This step first the normalization of the input image is done. After normalizing the input image some of the image transformation methods are applied on it. Images which are available on the website,it collected images contains various expressions.

3.2 Extracting the Features of the Face

Extracting the features of the face is the second step in the face recognition system. Feature. In this process the relevant information from a face image is extracted. Whatever features we will extract in this step that we will use later on for the recognition of the face in the third step. The image which we are representing mathematically, a mathematical representation of original image called as a biometric template or biometric reference biometric template or biometric reference is generated in this step of feature extraction,. In the database this biometric reference or template which is generated is stored and will form the basis (vector) of any recognition task. The First initial feature which we are considering is the gray scale pixel.

3.3 Recognition of Face

Once we select and extract the features in the second step, the third step in the proposed face recognition system is of classification the image for the recognition purpose. Principal Component Analysis algorithm is most widely used algorithm for the recognition of the face. In the step of the classification, the similarity between faces from thesame individual and different individuals after all the face images in database are represented with relevant features. Sometimes feature extraction of the face image & recognition of the face images, these two process are done simultaneously. Once the image processing part of the recognition of the Face is done the recognized image is applied to the application Hardware. Here we are developing the face recognition system for the strong room of Military Security System, to get the entry in that strong room to only authorized person of that strong room. The application Hardware Consist of AVR Microcontroller AT mega 16 A, Motor driver, GSM Module, etc.

4. Application Hardware

4.1AVR Microcontroller ATmega16 (A)

AVR AT mega 16 (A) controller is a 8 bit controller which is mostly used in the world. It is a 8 bit on chip system with Reduced Instruction set command system. It contains the 32 general purpose registers. The ATmega16 is a low-power controller. It is a CMOS 8-bit microcontroller. It is based on the AVR enhanced RISC architecture. It executes the powerful instructions in a single clock cycle. In a single clock cycle powerful instructions are executed. The ATmega16 achieves throughputs approaching 1 MIPS per MHz Power consumption versus processing speed is optimized. This controller has some of the Features such as it has 16K bytes of In-System Programmable Flash Program memory, which has the read capabilities as well as the write capabilities. It contains the 512 bytes EEPROM. It also includes the 1k byte SRAM. It contains the 32 general purpose I/O lines. It has the 16-bit Timer/Counter this 16 bit Timer/Counter unit allows accurate program execution timing (event management), also this unit allows the wave generation, as well as the signal timing measurement. With a full suite of program and system development tools this AVR AT mega 16A controller is supported. The different development tools with which it is supported are C compilers tool, tool of the macro assemblers, tools for program debugger or the program simulators, also it is supporting in-circuit emulators, and evaluation kits etc. The most of the commands in this controller are performed in the single clock cycle. During the execution of the previous command the reading of the next instruction is done on this controller.so in this controller overall number of commands in 1 second is almost equal to the working frequency. It differs from the other microcontroller that is it requires the less power in the higher frequencies. It has the more advanced architecture than the other microcontroller that allows to run one instruction per clock cycle while PIC microcontrollers run one instruction in 4 clock cycles.

4.2 Sim900A

There are various features of this SIM900 like it has the GPRS multi- slot class 10/ class 8 (optional) and it also supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm. SIM900 can meet almost all the space requirements in User's applications, like the application such as M2M, smart phone, PDA and other mobile devices.

4.3 Dc Motor

A DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings.

4.4 Liquid Crystal Displays (LCD)

It is a low cost display. It is easy to interface with the microcontroller. Because of an embedded controller. This controller is standard across many displays (HD 44780) which means many micro-controllers have libraries that make displaying messages as easy as a single line of code. It is a 16 x 2 LCD display. It is used to display the message for the entry if the face is getting matched then this message is get displayed on the LCD.

