*International Journal of Interdisciplinary Innovative Research & Development (IJIIRD)*
**ISSN: 2456-236X**
Vol. 02 Issue 02 | 2018

# Efficient Face Recognition System Using Hybrid Methodology

Laxmikant S. Bhattad[1], Prof. Komal B. Bijwe[2]
[1,2] *Department of Computer Engineering, P. R. Pote College of Engineering & Management, Amravati, Maharashtra, India.*

**ABSTRACT**

***At one of the most successful application of images analysis and understanding, face recognition has recently received significant attention, especially during the past few years. Face recognition System (FRS) has emerged as an attractive solution to address many contemporary needs for identification and the verification of identity claims. It brings together the promise of other biometric systems, which attempt to tie identity to individually distinctive features of the body. Recognizing frontal countenance of human beings by a computer system is an interesting and challenging problem. It brings together, the port end of other biometric systems, which attempt to tie identity to individually distinctive features of the body. Facial feature extraction consists in restraining the most characteristic face countenance such as eyes, nose, and mouth regions within the face images that portray the human faces. the two most well known algorithms i.e. face detection and feature extraction are introduced and the combination of face detection and feature extraction is presented as our proposed approach in which the proposed approach has achieved 100% of face detection. LBP algorithm is used as feature extractor of the face image. Template matching is used for their resistance against changing frontal facial expressions. PCA algorithm is used for dimension reduction of the countenance vector. The complete approach has been tested on databases of people under different facial expressions.***

***Keywords-Face Recognition, face detection, Template Matching , Hybrid Method.***

## 1. INTRODUCTION

Face recognition is one of the most relevant applications of image analysis. Face detection is included as a pre-processing step for face recognition and as an issue by itself, because it presents its own difficulties and challenges, sometimes quite different from face recognition. It is a challenge to build an automated system which commensurate human ability to recognize faces. Although humans are quite good in identifying known faces, we are not able to recognize or deal with a large amount of unknown faces. The computers, with an almost limitless memory and computational speed, should overcome the problem of identifying human's limitations. Face recognition is one of the most relevant applications of image analysis.

We have soon recognized that the amount of published information is unmanageable for a short term effort, such as required of a PFC, so in agreement with the supervisor we have stopped at a reasonable time, having reviewed most conventional face detection and face recognition approaches, leaving advanced issues, such as video face recognition or expression invariance's, Basically Face Recognition is the process through which a person is identified by his facial image. With the help of this technique it is possible to use the facial image of a person to authenticate him into any secure system. Face recognition approaches for still images can be broadly categorized into holistic methods and feature based methods. Holistic methods use the entire raw face image as an input, whereas feature based methods extract local facial features and use their geometric and appearance properties. This work studies the different approaches for a Face Recognition System. The different approaches like face detection template matching, LBP and different types of Wavelets have been studied with the help of Euclidean distance as a classifier and Neural Network as a classifier.

## 2. MOTIVATION

Face Recognition has evolved over the years and it has been successfully used in various applications in biometric systems for more than last two decades. The importance of utilising biometrics to establish personal authenticity and to detect impostors has grown in the present scenario of global security concern. So there is a need for the development of a biometric system for personal identification, which fulfils the requirements for access control of secured areas and other applications like identity validation for social welfare, crime detection, ATM access, computer security, etc. Variations in lighting conditions, pose and expression makes face recognition an even more challenging and difficult task. A lot of techniques have been applied for different applications. Robustness and reliability becomes more and more important for these applications especially in security systems. So in this work have studied the different approaches to the Face Recognition via Discrete Cosine Transform (DCT), Principal Component Analysis and Wavelet Analysis and tried to compare the success rate of all the algorithms on two databases namely AMP and ORL (Olivetti Research Lab).

### 2.1 Objectives

- To create a Face Recognition System which can work and should be applied in real world.
- To create a new approach using existing algorithms for Face Recognition System.
- To reduce the processing memory required while performing Face Recognition System.
- To create various algorithms which leads to get better space efficiency

### 2.2 Scope of Work

Goal of this paper is to create a efficient Face Recognition System which can work and should be applied in real world. It can be applied in small scale organizations like Universities/Colleges, Industries, Hospitals. Application that can be used with as much ease as possible for Recognition of person. Further with the sufficient information it can be applied Globally, like it can be used in Defence, Law Enforcement, Security Applications, etc. Its a true challenge to build an automated system which equals human ability to recognize faces. Although humans are quite good identifying known faces, we are not very skilled when we must deal with a large amount of unknown faces. The computers, with an almost limitless memory and computational speed, should overcome humans limitations.

