BIOMETRIC AUTHENTICATION FOR ATM SECURITY SYSTEM

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ABSTRACT

To implement the biometric security system based on finger vein and face recognition. A biometric system is essentially a pattern recognition system that uses of biometric traits to recognize individuals. The most unique feature of a person is finger vein even it is different for the twins. PCA (Principal Component Analysis) transformation based technique applied for finger vein technology to analyze the feature of vein. PCA is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. PCA is a powerful tool for analyzing data by finding the patterns in the data, and compress the data that is by reducing the number of dimensions, without much loss of information. Face recognition is the actual task of recognizing the face by analyzing the part of the imaged identified. The algorithm used for face recognition is Linear Discriminant Analysis for recognizing and extracting the various features of the given input face image. Linear Discriminant Analysis (LDA) has been successfully applied to face recognition which is based on a linear projection from the image space to a low dimensional space by maximizing the between class scatter and minimizing the within-class scatter. The feature of the vein is compared with the image database and it is recognized. Face recognition is for high security and also it can be used when the finger vein is damaged for a person for easy cash transaction.

Keyword:-*Finger Vein Recognition Algorithm, Principal Component Analysis, Face recognition, Linear Discriminant Analysis.*

1. INTRODUCTION

A biometric system is essentially a pattern recognition system that uses of biometric traits to recognize individuals. The most unique feature of a person is finger vein even it is different for the twins. PCA (Principal Component Analysis) transformation based technique applied for finger vein technology to analyze the feature of vein. PCA is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. PCA is a powerful tool for analyzing data by finding the patterns in the data, and compress the data that is by reducing the number of dimensions, without much loss of information. Face recognition is the actual task of recognizing the face by analyzing the part of the imaged identified. The algorithm used for face recognition is Linear Discriminant Analysis for recognizing and extracting the various features of the given input face image. Linear Discriminant Analysis (LDA) has been successfully applied to face recognition which is based on a linear projection from the image space to a low dimensional space by maximizing the between class scatter and minimizing the within-class scatter. The feature of the vein is compared with the image database and it is recognized

2. FINGER VEIN RECOGNITION

Finger vein recognition is a method of biometric authentication that uses pattern-recognition techniques based on images of human finger vein patterns beneath the skin's surface an example for finger vein image. This technology is currently in use or development for a wide variety of applications, including credit card authentication, automobile security, employee time and attendance tracking, computer and network authentication, end point security and automated teller machines. A biometric system is essentially a pattern recognition system that uses of biometric traits to recognize individuals. PCA is a powerful tool for analyzing data by finding the patterns in the data, and compress the data that is by reducing the number of dimensions, without much loss of information. A biometric system is essentially a pattern recognition system that uses of biometric traits to recognize individuals. The most unique feature of a person is finger vein even it is different for the twins. PCA (Principal Component Analysis) transformation based technique applied for finger vein technology to analyze the feature of vein. PCA is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. PCA is a powerful tool for analyzing data by finding the patterns in the data, and compress the data that is by reducing the number of dimensions, without much loss of information.

2.1 Principal Component Analysis

In enroll stage as well as recognition stage three sequential processes are done which is shown in the figure 3.2. They are image capturing, preprocessing and feature extraction. In image capturing the near-infrared (NIR) technique is used, which are suitable to capture human body part images in a non-harmful way**.** Principal Components Analysis is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. PCA is a powerful tool for analyzing data. The other main advantage of PCA is that once these patterns are found in the data and compress the data that is by reducing the number of dimensions, without much loss of information.

The steps needed to perform a Principal Components Analysis on a set of data are given below

Step 1: Get some data

The data is in the form of image and this image is processed by the preprocessor before enter into the feature extraction process. The image should be converted from rgb to grayscale.

Step 2: Calculate the covariance matrix

Since the data is 2 dimensional, the covariance matrix will be calculated. Since the non-diagonal elements in this covariance matrix are positive, we should expect that both the variable increase together.

$$Cov=1/m\sum(X-\mu)(X-\mu)^T$$

Where X represents feature vector which is two dimensional (width and height)

μ represents the mean

Step 3: Calculate the height and width of the finger vein

Since the covariance matrix is square, we can calculate the eigenvectors and eigenvalues for this matrix. These are rather important, as they tell us useful information about our data. It is important to notice that these eigenvectors are both *unit* eigenvectors that is their lengths are both 1.

$$AX=¥X$$

Here ¥1, ¥2 corresponding to these 2 values we calculate 2 Eigen vectors. Eigen vector corresponding to largest Eigen values is called Principal Component 1 and another one is Principal Component 2.