5. Principal Component Analysis Algorithm

Principal component analysis (PCA) was invented in 1901 by Karl Pearson. It is one of the most popular method used for the recognition of the Faces. It reduces the number of the variables in the face recognition. The main task of the Principal Component Analysis algorithm is that it can do that are prediction, redundancy removal, feature extraction, data

compression, etc. There are various steps that are involved in the recognition of the faces using the PCA algorithm. First it compares the input image/face with images/faces that are stored in the data-base with fixed background such as white in color. The images/faces that are present in the database are called authorized images/faces and the input image/face is called as un-known/unauthorized image/face. Then images are stored in our database for testing purpose. In the recognition steps of the face using Principal Component Analysis first the Eigen vectors are calculated from the images and then its threshold values are determined. By using Euclidian distance between threshold values of authorized and unauthorized faces corresponding images are compared and persons will be identified accordingly.

A] Training Set

It is a set which is formed by combining the different set of the images. From the different type of sources these images are collected. These collected images contains the different pose and expressions. These images are used for the recognition.

B] Eigen Face

These are set of the features in the form of the vectors. It denotes the variations between the different faces. It is weighted combination of some component of base faces. Each image in the training set has its own contribution on making the Eigen faces . Facial expression which occurs in the Eigen faces are deviates from the original images. Eigen vectors are formed by converting the image matrix into the vector form. These Eigen vector should satisfy the Eigen value equation .The size of this eigenvector is less but there is no loss of data in these eigenvector.

C] Weight Vector

For the recognition of the face, the weight of the largest Eigen face is calculated. When the new face image is to be recognized then the weight associated with that Eigen face is calculated. By comparing these calculated weighs with the weights of the known face images we can recognize the whether the face is known face or unknown face

D] Euclidian Distance

Euclidian Distance is a ordinary distance between the two points. By using the Pythagorean formula we can calculate this Euclidian distance. The Euclidian distance between two points is a length of the segment connecting these two points .Here we are calculating the Euclidian distance between the input image and the training face. If the Euclidian distance is less than the threshold then the face which is determined in known face or if this distance is above the threshold then the determined face is unknown.

5.1Benefits of the Principal Component Analysis Algorithm

1) Due to the Principal Component Analysis algorithm there is a the reduction in the dimension of the data.
2) There is no any data redundancy as all the components are orthogonal.
3) Due to this algorithm there is the reduction in the complexity of grouping the images.
4) There are different applications of this algorithm in recognition of the faces like for, Entrance control in Building, for getting control to computers, for Automated Teller Machines, at the post office, For the passport verification, and identifying the faces in a given database.

5.2Steps of the Principal Component Algorithm

1) Get database set of images and then find mean of the images
2) Find the difference between mean image and each of database images.
3) Find covariance matrix of the matrix obtained from step 2 for this covariance matrix.
4) Find Eigen values and Eigen vectors, and then we will find the Eigen faces with larger Eigen values.
5) Find out weight vector using this Eigen faces
6) For new/unknown image also the process will be echoed from step 1to3 and then find out weight vector for test image.
7) Now find Euclidian distance between weight vectors of unknown image and database images.
8) If this distance is less than threshold then test image is considered to be in database and hence authorized, otherwise unauthorized

5.3 Flowchart of the Principal Component Analysis Algorithm

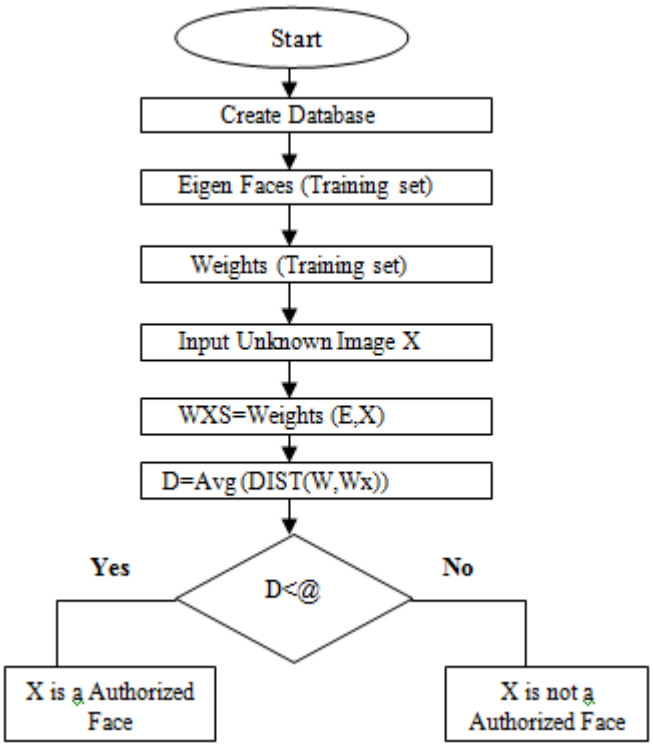
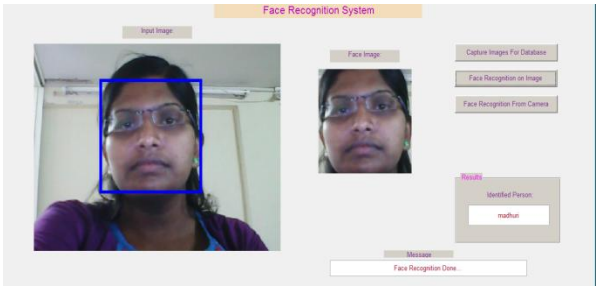