## 3. LITERATURE SURVEY

One early paper that answered this question was published by Diamond and Carey back in 1986 [2]. hear presented four experiments. and analyzed to know if the difficulty of recognizing tangled faces was also common in other class of stimuli. S. Bentin in 1994 That specilize brain area contribute to face Face is suggested by occasional patients with specific in identified familiear, faces Face recognition has been investigated extensively in human and monkeys using behavioral used.More recent studies demonstrated that face recognition is a dedicated process in our brains[3]. Local Binary Patterns was first described in 1994 and intrdusce by T Ojala,[11] is an accepted technique for efficient face recognition. The local features improve the recognition process. However, high memory and computational resources are needed for LBP required approaches to improve the performance

Andrew W Yip 2002 [5] has proposed many face recognition algorithms don't use color as a feature. However, it could be interesting to know if color play a key role in human face recognition process. It is widely accepted that color cues do not provide diagnostic information for recognition, but they are not completely unrelated to face recognition systems. They could be nearly irrelevant when we try to recognize chromatically similar objects. On the other hand, it has been demonstrated that their contribution is essential under degraded conditions [5]. Pawan Sinha 2006 [4] proposed the dedication of the fusiform face area (FFA) as a face processing module seems to be very strong. However, it may be responsible for performing subordinate or expert- level categorization of generic objects [4]. L. sirovich [6] in 2009 proposed a method of both neurological and computational point of view the answer is the same: yes. It has been demonstrated that an exceptional dimension reduction can be made by taking into account facial symmetry [6]. The cited study also concludes that there are less than 70 dimensions for human recognition system. This result is smaller than the previously proposed 100 dimensions. The cause is the relevance of human face similarity.

According to Anshuman prakash said in 2010, The identification of a person by their facial images can be done in a number of different ways such as by capturing an image of the face in the visible spectrum using an inexpensive camera or by using the infrared patterns of facial heat emission. Facial Recognition in visible light typically model key features from the central portion of the facial image using a wide assortment of cameras in visible light system extract features from the captured images that do not change over time while avoiding superficial features such as facial expression or hair [7]. The input of a face recognition system is always an image or video stream. The output is an identification or verification of the subject or subjects that appear in the image or video. Some approaches [8] W. Zhao by defense a face recognition system as a three step process – see Figure 2.1. From this point of view, the Face Detection and Feature Extraction phases could run simultaneously.

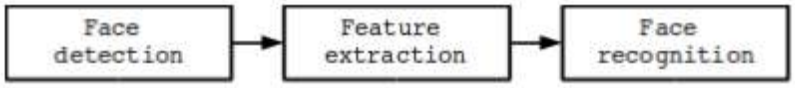


Figure 2.1: Collective Face recognition System.

The system does recognize the face. In an identification task, the system would report an identity from a database. This phase involves a comparison method, a classification algorithm and an accuracy measure. Face detection must deal with several well known challenges [9] [8]. They are usually present in images captured in uncontrolled environments, such as surveillance video systems. These challenges can be attributed to some factors by M.-H. Yang is with Honda Fundamental Research Labs

Once the face image has been normalized, the feature extraction and recognition of the face can take place. In feature extraction, a mathematical representation called a biometric template or biometric reference is generated, which is stored in the database and will form the basis of any recognition task.[9]

R.Brunelli has studies Facial recognition algorithms differ in the way they translate or transform a face image (represented at this point as grayscale pixels) into a simplified mathematical representation (the "features") in order to perform the recognition task. It is important for successful recognition that maximal information is retained in this transformation process so that the biometric template is sufficiently distinctive.[10]

