ORL and show that the kernel-based Gabor least mean square discrimination method Feature extraction methods such as PCA, LDA or PCA Ernel generalized discriminant (GDA) analysis, and the combination of these methods and Gabor representation of face images. In the introduction of a technique there is extracted a high intensity feature vector of the Gabor wavelet transform of the image combined with the front face and the face recognition reinforcement ICA.

The new technique used in feature extraction in the literature shows that the Gabor filter can extract the maximum information from the region of the local image and is invariant, translational, rotating due to changes in light And proportion . In Gabor Wavelet Neural Network proposed face detection. A proposed a Gabor feature-trained faces recognition hybrid neural network solution. Used Gabor wavelets to present face and applied neural networks to classify viewpoint views. Dimension is reduced by principal component analysis. An eigenvector technique for extracting the entire face in an image of a database developed using the Gabor filter, known as constant illumination and facial expressions [27]. The network achieves a higher recognition rate when the eigenvectors have a lower dimension and more better classification efficiency.

G. Artificial Neural Network (ANN)

The MLP is chosen for the simplicity of the proposed system and the ability to monitor pattern matching is directly due to the previous learning algorithm. It has been successfully applied to many classification schemes [28]. A new approach to face the Gabor wavelet and proposed a feed forward neural network for detection. The method used is the wavelets transform Glets and the search feature to extract the feed change points and the eigenvectors of the neural network. The experimental results show that the method has achieved better results than with the matching method and the Eigen face of the graph, which is known to be the most successful method. New classes of convolution neural networks, in which processing units shunt inhibitory neurons are introduced. Previously bypassed neurons have a class of feed forward classification and non-linear regression, used in traditional buildings, are easier to prove than the teacher's model of development A hybrid neural network was proposed in [29], which combines local image sampling, self-organizing map neural networks, and a convolution neural network. The self organizing map provides an image of the topological space of the sample, both in the vicinity of the original space also in the vicinity of the output space of the quantitative analysis, the sample image provides three-dimensional reduction and invariant slight changes in the convolution neural network (CNN) Partial invariant translation, rotation, scaling, and deformation. PCA + SOM + CNN and CNN methods are superior to the technical features of the face, even though the persona.SOM + CNN method has only one image forming a consistent performance better than the PCA + CNN method. A new approach to face detection is proposed by using neural network polynomials (PNN). NNP works as a classification of multiple scales to assess the likelihood of a localized face image pattern in the displaced area. The PCA technique is used to reduce the number of image patterns and features extracted for the NNP. Using a single network I have achieved fairly high detection rates and low false positive rates on images with complex backgrounds. Compared to multi-layer sensing, PNN superior performance, (SRKDA) [30] based on regression analysis and the introduction of spectrograms in the proposed method, which is based on the proposed method. When sample vectors are linearly independent, usually with small sample size problems, the SRKDA can give a more accurate solution than the ordinary subspace learning method. It not only solves the problem of dimension and small sample size, but also improves the feature extraction nonlinear local structure, LPP, OLPP, SR and KDA to show the efficiency of the algorithm for recognizing 3D faces, especially for Change of expression. SRKDA only has to address a set of non-normalized regressions and eigenvector calculations that are involved in calculating the huge savings in cost.

A new process based on facial recognition of the face recognition is being performed using a set of features extracted from the Haarlets image in the gray plane. PCA is commonly used, but it is time. According to an experiment performed by the authors, it has been concluded that facial recognition algorithms for PCA, FDA, ALL LBP and show GNN recognition rates

above 40% for local plastic surgery. The facelift is based on face recognition using a set of set theory new approaches proposed. According to the recent theory of the entire facial image to compare proposed before and after the practice.

IV. CONCLUSION

This work attempts to revise a significant number of operations to compensate for the latest developments in the field of facial recognition. This study shows that facial recognition to improve the performance of new algorithms using soft computing tools such as Artificial Neural Networks, SVM, and SOM can yield better performance in hybrid method development. A list of references to provide a more detailed understanding of the methods described is already prepared. We apologize for the fact that important contributions to the researcher may have been overlooked.

