

# Design and Implementation of Automated Door Accessing System with Face Recognition

I. Yugashini, S. Vidhyasri, K. Gayathri Devi

**Abstract :** *In the last two decades face recognition has received significant attention and an important issue in many applications such as access control, security systems, credit card verification and criminal identification. This paper proposes three main sub systems namely face recognition, face detection and automatic door access control. The face recognition and detection process is implemented by modifying principal component analysis (PCA) approach to fast based principal component analysis (FBPCA) approach, by which the captured image is detected using a web camera and compared with the image in the database. If the image is an authenticated one the door will be opened automatically else an SMS will be generated using a GSM modem to the user that an unauthorized person has entered home.*

**Index Terms:** Face recognition (FR), Face detection (FD), Fast Based Principle Component Analysis (FBPCA) algorithm, GSM.

## I. INTRODUCTION

Many methods are available in biometric identifications like fingerprint, eye iris, retina, voice, face etc. These different methods have certain advantages and disadvantages which must be considered in developing biometric systems, such as system reliability, price, flexibility, necessity of physical contact with the scanning device and many other parameters. Security system plays an important role of providing an extra layer of security through user authentication by which illegal intrusions can be easily tracked at the entry itself. Many researches are done in order to design various types of automated security system. Choi et al. [2] proposed a new algorithm for an acoustic intruder detection system for home security. This algorithm estimates the variation of features in the room acoustic transfer function to detect intruders. The system ranges from the personalized security systems of a home to large-scale systems for the protection of crucial national installations. Zuo et al. [3] proposed Home Face, real-time embedded face recognition system for consumer applications which enables a personalized service by automatic identification of users. This system is embedded into a smart home environment for user identification. Zhao et al. [4] proposed a low cost GSM/GPRS based wireless home security system which includes two modules namely sensor nodes for wireless security and a GSM/GPRS gateway. Using a wireless transceiver module the data transfer between gateway and sensor nodes is established. Kramberger et al.

[5] proposed the architecture of a door phone embedded system with interactive voice response. The main advantage of this system is even in noisy environment the effectiveness of speech recognition is increased using embedded microphone array. The system uses two different platforms namely user identification and verification platform based on a VoIP door phone embedded system and server-based speaker authentication system.

Khoyal et al. [6] proposed a system that allows user to control home appliances universally and also provide security on detection of intrusion via SMS using GSM technology. Ibrahim et al. [7] paper focuses on the study and development of an automated face recognition system with the potential application for office door access control. This technique of Eigen face is based on the principle component analysis (PCA) and artificial neural networks. Three main factors of face recognition are considered namely illumination, distance and subject's head orientation on the developed system that is purposely built for office door access control. Zhao et al. [8] proposed a new IPCA method which is based on singular value decomposition (SVD) updating algorithm, this is an SVD updating-based IPCA (SVDU-IPCA) algorithm. Using this SVDU-IPCA algorithm, the approximation error is mathematically proved to be bounded.

Kim et al. [9] paper proposed an enhanced multimodal personal authentication system for mobile device security which integrates the modalities like voice, face and teeth using the various fusion techniques such as the weighted-summation rule, K-NN, Fisher and Gaussian classifiers, and by which the authentication performance of the system is evaluated. Liting et al. [10] paper describes an effective, efficient face live detection method which uses physiological motion detected by estimating the eye blinks from a captured video sequence and an eye contour extraction algorithm. This technique uses the conventional active shape model with a random forest classifier trained to recognize the local appearance around each landmark. Hwang et al. [11] proposed digital door locking system which is a novel wireless access monitoring and control system. Digital door lock is an electronic locking system which is operated by certain combination of digital key which acts as a security password. Wireless sensor network is achieved using the ZigBee module and also ZigBee tags are used to identify the access objects. By using the digital consumer device, digital door lock module can be implemented to control the access system as well as locking system. Zanuy et al. [12] proposed PC-based system is more suitable for testing the device, and can be easily transferred to a low-cost ARM core pc. This Low-cost finger print scanners designed for a F/C environment are mainly thought to lock the computer screen and avoid passwords.

**Manuscript Received November, 2013.**

**I.Yugashini**, Department of Electronics and Communication Engineering, Dr.NGP. Institute Of Technology, Coimbatore, India.

**S.Vidhyasri**, Department of Electronics and Communication Engineering, Dr.NGP. Institute Of Technology, Coimbatore, India.

**Prof.K.Gayathri Devi**, Working as Associate Professor in Department of Electronics and Communication Engineering, Dr.NGP. Institute Of Technology, Coimbatore, India.