If this cannot be achieved, the algorithm will not have the discriminating ability required for successful recognition. The problem of biometric templates from different individuals being insufficiently distinctive or too close to each other. It is in this process of mathematical transformation (feature extraction) and matching (recognition) of a biometric template that particular algorithms differ significantly in their approach. We will merely summarize some of the work and indicate some of the issues that relate to the different approaches.[18]

The most evident face features were used in the beginning of face recognition. It was a sensible approach to mimic human face recognition ability. There was an effort to try to measure the importance of certain intuitive features [10] (mouth, eyes, cheeks) and geometric measures (between-eye distance , width-length ratio). Nowadays is still an relevant issue, mostly because discarding certain facial features or parts of a face can lead to a better performance. However, the introduction of abstract mathematical tools like eigenfaces [28] [11] created another approach to face recognition. It was possible to compute the similarities between faces obviating those human-relevant features. This new point of view enabled a new abstraction level, leaving the anthropocentric approach behind. There are still some human-relevant features that are being taken into account. For example, skin color [12 ] is an important feature for face detection. The location of certain features like mouth or eyes is also used to perform a normalization prior to the feature extraction step [8]. To sum up, a designer can apply to the algorithms the knowledge that psychology, neurology or simple observation provide.

These two starting points: geometry and the photometric approach are still the basic starting points for developers of facial recognition algorithms. To implement these approaches a huge variety of algorithms have been developed. Here we will highlight two of the most significant streams of work: Principal Components Analysis (PCA),Local Binary Pattern (LBP)

## 4. PROPOSED SYSTEM ANALYSES AND DESIGN

### 4.1 Problem Definition

Many algorithms rely on color information to recognize faces. Features are extracted from color images, although some of them may be gray-scale. The color that we perceive from a given surface depends not only on the surfaces nature, but also on the light upon it. There can be relevant illumination variations on images taken under uncontrolled environment. The intensity of the color in a pixel can vary greatly depending on the lighting conditions. Pose variation and illumination are the two main problems face by face recognition researchers. The vast majority of face recognition methods are based on frontal face images. Image representation methods, dimension reduction algorithms, basic recognition techniques, illumination invariant methods and many other subjects are well tested using frontal faces. On the other hand, recognition algorithms must implement the constraints of the recognition applications.

### 4.2 Face recognition system structure

Face Recognition is a term that includes several sub-problems. There are different clas-sifications of these problems. Some of them will be explained in this section. Finally, a general or unified an eficient FRS algorithm/method will be proposed.