References

1. Changxing Ding, Jonghyun Choi, Dacheng Tao, Fellow and Larry S. Davis by "Multi-Directional Multi-Level Dual-Cross Patterns for Robust Face Recognition", IEEE Journal of Biomedical and Health Informatics, 2016.
2. E Ji1,, CS Weickert1, R Lenroot1, J Kindler1,, AJ Skilleter1, A Vercammen1,C White , RE Gur6 and TW Weickert1 by "Adjunctive selective estrogen receptor modulator increases neural activity in the hippocampus and inferior frontal gyrus during emotional face recognition in schizophrenia", 2016.
3. Tal Hassner, Iacopo Masi Jungyeon Kim Jongmoo Choi Shai Harel Prem Natarajan Gérard Medionia by "Pooling Faces: Template based Face Recognition with Pooled Face Images", 2016.
4. Jun Lee and Jeong-Sik park by "Efficient head pose determination and its application to face recognition on muti-pose face DB", ,ISSN Vol.11,No.2(2016).pp.49-56.
5. Yang Libo and Chang Hao, by "Face Recognition Based on the Combination Method of Multiple Classifier", International Journal of Signal Processing, Image Processing and Pattern RecognitionVol.9, No.4 (2016), pp.151-164.
6. Shrutika Shukla and Anuj Bhargav, by "Design of Face Recognition System Using Viola-Jones and GLD Method" International Journal of Advanced Engineering Research and Science (IJAERS) Vol-3, Issue-3 , March- 2016].
7. Samal, A. and Iyengar, P. Automatic recognition and analysis of human faces and facial expressions: A survey. Patt. Recog. 25, 65–77.1992.
8. M. Turk and A. Pentland, "Eigenfaces for recognition," J. Cognitive Neuroscience,vol. 3, 71-86., 1991.
9. D. L. Swets and J. J. Weng, "Using discriminanteigenfeatures for image retrieval", IEEE Trans.PAMI., vol. 18, No. 8, 831-836, 1996.
10. C.Magesh Kumar, R.Thiyagarajan , S.P.Natarajan, S.Arulselvi,G.Sainarayanan,|| Gabor features and LDA based Face Recognition with ANN classifier||,Procedings Of ICETECT 2011.
11. Önsen TOYGAR Adnan ACAN,||Face recognition using PCA,LDA and ICA approaches on colored images||, Journal Of Electrical and Electronics Engineering, vol- 13,2003.
12. Y. Cheng, C.L. Wang, Z.Y. Li, Y.K. Hou and C.X. Zhao,|| Multiscale principal contour direction for varying lighting face recognition||,Proceedings of IEEE 2010.
13. F. Al-Osaimi·M. Bennamoun · A. Mian,|| An Expression Deformation Approach to Non-rigid 3D Face Recognition||, Springer Science+Business Media, LLC 2008.
14. Issam Dagher,||Incremental PCA-LDA algorithm||, International Journal of Biometrics and Bioinformatics (IJBB), Volume (4): Issue (2)
15. J. Shermina,V. Vasudevan, An Efficient Face recognition System Based on Fusion of MPCA and LPP||, American Journal of Scientific Research ISSN 1450-223X Issue 11(2010), pp.6-19
16. Ishwar S. Jadhav, V. T. Gaikwad, Gajanan U. Patil,||Human Identification Using Face and Voice Recognition||, International Journal of Computer Science and Information Technologies, Vol. 2 (3), 2011.
17. Yun-Hee Han,Keun-Chang Kwak,|| Face Recognition and Representation by Tensor-based MPCA Approach||, 2010 The 3rd International Conference on Machine Vision (ICMV 2010).
18. Neerja,Ekta Walia, Face Recognition Using Improved Fast PCA Algorithm||,Proceedings of IEEE 2008.
19. S.Sakthivel,Dr.R.Lakshmipathi,||Enhancing Face Recognition using Improved Dimensionality Reduction and feature extraction Algorithms_An Evaluation with ORL database||, International Journal of Engineering Science and Technology Vol. 2(6), 2010.
20. Lin Luo, M.N.S. Swamy, Eugene I. Plotkin, ―A Modified PCA algorithm for face recognition, Proceedings of IEEE 2003.
21. Hossein Sahoolizadeh, B. Zargham Heidari, and C. Hamid Dehghani,|| A New Face Recognition Method using PCA, LDA and Neural Network||, International Journal of Electrical and Electronics Engineering 2:8 2008
22. Feroz Ahmed Siddiky, Mohammed Shamsul Alam,Tanveer Ahsan and Mohammed Saifur Rahim,||An Efficient Approach to Rotation Invariant Face detection using PCA,Generalized Regression Neural network and Mahalanobis Distance by reducing Search space||,Proceedings Of IEEE 2007
23. Vapnik. Statistical Learning Theory. JohnWiley and Sons, New York, 1998.
24. E. Osuna, R. Freund, and F. Girosit. Training support vector machines: an application to face detection. Proc. of CVPR, pages 130–136, 1997.

25. B. Heisele, T. Serre, and T. Poggio. A componentbased framework for face detection and identification. IJCV, 74(2):167–181, 2007.
26. Q. Tao, D. Chu, and J. Wang. Recursive support vector machines for dimensionality reduction. IEEE Trans. NN, 19(1):189–193, 2008.
27. Marian Stewart Bartlett, Javier R. Movellan, Terrence J. Sejonowski, ―Face Recognition by Independent Component Analysis, IEEE Transactions on Neural Networks, vol-13, No- 6,November 2002, PP 1450- 1464.
28. Pong C.Yuen, J.H.Lai, ―Face representation using independent component analysis‖, Pattern Recognition 35 (2002) 1247-1257.
29. Tae-Kyun Kim, Hyunwoo Kim, Wonjum Hwang, Josef Kittler, Independent component analysis in a local facial residue space for face recognition‖, Pattern Recognition 37 (2004) 1873-1885
30. Aapo Hyvärinen and Erkki Oja ―Independent Component Analysis: Algorithms and Applications Neural Networks Research Centre Helsinki University of Technology P.O. Box 5400, FIN-02015 HUT, Finland,Neural Networks, 13(4-5):411-430, 2000.

