Real Time Face Detection and Recognition System

[1]Pankaj R.Bhusari, [2]Vrushali G.Raut
[1,2]Dept. of Electronics and Telecommunication, Sinhgad College of Engineering
Vadgaon, Pune, Maharashtra, India

Abstract
Security and surveillance are the two important aspects of human being. In this paper we propose face detection and recognition system that will capable of processing images very fast while acquiring very high true positive face detection rate. Here, three aspects are important as Haar like feature for face detection second is principal component analysis algorithm for face recognition purpose and data base created by us or we can use Yale data base. Then, the complete system can be implemented on Raspberry Pi module. On that basis, we can calculate different parameters like false rejection rate and false acceptance rate.

Keywords
Face Detection, Haar Like Feature, Yale Data Base, Principal Component Analysis, Histogram Equalization, Raspberry Pi Module

I. Introduction

A. Problem Definition
We have given a capture input face image from a web cam, in that we have to detect and recognize the accurate number of faces by comparing with database of face images for known individuals?

B. Face: The Most Attractive Biometric
One of the unique features of our brain is that it can think only in images not in words. Once you may forget to keep your Car's key but you will never forget to bring a face with you. God has given everyone a unique face. Face is the most important part of our body, so that it can reflect many emotions of a person. From a long year ago, we are using non living thing (smart cards, plastic cards, PINS, tokens, keys) for authentication and to get grant access in restricted areas like ISRO, NASA, and DRDO etc. There are two types of biometric as physiological characteristics (face, fingerprint, finger geometry, hand geometry, palm, iris, ear and voice) and behavioral characteristics (gait, signature and keystroke dynamics). Sometimes your behavioral traits may changes because of illness, fear, hunger etc. Face detection and recognition system is more cheap, simple, accurate and non intrusive process as compare to other biometrics. The system will fall into two categories as face detection (1:1) and face recognition (1:N).In the face detection we have to classify between face versus non face region while in recognition process we have to compare that single face image with multiple images from the input image. While capturing an images from a web cam we have to come across some problems like pose (position of camera), presence of structural components (spectacles and beard), facial expression, occlusion (obstructed by someone), image orientation (variation in rotation), imaging condition (lightning and camera characteristics) etc. Face detection is a common feature of digital cameras since 2006. Automatic face detection and recognition system is placed at New Zealand airport only for that citizen since 2010 while airport in Europe started to be equipped with similar systems from 2008 for security purpose.

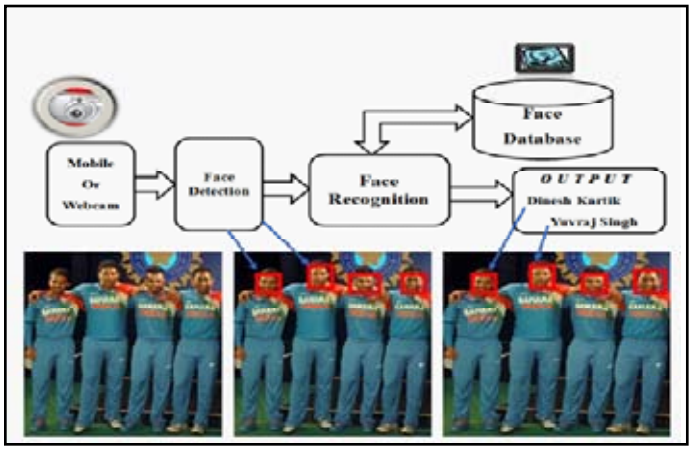

Fig. 1: Block Diagram of the System

II. Proposed Approach
Whatever the system that we have to implement it should work in real time with low false detection rate. Fig. 1 shows the block diagram for real time face detection and recognition system that will contain various hardware and software components.

A. Haar Like Feature for Face Detection
Haar like features are digital image feature used for object detection but here we used it for face detection. The biggest advantage of it over most other features is its calculation speed. Fig. 2 shows the types of Haar like feature. Generally eye region is darker than other region from the face. Figure 3 shows how Haar like feature is used for face detection purpose. Figure 4 gives the complete preprocessing steps, which includes binary to gray scale image conversion, Histogram Equalization method (HE), Laplacian of Gaussian filter (LG) and final step is contrast adjustment. Preprocessing is done because we have to remove influence cause by illumination variation for accurate face recognition.