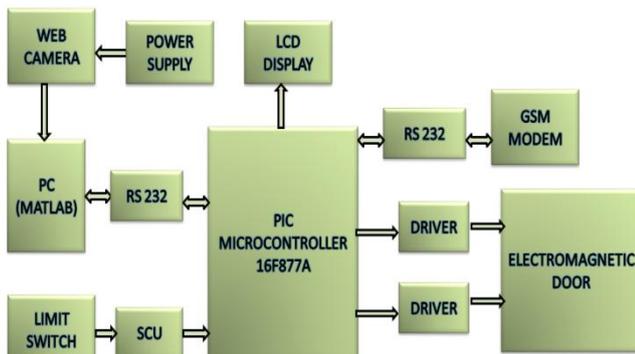
The organization of this paper is as follows. In section II, the integrated architecture of the proposed system is elaborated. In section III, the feature extraction process using FBPCA is discussed. In section IV, the experimental result of the proposed system is discussed. Finally, section V will give the conclusion and future directions.

### II. METHODS

#### Proposed system:

In the proposed system defining keys is an automated process and hence no man power is required. Once the system identifies the face it opens or closes the door when a recognized person enters the room. A face identification system does not require any advanced hardware, as it can be used with existing image capture devices (webcams, security cameras etc.). The first step of human face identification is to extract the relevant features from facial images. There are three major research groups which propose three different approaches to the face recognition problems namely the first group with facial characteristics which are used by human beings in recognizing individual faces. The second group performs with the human face identification based on feature vectors extracted from profile silhouettes while the third group uses feature vectors extracted from a frontal view of the face. Most of face recognition algorithms fall into one of two main approaches: feature-based and image based algorithms. Feature-based methods explore a set of geometric features, such as the distance between the eyes or the size of the eyes, and use these measures to represent the given face. These features are computed using simple correlation filters with expected templates.

In this paper, an automated face recognition system application is designed for the purpose of door access control application. The proposed architecture is divided into three subsystems—face detection system, face recognition system and automated door accessing system. These three sub systems are incorporated into a single automated architecture for practical implementation in intelligent home environments. Fig. 1 shows a block diagram of the proposed system architecture and its setup and connections.



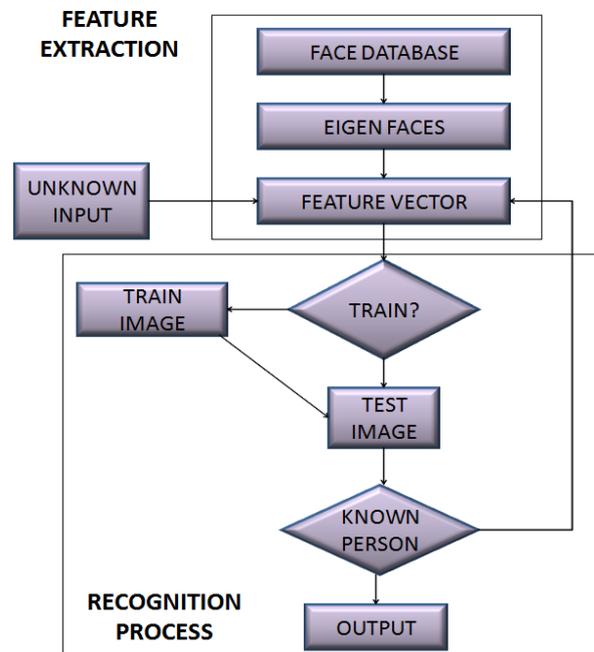
**Fig 1. Block diagram of the proposed system**

### III. FEATURE EXTRACTION

#### Eigen face generation

Principle Component Analysis (PCA) is a well known Eigen face based face recognition algorithm. A set of Eigen faces, Eigen vectors and mean were extracted by performing a mathematical process on a set of trained images depicting different human faces. Here the training images are defined

as a set of flattened vectors and these vectors are assembled together into a single matrix. The extracted Eigen vectors of the matrix are stored in a database. Eigen vectors are defined by the face spaces which are the training face images that are projected. This results in the variation between the set of faces without emphasis on any one facial region like the eyes or nose.



**Fig 2. Flow chart for face recognition**

The projected face space representation of each training image is also saved to a database. To identify a face, the test image is projected to face space using the saved Eigen vectors. The projected test image is then compared against each saved projected training image for similarity. The identity of the person in the test image is assumed to be the same as the person depicted in the most similar training image.

In a real-time face recognition system, the overall Computation time should only consist of the pre-processing and feature extraction time, and classification time. The training process is usually only carried out whenever there are new enrolments or new image updates. The technique used in creating Eigen faces and using them for recognition is also used outside of facial recognition. This technique is also used for handwriting analysis, lip reading, voice recognition, sign language/hand gestures interpretation and medical imaging analysis.

