Secured Smart Home System Using Video Face Recognition

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Abstract

Face Recognition is a biometric information system whose applicability is easier and the working range is larger. One of the key tasks of Face Recognition in the field of security is to identify a person captured on image or video. Video Face Recognition system is an important technique used in Secured Smart Home system. It is an Image Processing technology used to detect unknown faces in the real-time environment. This includes matching faces on both still images and video clips. High-quality performance can be achieved in still images, but for video-based face recognition, it is hard to attain the same levels of performance. Images captured by cameras are generally of high quality but in case of video sequences, Image resolution is comparatively lower due to illumination, different expression, the variation of pose, occlusion, and motion. This approach can address the unbalanced distribution between still images and videos by generating multiple bridges. So the implementation is the image to video matching approach to knowing the unknown matches. Hybrid Machine learning algorithm is implemented to classify the face images in real time captured videos. Finally to provide an alert message along with the picture of the unknown person to the all registered authorities of the house.

I. INTRODUCTION

This paper describes the face recognition using PCA and ICA for analyzing the facial images and also result will send to the control block via E-mail. This paper algorithms. PCA, a statistical approach that reduces the number of variables in face recognition. In the training set, every image is represented as a linear combination of weighted eigenvectors known as Eigen faces. These eigenvectors are obtained from the covariance matrix of a training image set. The weights are found after selecting a set of most relevant Eigen faces present. Independent Component Analysis (ICA) algorithm separates the randomly mixed auditory signals. Face recognition for images having face orientations and different illumination conditions this ICA algorithm gives better results when compared to other existing algorithms. Now face recognition has become a popular area of research in computer vision and one of the most successful applications of image analysis and understanding. Due to the problem nature, not only computer science, researchers are interested in it, but also some neuroscientists and psychologists are examining it. The ultimate aim is to implement the model for a particular face and also to differentiate it from a large number of previously stored faces with some real-time variations. It is an adequate way to find the lower dimensional space. Further, it can be used to recognize the person's gender and also to interpret their various facial expressions. Recognition includes broadly differing conditions but in the case of training data set it covers only limited dimensions. This also includes real-time varying lighting conditions. This describes the building of face recognition system by using Principal Component Analysis (PCA) and Independent Component Analysis (ICA)

research aims to develop an effective MATLAB program with Principal Component Analysis and Independent Component Analysis for optimization and better accuracy. This approach is suitable due to its accuracy, simplicity, learning capability and speed.

A. Principle Component Analysis (PCA)

PCA is called as Karhunen-Loeve method, as it is one of the popular methods available for dimension reduction and feature selection. PCA recognition was first done by Turk and Pentland and reconstruction of human faces was done by Kirby and Sirovich. The recognition method used was known as the Eigen face method. It defines a feature space in order to reduce the dimensionality of the original data space which can be used for recognition. Discriminating power within the class was poor and needs large computations are the well-known common problems in PCA method. To overcome these issues Linear Discriminate Analysis (LDA) algorithm is proposed. In the appearance based methods, LDA is the most dominant algorithms for feature selection. Most of the recognition systems use PCA algorithm first for dimensions reduction then followed by LDA algorithm to maximize the discriminating power of feature selection. Because LDA has a small sample size problem in which dataset selected should have larger samples per class for good discriminating features extraction. Because of this reason

implementing LDA directly without using PCA results in poor extraction of discriminating features.

B. Independent Component Analysis (ICA)

Independent component analysis (ICA) is proposed for identifying necessary components or factors from multidimensional statistical data. For facial images having various orientations and different illuminations of face ICA algorithm is

needed, which will give better outcome than the existing systems. ICA includes both the components that are statistically independent and non-Gaussian, Which classify it from some other techniques.

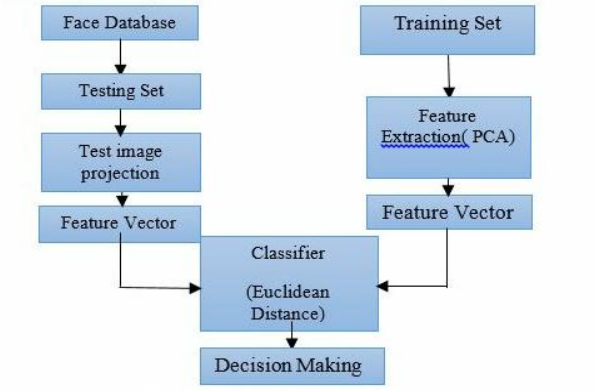

Fig.1PCA Flow diagram

II. RELATED WORKS

Face recognition is said to be difficult to implement on the mobile phones. In this paper, face recognition system using mobile phone was implemented. Firstly the mobile camera is used to capture the face image, and then it is transmitted to the background server which deals with the new face image using the trained convolution neural network. Then the server gives the results to the mobile phone. The result shows it can minimize the requirements for the better performance and to identify the faces accurately [1].