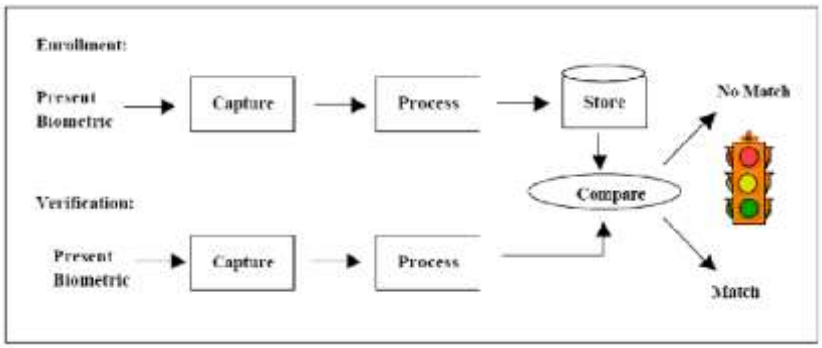


Fig. 4.2 System Structure

### 4.3 Working Methodology

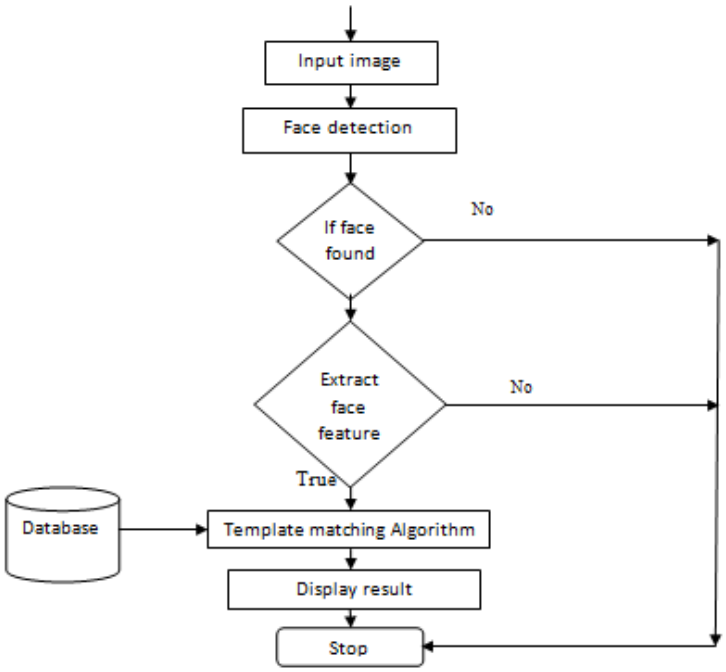


Fig. 4.3: Data Flow Diagram of Face recognition system.

### 4.4 Algorithm of Template Matching

Template matching methods try to define a face as a function. We try to find a standard template of all the faces. Different features can be defined independently. For example, a face can be divided into eyes, face contour, nose and mouth. Also a face model can be built by edges. But these methods are limited to faces that are frontal and unconcluded. A face can also be represented as a silhouette. Other templates use the relation between face regions in terms of brightness and darkness. These standard patterns are compared to the input images to detect faces. This approach is simple to implement, but it's inadequate for face detection.

1:Start
2:Input image feature (IF)
3:Load database faces(of)
4:For i=1 to length (IF)
For j=1 to length (DF)
Locate if (i) into df(j)
If found
Draw rectangle
End
End
End
5:get may feature found
6:for k=1 to length (fi)
Match the input face with FI(k)
Calculate deviation
7:sort the result in ascending order
8:display the image with deviation as rectangular face
7:stop

Algorithm : Template Matching

1: start
2: input image (I)
3:For i=1 to W (1)
For j=1 to H(1)
Read P(I,j) extract R,G,B from P(I,j)
If R>Threshold min && R< Threshold max
work as skin pixel
M=1
End
End
End
4:if M==1
Detect face feature & draw face rectangle.
End
5:crop detected face
6:save face image
7:stop

Algorithm of Face Detection

## 5. PROPOSED SYSTEM

### 5.1 Face Detection

Nowadays some applications of Face Recognition do not require face detection. In some cases, face images stored in the data bases are already normalized. There is a standard image input format, so there is no need for a detection step. An example of this could be a criminal data base. There, the law enforcement agency stores faces of people with a criminal report. If there is new subject and the police has his or her passport photograph, face detection is not necessary. However, the conventional input image of computer vision systems is not that suitable. They can contain many faces. In these cases face detection is mandatory. It is also unavoidable if we want to develop an automated face tracking system. For example, video surveillance systems try to include face detection, tracking and recognizing. So, it is reasonable to assume face detection as part of the more substantial face recognition problem. Face detection must deal with several well known challenges. They are usually present in images captured in uncontrolled environments, such as surveillance video systems.

### 5.2 Output of face detection

As shown in the Fig: 5.2 the simulation takes place in matlab by inputting the image no. after processing the image the result is shown below as.

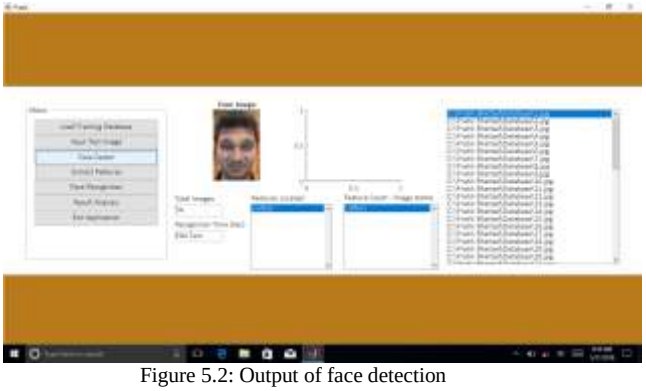

Figure 5.2: Output of face detection

### 5.3 Feature Extraction

Humans can recognize faces since we are 5 year old. It seems to be an automated and dedicated process in our brains, though it's a much debated issue. What it's clear is that we can recognize people we know, even when they are wearing glasses or hats. We can also recognize men who have grown a beard. It's not very difficult for us to see our grandma's wedding photo and recognize her, although she was 23 years old. All these processes seem trivial, but they represent a challenge to the computers. In fact, face recognition's core problem is to extract information from photographs. This feature extraction process can be defined as the procedure of extracting relevant information from a face image. This information must be valuable to the later step of identifying the subject with an acceptable error rate.