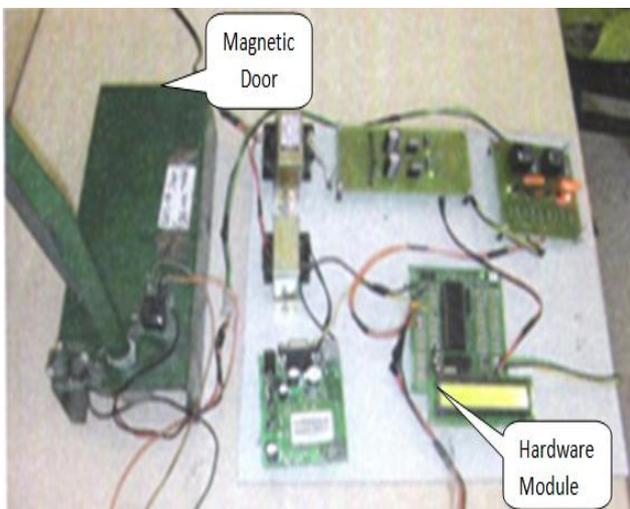
### IV. EXPERIMENTAL RESULTS AND DISCUSSION

The experimental results shown below defines two different cases like if it is an authenticated person then the magnetic door will be opened automatically and in the case of unauthenticated person the magnetic door will remain closed and with the help of the GSM an SMS will be delivered to the user. Fig 3 represents the snap shot of the authenticated person. The captured image is compared with the image in the database, by extracting the eigen face and eigen values. With these features the image is decided to be an authenticated one.



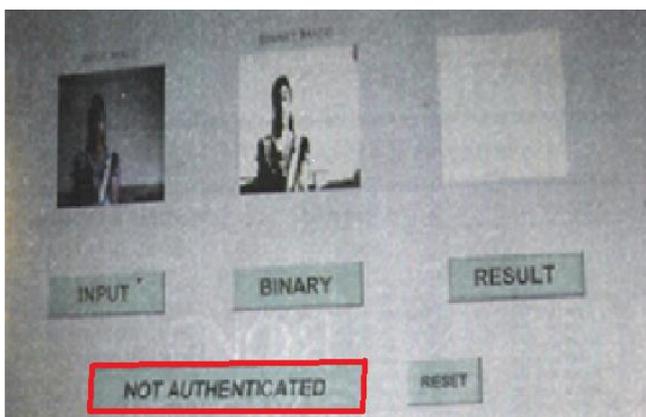
**Fig 3. Snap shot of an Authenticated Person:**

Once the image is declared to be an authenticated one, then the magnetic door of the system will be opening automatically. Fig 4 represents the snap shot of the automatic door opening system.



**Fig 4. The magnetic door is opened automatically**

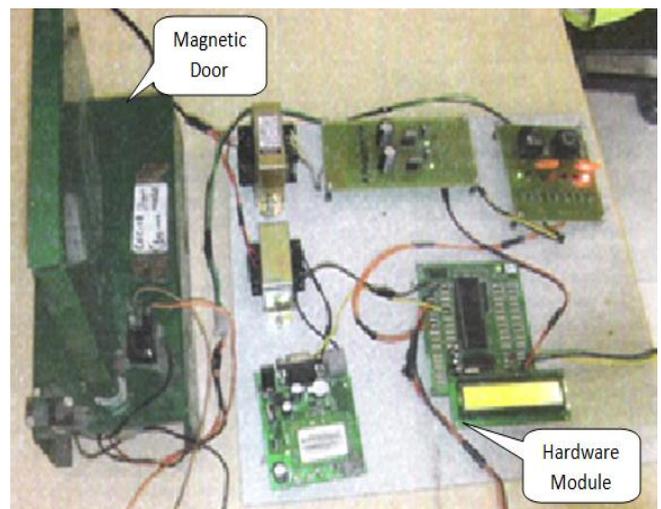
Sometimes unknown person may also enter, this cannot be avoided but at all times everyone will not be aware of the intruder. For this type of situation this paper proposes a solution, if the captured image is an unauthenticated person as shown in fig 5. then an SMS will be automatically generated to the user that an “Unauthenticated Person Has Entered Home” as shown in fig 6. and the magnetic door will remain closed itself which is shown in fig 7.



**Fig 5. Snap shot of an Unauthenticated Person**



**Fig 6. SMS is generated when an unauthenticated person enters home**



**Fig 7. The magnetic door remains closed**

## V. CONCLUSION

In this paper, face recognition system has been developed in order to study the potential application for automated door access control. Among the other bio-metric techniques, face recognition approach poses one great advantage which is user friendliness. The technique of Eigen faces has been applied into the system which makes the system more secure. A cost effective and SMS operated home security system has been designed and tested with the GSM network. As future efforts, improving the reliability and robustness in both the recognition and detection process can be concentrated more.