- Edge feature
- Line feature
- Center-surround feature

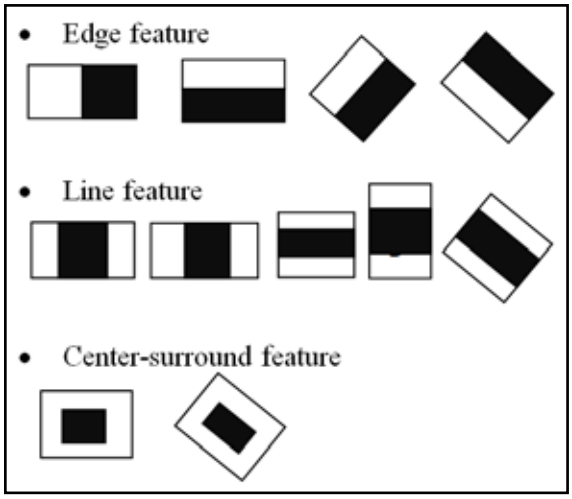

Fig. 2: Types of Haar Like Features

ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)

Fig. 3: Haar Like Feature for Face Detection

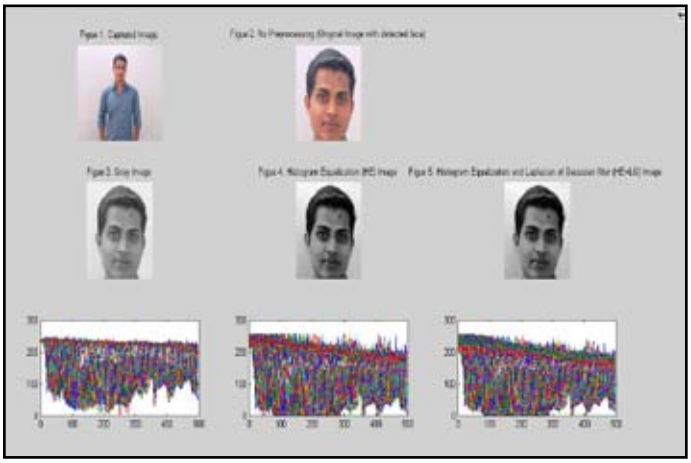

Fig. 4: Preprocessing for Face Detection and Recognition System

B. Principal Component Analysis for Face Recognition

Principal Component Analysis (PCA) was invented in 1901 by Karl Pearson. It involves a mathematical procedure that transform a number of correlated variables to number of uncorrelated variables called principal components, related to original variables by an orthogonal transformations. PCA is sensitive to the relative scaling of the original variables [4, 12]. If the image elements are considered as random variables, the PCA basis vectors are define as eigenvectors of scatter matrix S_T from equation (1). The orthogonal normalized eigenvector e_i of S_T can be obtained from equation (2). Signal to noise ratio is given by r(x) and calculated from equation (3).

$$S_T = \sum_{i=1}^{N} (x_i - \mu)(x_i - \mu)^T \quad (1)$$

$$e_i = \frac{1}{\sqrt{\lambda_i}} X v_i (i = 1,2,3, \ldots N) \quad (2)$$

$$r(x) = 10log\left(\frac{\|x\|^2}{\|x - x'\|^2}\right) \quad (3)$$

C. Database

In order to compare the processed image with standard images we require a standard database but it is better to create our own database. These databases are recorded under various conditions for different applications. If in case we have to use database, then we can go for Yale database because images present in it are frontal faces and free from light illumination. Fig. 5 gives the flow chat for complete system.

Table 1: Different Data Bases and Their Location [11-12]

Data set	Location	Description
MIT Database	ftp://whitechapelrious.media.mit.edu/pub/images/	Faces Of 16 People, 27 of Each Person Under Various Illumination Conditions, Scale And Head Orientation.
Feret Database	http://www.nist.gov/humanid/feret	A Large Collection of Male And Female Faces. Each Image Contains A Single Person With Certain Expression
University university of Bern Database	ftp://iamftp/unibe.ch/pub/images/faceimages	300 Frontal Face Images People(10 Images Per Person) And 150 Profile Face Images (5 Images Per Person)
Yale Database	http://http://cvc.yale.edu	Face Images With Expression, Glasses Under Different Illuminations Conditions.
At&T(Olivetti) Database	http://uk.research.att.com	40 Subjects,10 Images Per Subject
Harvard Database	ftp://ftp.hrl.harvard.edu/pub/faces	Cropped, Masked Face Images Under A Wide Range Of Lightning Conditions
M2VTS Database	http://poseidon.csd.auth.gr/M2VTS/index.html	A Multimodel Database Containing Various Image Sequences.