### 5.4 Output of face Feature Extraction

The simulation takes place in mat lab by inputting the image no. after processing the comparison is shown as in

Figure 5.4: Comparison Output of feature extraction

### 5.5 Hybrid Method

Selecting dataset to Train and Test the images. Applying face detection to get the frontal facial feature and extracting facial countenance then applying Template matching to extracted features this will generate reduced dimension feature vector of the images. Comparing the test input image to the trained dataset and the result is shown in ranked order. The algorithm for Hybrid method is as, where I is number of images, is the weight of neighboring pixels to generate the histogram Histo, is the string which stores the converted image number as string, M is for calculating mean value. Here the input to the PCA is the generated histogram Histo.

### 5.6 Output of Hybrid Method

In the proposed approach the output of the comparison is displayed in ranked order i.e the first best match result is shown first, second best match is shown on second position likewise, the result is simulated as in

Figure 5.6: Result analysis

## 6. RESULT ANALYSIS

Template matching methods try to define a face as a function. We try to find a standard template of all the faces. Different features can be defined independently. For example, a face can be divided into eyes, face contour, nose and mouth. Also a face model can be built by edges. But these methods are limited to faces that are frontal and unconcluded. A face can also be represented as a silhouette. Other templates use the relation

between face regions in terms of brightness and darkness. These standard patterns are compared to the input images to detect faces. The template based methods compare the input image with a set of templates. The set of templates can be construct educing statistical tools like Support Vector Machines (SVM), [Principal Component Analysis (PCA) , Linear Discriminate Analysis (LDA), Local Binary Pattern (LBP), Independent Component Analysis (ICA), Kernel Methods, or Trace Transforms. The geometry feature-based methods analyze local facial features and their geometric relationships. This approach is sometimes called feature based approach. There are algorithms developed using both approaches. For instance, a 3D morph able model approach can use feature points or texture as well as hybrid to build a recognition system

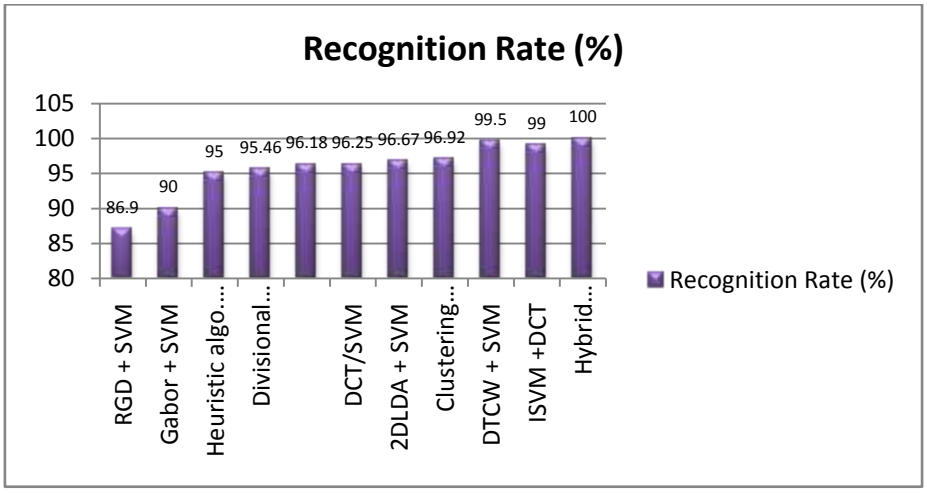


Figure 6.1 : Comparison of Recognition Rate

Table 6.2: Comparison table based on various parameters

| S.No. | Techniques | Database | Recognition Rate (%) |
|---|---|---|---|
| 1. | RGD + SVM | Image | 86.9 |
| 2. | Gabor + SVM | Image | 90 |
| 3. | Heuristic algo. + ISVM | Text | 95.0 |
| 4. | Divisional algo.+ ISVM | Text | 95.46 |
| 5. | ISVM + Recombining | Text | 96.18 |
| 6. | DCT/SVM | Image | 96.25 |
| 7. | 2DLDA + SVM | Image | 96.67 |
| 8. | Clustering algo. + ISVM | Benchmark | 96.92 |
| 9. | DTCW + SVM | Image | 99.5 |
| 10. | ISVM +DCT | Image | 99 |
| 11 | Hybrid methodology(Proposed Methodology) | Standard | 100 |