## REFERENCES

1. John See and Sze-Wei Lee, “An Integrated Vision-based Architecture for Home Security System,” IEEE Transactions on Consumer Electronics, Vol. 53, pp: 489-498, No. 2, May 2007.
2. Y.-K. Choi, K.-M. Kim, J.-W. Jung, S.-Y. Chun, and K.-S. Park, “Acoustic intruder detection system for home security,” IEEE Trans. Consumer Electron., vol. 51, no. 1, pp: 130-138, Feb. 2005.
3. F. Zuo, and P. H. N. de With, “Real-time embedded face recognition for smart home”, IEEE Trans. Consumer Electron., vol. 51, no. 1, pp: 183-190, Feb. 2005.
4. Y. Zhao and Z. Ye, “A Low Cost GSM/GPRS Based Wireless Home Security System”, IEEE Trans. Consumer Electron., vol. 51, no. 1, pp: 567-572, May. 2008.
5. I. Kramberger, M. Grasic, and T. Rotovnik, “Door Phone Embedded System for Voice Based User Identification and Verification Platform”, IEEE Transactions on Consumer Electronics, Vol. 57, No. 3, pp: 1212-1217, August 2011

6. Malik Sikandar Hayat Khiyal, Aihab Khan, and ErumShehzadi, "SMS Based Wireless Home Appliance Control System(HACS) for Automating Appliances and Security," IEEE Issues in Informing Science and Information Technology, Volume 6, 2009.
7. Ratnawati Ibrahim and Zalhan Mohd Zin, "Study of Automated Face Recognition System for Office Door Access Control Application", IEEE 3<sup>rd</sup> Conference on Communication Software and Networks, Pg no:132-136, May 2011.
8. Haitao Zhao, Pong Chi Yuen, and James T. Kwok, "A Novel Incremental Principal Component Analysis and Its Application for Face Recognition", IEEE Transactions On Systems, Man, And Cybernetics—Part B: Cybernetics, Vol. 36, No. 4, pp. 873-886, August 2006.
9. Dong-Ju Kim, Kwang-Woo Chung, and Kwang-Seok Hong, "Person Authentication using Face, Teeth and Voice Modalities for Mobile Device Security", IEEE Trans. Consumer Electron., vol. 56, no. 4, pp. 2678-2685, Nov. 2010.
10. WANG Liting , DING Xiaoqing and FANG Chi, "Face Live Detection Method Based on Physiological Motion Analysis", Tsinghua Science and Technology, Volume:14, Issue: 6 pp: 685 – 690, Dec 2009.
11. Il-Kyu Hwang, Member, IEEE and Jin-Wook Baek, "Wireless Access Monitoring and Control System based on Digital Door Lock", IEEE Transactions on Consumer Electronics, Vol. 53, No. 4, pp:1724-1730, Nov 2007.
12. Faundez-Zanuy, M. ; Escola Universitaria Politecnica de Matard, Barcelona, "A Door-Opening System Using A Low-Cost Fingerprint Scanner and a PC", IEEE Magazine on Aerospace and Electronic Systems, Vol:19 , Issue: 8, pp:23-26, Aug. 2004.

### AUTHOR PROFILE



**I.Yugashini**, obtained her B.E degree from Dr. N.G.P Institute of Technology, Coimbatore, Tamil Nadu in Electronics and Communication Engineering and presently doing her M.E Embedded Systems at Dr. N.G.P Institute of Technology, Coimbatore, Tamil Nadu. Her area of interest is Image Processing Based Embedded System. She has published 1 paper in national Conference.



**S.Vidhyasri**, obtained her B.E degree from Info Institute of Engineering, Coimbatore, Tamil Nadu in Electronics and Communication Engineering and presently doing her M.E Embedded Systems at Dr. N.G.P Institute of Technology, Coimbatore, Tamil Nadu. Her area of interest is Image Processing Based Embedded System. She has published 1 paper in national Conference.



**K.Gayathri Devi**, working as a Associate Professor in the Department of Electronics and Communication Engineering in Dr. N.G.P Institute of Technology, Coimbatore, Tamilnadu, India. She received her B.E. degree in Electronics & Communication Engineering from Coimbatore Institute of Technology, Coimbatore, India in 1998. She received her M.E (Applied Electronics) degree from Dr Mahalingam College of Engineering and Technology, Coimbatore, India in the year 2005. She is a research scholar of Anna University, Chennai. She has published 5 papers in national and international Conferences and journals. Her area of interest includes Image Processing and Digital signal Processing. She is the member of ISTE.