In this paper a model is proposed for recognizing and detecting the faces in videos. It attempts to minimize the processing time of recognition process. For its effectiveness the system is divided into three stages namely motion detection, face detection and recognition. Motion detection minimize the processing complexity [2].

This paper proposes a system for human face detection by Haar features and recognition by Eigen and Gabor filter in videos efforts are made to reduce processing time for detection and recognition process. The Eigen face method performs well in terms of computational complexity whereas Gabor filter are robust to pose changes [3].

In this paper, an approach for the automatic comparative labeling of facial soft biometrics is proposed. It explains the unconstrained human face recognition. With the help of LFW dataset the experiments show the effectiveness of automatic generation of comparative facial labels and highlighting the potential extensibility of the approach to other face recognition scenarios and larger ranges of attributes [4].

This paper presents the comparative study of various techniques such as face recognition using PCA, DCT transform, LDA, neural networks, etc. Different parameters like merits and demerits of all the techniques are taken into account to determine which technique is more useful in future [5].

This paper describes an efficient and rather robust face spoof detection algorithm based on Image Distortion Analysis. It consider different features like specula reflection, blurriness, and color diversity are obtained which forms the IDA feature vector. An ensemble classifier containing many SVM classifiers trained for different face spoof attacks is used to differentiate between live and spoof faces. It also includes spoof detection of videos using a voting-based method [6].

If the door recognize the visitor, the door will be opened, if not then the door will be locked

The rate of recognition is better when compared to PCA with statistically independent basis images and also to statistically independent coefficients. It is suitable for images with large rotation angles with poses and also the variations in illumination conditions. Sequential row column independent component analysis is a novel subspace method for face recognition. Each image is transferred to a vector followed by calculating the independent components.

The proposed model includes both PCA and ICA algorithms for face recognition approaches. Fistly face images are transformed into a small set of essential characteristics known as eigenfaces, which results in the learning images. Recognition process is projecting a new image in the eigenface subspace, after which the person is identified by comparing eigenface space with the already stored faces. This approach has betteraccuracy, simplicity, speed and tolerance to small or gradual changes on the faces.

automatically. This project makes use of the basic Pi cam, and the internet connection to create a door that unlocks by facial recognition. This system needs a face authentication to enter into the home. When it come across unknown person, that face will be captured and sent a Gmail alert [7].

This paper discuss about image-based biometrics be leveraged in an IoT environment with the help of Raspberry Pi. It proposes a proof-of-concept web-based information system, protected by a face recognition and gives authorized users access for sensitive information [8].

This paper describes a different way of deep network for recognizing the faces. In this system, it does not give raw pixel values as input, it gives only the extracted facial features as input. This can minimize the complexity of system by providing the rate of 97.05% accuracy on Yale faces dataset [9].

This work proposes a robust method using Supervised Descent Method based Viola-Jones and Skin color based on separation to determine various faces at a time under the different face illumination and in difficult background by face detection and tracking in conjunction with depth data. These methods are used to obtain better accuracy. Tracking and detection methods may use rigid representation to describe the faces [10].

The proposed model is for developing an efficient face recognition system by enhancing the efficiency of the existing systems and also for secured attendance system. In future various recognition system can be developed by using video streaming service. This also includes both grayscale and colored images with differing conditions [11].

An Eigen face approach for face recognition is proposed using CUDA framework. NVidia's Kepler architecture graphics card which is used to answer the data migration questions involving in the recognition phase, and this works effectively for the face detection phase [12].

This paper proposes a facial recognition approach depending on the Eigen faces and on Principal Component Analysis algorithm for processing and cleaning images, respectively. It finds the Euclidean distance between the facial features already available in a database and new faces captured in an interface with matching coded developed in MATLAB. They describes a data reduction method to be match, and gives a face detection method using image processing [13].

This technique includes features like age, gender, beard, height and some facial features. Gender identification is easy for human beings but it is difficult in case of computers. This study will give an exact analyze of the facial feature based on the gender classification [14].

This method includes image acquisition and RGB conversion to grayscale image. The image matches vector values of training dataset image with the vector values of test image by determining the Euclidean distance. By calculating the average value of dataset image, it can obtain 93% of accuracy [15].