## 7. CONCLUSION

Face recognitions has presented the different algorithms, the approach with their efficiency. The algorithms Face Detection, Template Matching and Hybrid approach are studied and implemented the results were analyzed and from that we can conclude that though the face detections requires less processing memory, and if we have large number of image database the required processing memory as compare to PCA would be less. The hybrid approach will make some good difference in terms of recognition (i.e.100% gains) as compare to these existing algorithms. Face recognition systems used today work very well under constrained conditions, although all systems work much better with frontal images and constant lighting. Face recognition systems used today work very well under constrained conditions, although all systems work much better with frontal images and constant lighting. Technology used in smart environments has to be restrained and allow users to act freely. Therefore, it isn't just a unresolved problem but also the source of new applications and challenges.

**8. REFERENCES**

[1] Ion Marques, Face Recognition Algorithms, Proyecto Fin de Carrera, http://www.ehu.es/ccwintco/uploads/e/eb/PFC-IonMarques.pdf.,June2010 .

[2] R. Diamond and S. Carey. Why faces are and are not special. an effect of expertise. Journal of Experimental Psychology: General, 115(2):107-117, 1986.

[3] S. Bentin, T. Allison, A. Puce, E. Perez, and G. McCarthy. Electrophysiological studies of face perception in humans. Journal of Cognitive Neuroscience, 8(6):551565, 1996.

[4] P. Sinha, B. Balas, Y. Ostrovsky, and R. Russell. Face recognition by humans: nine- teen results all computer vision researchers should know about. Proceedings of the IEEE, 94(11):1948-1962, November November 2006.

[5] A. W. Yip and P. Sinhao. Contribution of color to face recognition. Perception, 31:9951003, 2002.

[6] L. Sirovich and M. Meytlis. Symmetry, probability, and recognition in face space. PNAS - Proceedings of the National Academy of Sciences, 106(17):68956899, April 2009.

[7] Study of Different Algorithms. http://ethesis.nitrkl.ac.in/1701/2/B.pdf.

[8] W. Zhao, R. Chellappa, A. Rosenfeld, and P. Phillips. Face recognition: A literature survey. ACM Computing Surveys, pages 399-458, 2003.

[9] M.-H. Yang, D. Kriegman, and N. Ahuja. Detecting faces in images: A survey. IEEE Transactions on Pattern Analysis and Machine Intelligence, 24(1):34-58, January 2002. 28

[10] R. Brunelli and T. Poggio. Face recognition: Features versus templates. IEEE Trans- actions on Pattern Analysis and Machine Intelligence, 15(10):1042-1052, October 1993.

[11] M. Kirby and L. Sirovich. Application of the karhunen-loeve procedure for the char- acterization of human faces. IEEE Transactions on Pattern Analysis and Machine Intelligence, 12(1):103-108, 1990.

[12] S. K. Singh, D. S. Chauhan, M. Vatsa, and R. Singh. A robust skin color based face detection algorithm. Tamkang Journal of Science and Engineering, 6(4):227234, 2003.

[13] L. Torres. Is there any hope for face recognition? In Proc. of the 5th International Workshop on Image Analysis for Multimedia Interactive Services, WIAMIS, Lisboa, Portugal, 21-23 April 2004.

[14] R. Gross, J. Shi, and J. Cohn. Quo vadis face recognition? - the current state of the art in face recognition. Technical report, Robotics Institute, Carnegie Mellon University, Pittsburgh, PA, USA, June 2001.

[15] G. Guo, S. Li, and K. Chan. Face recognition by support vector machines. In Proc. of the IEEE International Conference on Automatic Face and Gesture Recognition, pages 196-201, Grenoble, France, March 2000.