Figure 4: Flowchart of the Principal Component Analysis Algorithm

6. Results



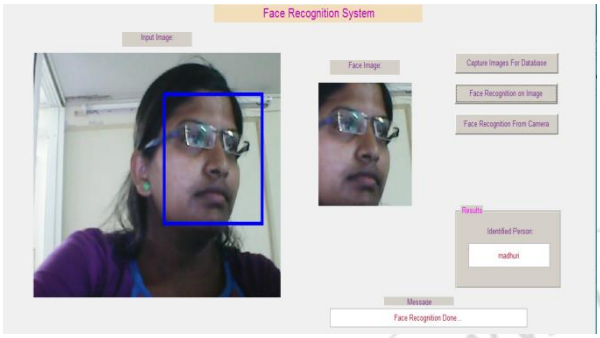


Table 1: Result Table of Face Recognition

Input Images	*Training Images*	*Testing Images*	*Images Matched*	*% Accuracy*
1	10	10	8	80%
2	10	10	7	70%
3	10	10	8	70%

Here we have taken 60 face images of three different person with different expressions. Out of that 60 images of face of each person 10 images are placed as the training images and 10 images are placed as the testing images of each person. And the face recognition is done on the testing images by using Principal Component Analysis Algorithm. The accuracy achieved in recognizing the first person faces of different expression is 80%. The accuracy achieved in recognizing the faces of second person with different expression is 90%.And the accuracy achieved in recognizing the faces of third person with different expression is 80%. The Face recognition result we got by using principal component analysis algorithm is compaired with other algorithm results.The result table of different algorithm is as follows.

Table 2: Results of Face different Recognition algorithm and Their Comparision

	PCA	ICA	KCPA	Bayes[21]
Accuracy	77%	77%	87%	95%
Uniqueness	Yes	No	Yes	Yes
Projections	Linear	Linear	Nonlinear	Linear

The results we got in Face Recogntion by using Principal Component Analysis Algorithm is compaired with other algorithm. The results are as shown in the above table. The benefits of Principal Component Analysis Algorithm over other algorithm is that Due to the Principal Component Analysis algorithm there is a the reduction in the dimension of the data and there is no any data redundancy as all the components are orthogonal. Due to this algorithm there is the reduction in the complexity of grouping the images.There are different applications of this algorithm in recognition of the faces like for, Entrance control in Building, for getting control to computers, for Automated Teller Machines, at the post office, For the passport verification, and identifying the faces in a given database.

7. Applications of the Face Recognition System

1) Security system for ATM.
2) For the Automatic face recognition.
3) For the security system of the Airport.
4) The automatic recognition of handwritten postal codes on postal envelopes.
5) For the security system of the industry.
6) Automatic recognition of images of human faces.

8. Conclusion

Face recognition is a both challenging and important recognition technique. Face recognition technique is user-friendliness and this is one of the great advantage of this technique among all other biometric technique. In this paper the PCA algorithm for recognizing the faces from an input is proposed. From the training set images are taken as a liner combination of weighted Eigen vector. By finding the Euclidian distance between the input face and the training set images the recognition of the face is done.

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