III. PROPOSED MODEL

This paper describes the face recognition using PCA and ICA algorithms to evaluate the facial images and also the result of unknown person's image will be captured and mailed to all the registered authorities of the house.

This paper basically focuses on the construction of face recognition system with Principal Component Analysis (PCA) and Independent Component Analysis (ICA). PCA is a statistical method in which the number of variables are reduced in face recognition. In the training set, every image is represented as a linear combination of weighted eigenvectors are said to be Eigen faces. This approach is used to transform the faces into a small set of essential characteristics, Eigen faces, which are the main components of the initial set of the training set. Recognition is done by projecting a new image in the Eigen face subspace, after which the person is classified by comparing its position in Eigen face space with the position of known individuals

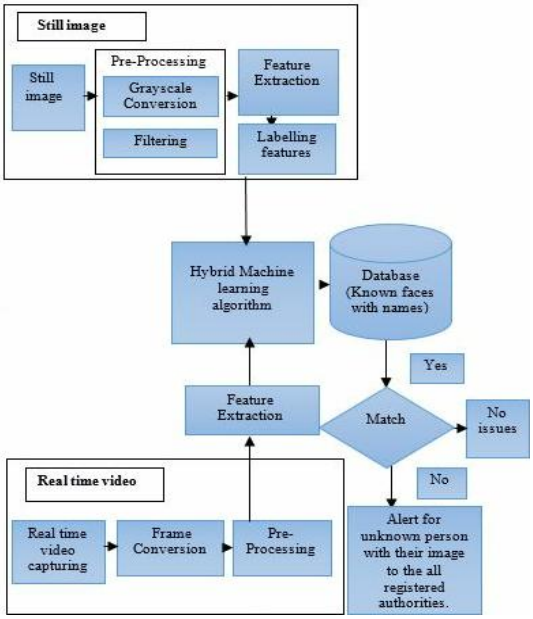

Fig.2 Architecture diagram

This approach has an advantage of better accuracy over other face recognition systems. The problem is that it is limited to files to recognize the

faces. Thus, the images must be vertical frontal views of human faces.

Two steps involving in recognition process are:

A. Initialization process (ICA)

B. Recognition process (PCA)

After initialization, it involves:

i. Determine a set of weights based on the input image and the N Eigen faces by projecting the input image onto each of the Eigen faces.

ii. Evaluate if the image is already known or unknown face by checking to see if the image is sufficiently similar to the free space.

Eigen Face Algorithm

In this paper we uses a set of image by 90×112 pixels. Its vector dimension be M × N, so that a typical image of size 200 × 149 becomes a vector of dimension 29,800 or equivalently a point in a 29,800 dimensional space.

Step1: Prepare the training set of images

Step 2: Prepare the data set

Step 3: Calculate the average face vector

Step 4: Subtract the average face vector.

Step 5: Determine the covariance matrix.

Step 6: Determine the eigenvectors and eigenvalues of the covariance matrix.

Step 7: keep only the largest eigenvalues Eigen vectors.

The faces having minimum eigenvalues can be omitted because they define only a small part of characteristic features.

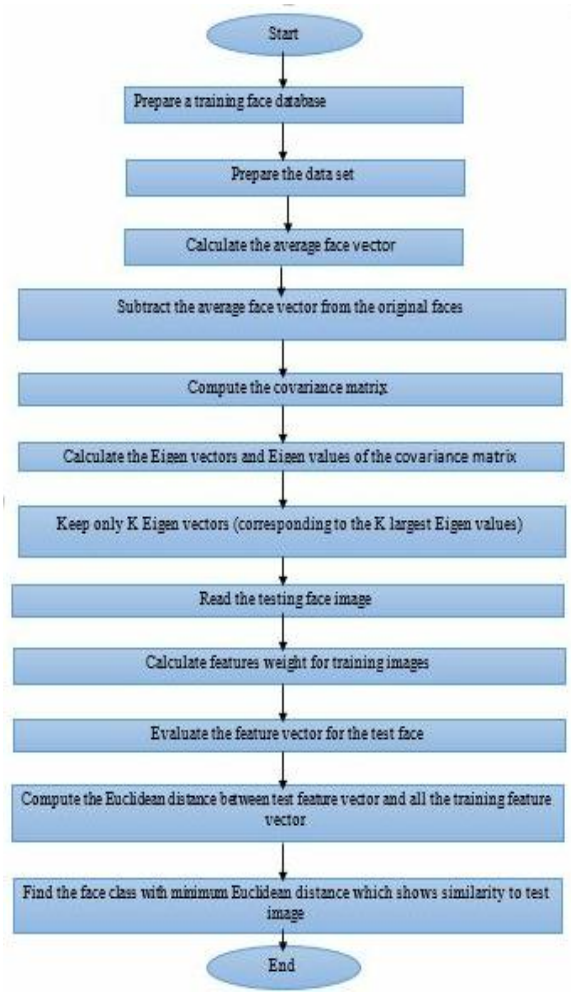

Fig.3 Dataflow diagram

TESTING SAMPLE CLASSIFICATIONS

(i) Read the test image and extract face from it by leaving the unnecessary details.