[16] B. Moghaddam and A. Pentland. Probabilistic visual learning for object representation. IEEE Transactions on Pattern Analysis and Ma- chine Intelligence, 19(7):696- 710, July 1997.

[17] M. Turk. A random walk through eigenspace. IEICE Transactions on Information and Systems, E84-D(12):1586-1595, December 2001.

[18] M. Turk and A. Pentland. Eigenfaces for recognition. Journal of Cog- nitive Neu- rosicence, 3(1):71-86, 1991.

[19] P. Belhumeur, J. Hespanha, and D. Kriegman. Eigenfaces vs. fisherfaces: Recognition using class specific linear projection. IEEE Trans- actions on Pattern Analysis and Machine Intelligence, 19(7):711-720, July 1997. 29

[20] M. Bartlett, J. Movellan, and T. Sejnowski. Face recognition by independent com- ponent analysis. IEEE Trans. on Neural Networks, 13(6):1450-1464, November 2002.

[21] C. Liu and H. Wechsler. Face recognition using evolutionary pursuit. In Proceedings of the Fifth European Conference on Computer Vision, ECCV'98, volume 2, pages 596-612, Freiburg, Germany, 1998.

[22] C. Liu and H. Wechsler. Comparative assessment of independent component analysis (ica) for face recognition. In Proc. of the Second International Conference on Audio- and Video-based Biometric Person Authentication, AVBPA'99, Washington D.C., USA, March 1999.

[23] V. Blanz and T. Vetter. Face recognition based on fitting a 3d morphable model. IEEE Transactions on Pattern Analysis and Machine Intelligence, 25(9):10631074, September 2003.

[24] A. Nefian. Embedded bayesian networks for face recognition. In Proc. of the IEEE International Conference on Multimedia and Expo, volume 2, pages 133-136, Lusanne, Switzerland, August 2002.
[25] L. Sirovich and M. Kirby. Low-dimensional procedure for the characterization of human faces. Journal of the Optical Society of America A- Optics, Image Science and Vision, 4(3):519-524, March 1987.
[26] Timo Ahonen, Abdenour Hadid, and Matti Pietikainen Face Recognition with Lo- cal Binary Patterns. Machine Vision Group, Infotech Oulu, FIN-90014 University of Oulu, Finland.
[27] N. Ahmed, T. Natarajan, and K. R. Rao. Discrete cosine transform. IEEE Transactions on Computers, 23:90-93, 1974.
[28] L.I. Smith, "A tutorial on Principal Component Analysis", Cornell University, USA, 2002.
[29] CHETAN BALLUR, SHYLAJA S S, "APPLICATION OF LOCAL BINARY PATTERN AND PRINCIPAL COMPONENT ANALYSIS FOR FACE RECOGNITION", International Journal of Electrical, Electronics and Data Communication, P.E.S.I.T, Bangalore. 30
[30] Mallikarjuna Rao G,Vijaya Kumari G, Babu G R, Rajesh V, "Fast Local Binary Patterns for Efficient Face Recognition", Internat. J. of Sci. and Eng. Vol. 2(2):22- 26, Dec. 2011.
[31] T.Ahonen, A.Hadid and M. Pietikainen. Face recognition with Local Binary Pat- terns. Machine Vision Group, University of Oulu, Finland,2004.
[32] Etemad, K., Chellappa, R.: Discriminant analysis for recognition of human face images. Journal of the Optical Society of America 14 1997.
[33] Computer Vision Science Research Projects. http://cswww.essex. ac.uk/mv/allfac

**BIOGRAPHIES**

| | |
|---|---|
|  | Laxmikant S. Bhattad, Pursing Master of Engineering in Computer Science and Engineering from, P. R. Pote College of Engineering & Management, Amravati, Maharashtra, Affiliated to Sant Gadgebaba Amravati University, Amravati, Maharashtra, India**.** |
|  | Prof. Komal B. Bijwe, received Master of Engineering in Computer Science and Engineering from Sant Gadgebaba Amravati University, Amravati and currently working as Assistance Professor in P. R. Pote College of Engineering & Management, Amravati. |