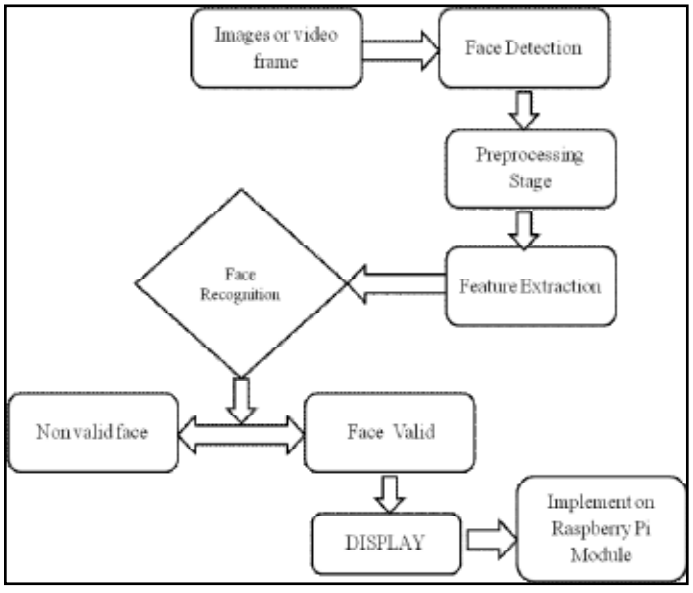

Fig. 5: Flow Chart

III. Application

It has wide range of applications including biometric identification, video conference, indexing of image, video database, and human machine interface. Also other than this there are many applications such as entertainment (video games, virtual reality and human robot interaction), smart cards (driver's license, immigration, national ID, passport, voter registration), Information security

(personal device login such as laptop, TV parental control), law enforcement and surveillance (CCTV control, portal control, post event analysis).

IV. Conclusion

We have to study face detection and recognition system in real time on Raspberry Pi module. Face detection and recognition is currently a very active research area. Some of the best algorithms are still too computationally expensive to be applicable for real time processing, but this may be change with coming improvement in computer hardware. Yale data base can be used but database created by us may be more efficient. We came up to recognition stage we have to interface it with the Raspberry Pi module especially module A.

References

[1] P. Kakumanu, S. Makrogiannis, N. Bourbakis,"A Survey of Skincolor Modeling and Detection Methods", Pattern Recognit, Vol. 40, No. 3, March 2007, pp. 1106-1122.

[2] P. Shihand, C. Liu,"Face Detection Using Discriminating Feature Analysis and Support Vector Machine", Pattern Recognit., Vol. 39, No. 2, Feb 2006, pp. 260-276.

[3] M. Kirby, L. Sirovich,"Application of the KL procedure for the characterization of human faces", IEEE Trans. Pattern Anal. Machine Intell. 12 (1990) (1), pp. 103–108

[4] K. Tan, S. Chen,"Adaptively weighted sub-pattern PCA for face recognition", Neurocomputing 64 (2005), pp. 505–511

[5] Lay, David.,"Linear Algebra and its Applications", Addison-Wesley, New York, pp. 441-486, 2000.

[6] R. Lienhart, J. Maydt,"An Extended Set of Haar-like Features for Rapid Object Detection", IEEE International Conference on Image Processing, 2002.

[7] M. Pham, Y. Gao, V. Hoang, T. Cham,"Fast polygonal integration and its application in extending haar-like features to improve object detection", In IEEE Conference on Computer Vision and Pattern Recognition. IEEE, 2010, pp. 942–949.

[8] N. Dalal, B. Triggs,"Histogram of Oriented Gradients for Human Detection", In Proc. IEEE Computer Vision and Pattern Recognition (CVPR), June 2005, Vol. 1, pp. 886-893.

[9] R. C. Gonzalez, R. E.Woods,"Digital Image Processing", Third Edition, 2008. PEM

[10] P. J. Phillips, P. Rauss, S. Der,"FERET (Face Recognition Technology) Recognition Algorithm Development and Test Report", Technical Report ARL-TR 995, U.S. Army Research Laboratory.

[11] A. C. Loui, C. N. Judice, S. Liu,"An Image Database for Benchmarking of Automatic Face Detection and Recognition Algorithms", Proc. IEEE Conference on Image Processing, Vol. 1, pp. 146-150, 1998.

[12] Keqing Shi, Shurong Pang, Fengqi Yu,"A Real-time Face Detection and Recognition System", 978-1-4577-1415-3/12 ©2012 IEEE pp. 3074-3077

Pankaj R. Bhusari received his B.E. Degree in Electronics and Telecommunications with distinction from Amravati University, Maharashtra, India in 2011, he is pursuing his Master of Engineering degree in VLSI and Embedded systems in Department of Electronics and Telecommunication from Sinhgad College of Engineering, Pune University, Pune, India. He has a good algorithmic skill and has published national conference paper and has done poster presentation. His research interest includes image processing, VLSI and Embedded systems.

Vrushali G. Raut received her BE degree in Electronics from Shree Gurugovind Singhji College of Engineering, Nanded, India, in 1997, the Master of Engineering degree in Digital Systems, Electronics from Sinhgad College of Engineering, Pune, India, in 2009. She is a assistant professor, with Department of Electronics and Telecommunication, Sinhgad College of Engineering, Pune University, from 2000 till date. Her research interests include digital signal processing, electronic measurement techniques, microwave and VLSI.