(ii) Determine the feature vector of the test face.

The test image is converted into its Eigen face components. Firstly compare the line of our test image with our mean image and multiply their difference with each eigenvectors. Now to determine the average Euclidean distance between test feature vector and all the training feature vectors. Mathematically, recognition is calculating the minimum Euclidean distance, between a testing image and a training image. Thus face image with minimum Euclidian distance shows similarity to the test image, it can be determined by,

$$d(P,Q) = \sqrt{\sum (pi - qi)^2}$$

IV. RESULTS

The performance of face recognition system highly depends on the algorithms used. In general, if a person is moving then the performance gets affected. But here with the use of ICA (Independent Component Analysis) algorithm, we overcome those issues and also we can obtain a higher rate of accuracy.

Table.1 Accuracy of different Algorithms

Images	Algorithms	Accuracy (%)
100	PCA	91.5
100	LDA	95
100	ICA	92
100	PCA & ICA	97

We calculate the Euclidean distance to obtain the most similar images and we provide an alert message along with the image of the unknown person. By analyzing the performance of different algorithms it is reviewed that different accuracy rates can be achieved. Here we use Hybrid Machine Learning Algorithm including the fusion of PCA (Principle Component Analysis) and ICA (Independent Component Analysis) algorithms.

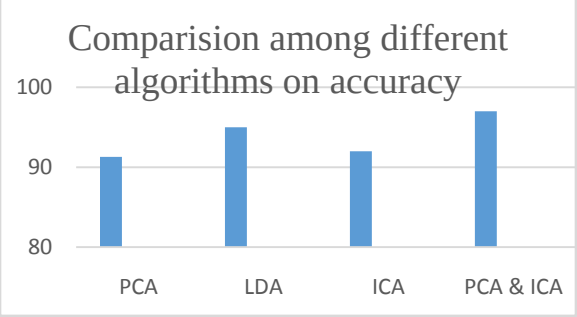

Fig.4 Comparison among different algorithms

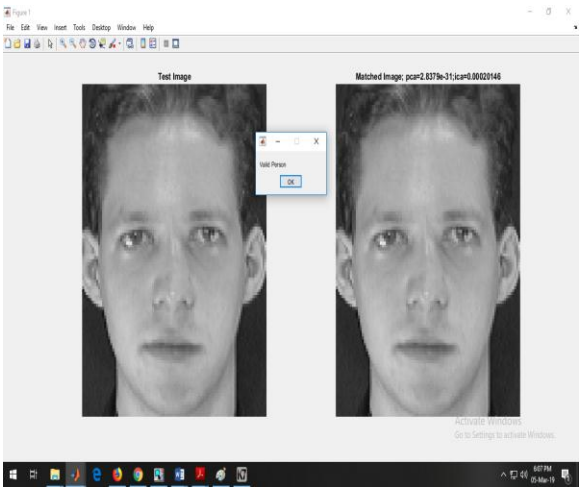

Fig.5 Matching test image with stored image

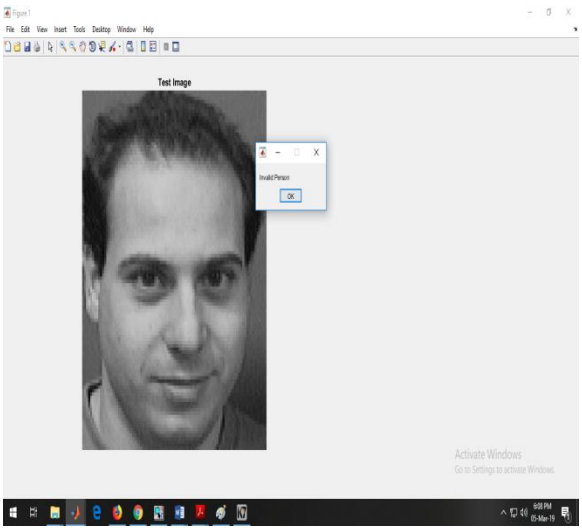

Fig.6 Identifies the Unknown face image

This fusion algorithm gives a better accuracy rate when compared to the previously available face recognition algorithms. We calculate the Euclidean distance to obtain the most similar images and we provide an alert message along with the image of the unknown person.

V. CONCLUTION

In this paper, the implementation of the face recognition system using Principal Component Analysis (PCA) and Independent Component Analysis (ICA) algorithm. The proposed system successfully recognizes the human faces and worked better in the different face orientations and with the greater rate of accuracy. The algorithms fused in such a way that works well with any type of images and videos. For different poses and facial angles, this method gave a very good classification of faces though it has many variations in size of the image. The Eigen face method thus fitting to the problem of face recognition. It is an effective, fast, relatively simple

and has a higher rate of accuracy to work well in a constrained environment.

REFERENCES

[1] Haifeng Li, Xiaowei Zhu," Face Recognition Technology Research and Implementation based on Mobile Phone System", 12th International Conference on Natural Computation, pp.972-976, China, 2016.

[2] S. V. Tathe, A. S. Narote, S. P. Narote," Human Face Detection and Recognition in Videos", Intl. Conference on Advances in Computing, Communications and Informatics (ICACCI), pp.2200-2205, India, 2016.

[3] S. V. Tathe, A. S. Narote, S. P. Narote," Face Detection and Recognition in Videos", IEEE Annual India Conference (INDICON), India, 2016.

[4] Nawaf Yousef Almudhahka, Mark S. Nixon, Jonathon S. Hare,"Automatic Semantic Face Recognition",IEEE 12th International Conference on Automatic Face & Gesture Recognition,pp.180-185, USA,2017.

[5] Dr. Naveen Kumar Gondhi, Er. Navleen Kour,"A Comparative Analysis on various Face Recognition Techniques",International Conference on Intelligent Computing and Control Systems, pp.8-13, India, 2017.

[6] Priyanka P. Raut1, Namrata, R. Borkar,"Techniques and Implementation of Face Spoof Recognition",International Journal of Engineering Science and Computing, pp.15980-15987, India, 2017.

[7] Sandesh Kulkarni, Minakshee Bagul, Akanksha Dukare, Prof. Archana Gaikwad,"Face Recognition using IoT",International Journal of Innovations & Advancement in Computer Science,pp.692-696,India,2018

[8] Rok Novosel1, Blazˇ Meden1, Zˇ iga Emersˇicˇ1, Vitomir Sˇ truc2, Peter Peer1,"2.8.Face recognition with Raspberry Pi for IoT Environments", 6th International Istanbul Smart Grids and Cities Congress and Fair (ICSG),pp.477-480, Turkey,2017.

[9] Dr. Priya Guptaa, Nidhi Saxenaa, Meetika Sharmaa, Jagriti Tripathia,"Deep Neural Network for Human Face Recognition",Published Online January 2018 in MECS,pp.63-70,India,2018.

[10] Satbir Kaur, Er. Aayushi Chadha,"A Comprehensive Review of Face Detection and Tracking Techniques", International Journal Of Engineering Development", pp.1010-1016, India, 2017.

[11] P. Arun Mozhi Devan, M. Venkateshan, A. Vignesh, S.R.M. Karthikra ,**"**Smart Attendance System Using Face Recognition",American-Eurasian Network for Scientific Information Journals,pp.139-144,India,2017.

[12] Bhumika Agrawal, Chelsi Gupta, Meghna Mandloi, Divya Dwivedi, Jayesh Surana,"GPU Based Face Recognition System for Authentication",International Journal Of Engineering Development And Research,pp.931-935,India,2017.

[13] Richard Mejía-Campos, Diego Néjer-Haro, Santiago Recalde-Avincho, Paul Rosero-Montalvo, Diego Peluffo-Ordóñez**"**Face Detection and Classification using Eigenfaces and Principal Component Analysis: Preliminary Results",International Conference on Information System and Computer Science,pp-309-315,Ecuador,2017.

[14] Sandeep Kumar**,** Sukhwinder Singh, Jagdish Kumar, **"**A Study on Face Recognition Techniques with Age and Gender Classification", International Conference on Computing, Communication and Automation (ICCCA),pp.1001-1006,Noida,2017.

[15] Mustamin Anggo1 and La Arapu1,"Face Recognition Using Fisherface Method",2nd International Conference on Statistics, Mathematics, Teaching and Research, Indonesia, 2018.