Step 4: Reduce the number of dimensions

There are two principal component obtained from Eigen vectors. This Eigen vectors are used to reduce the number of dimensions. The Eigen vector corresponding to largest Eigen values is called the Principal Component 1(PC1) and this PC1 captures the direction where most of the variations are present. The Eigen vector corresponding to smallest Eigen values is called the Principal Component 2(PC2) and this PC2 captures the direction with second most variations are present. By using these two Principal Component the numbers of dimensions are reduced.

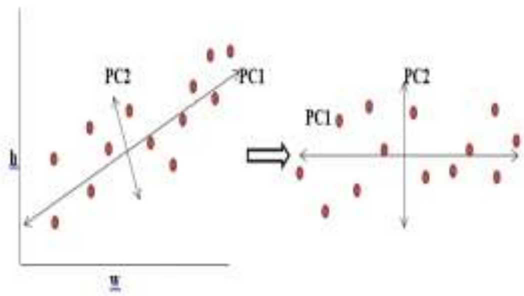


Fig-1: Reduce the number of dimensions

3. FACE RECOGNITION

A face recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. In our project we use face recognition method as a backup in-case the finger vein recognition is not possible only when the finger vein is deeply damaged. The process of recognizing a face in an image has two phases:

Face detection-detecting the pixels in the image which represent the face. There are several algorithms for performing this task.

Face recognition– the actual task of recognizing the face by analyzing the part of the imaged identified during the face detection phase

3.1 Linear discriminant analysis

Linear Discriminant Analysis (LDA) has been successfully applied to face recognition which is based on a linear projection from the image space to a low dimensional space by maximizing the between class scatter and minimizing the within-class scatter. LDA allows objective evaluation of the significance of visual information in different features of the face for identifying the human face. Linear Discriminant analysis explicitly attempts to model the difference between the classes of data.

3.1.1 STEPS IN LDA

In Linear discriminant analysis we provide the following steps to discriminant the input images:

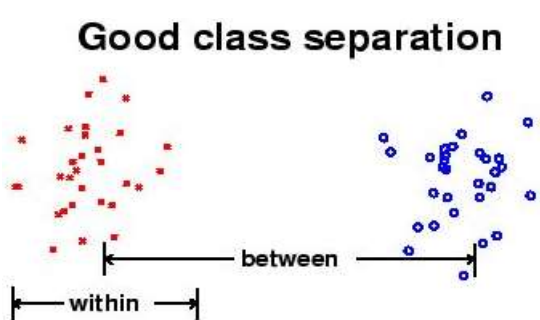
Step-1

We need a training set composed of a relatively large group of subjects with diverse facial characteristics. The appropriate selection of the training set directly determines the validity of the final results. The database should contain several examples of face images for each subject in the training set and at least one example in the test set.

Step-2

For each image and sub image, starting with the two dimensional m × n array of intensity values I(x, y), we construct the vector expansion Φ_ R m× n. This vector corresponds to the initial representation of the face. Thus the set of all faces in the feature space is treated as a high-dimensional vector space.

Step-3



Now with-in class scatter matrix 'Sw' and the between class scatter matrix 'Sb' are defined in the following equation respectively.

$$S_W = \sum_{j=1}^{c} \sum_{i=1}^{c} (\Gamma_i^j - \mu_j) (\Gamma_i^j - \mu_j)^T$$

Where, Γi j , the ith samples of class j, μj is the mean of class j, c is the number of classes, Nj is the number of samples in class j.

$$S_b = \sum_{j=0}^{c} (\mu_j - \mu) (\mu_j - \mu)^T$$

Where, μ represents the mean of all classes.

Then the subspace for LDA is spanned by a set of vectors W = [W1, W2,...., Wd] , Satisfying equation as follows

$$W = \arg\max = \mathrm{mod} \left[\frac{W^T\, Sb\, W}{W^T\, Sw\, W}\right]$$

4. HARDWARE AND SOFTWARE REULTS

The various steps involved in identifying whether the person is authenticated or not along with the results is discussed below. Browse the test image of finger vein. Selecting one image from several images of finger vein for further processing is shown below

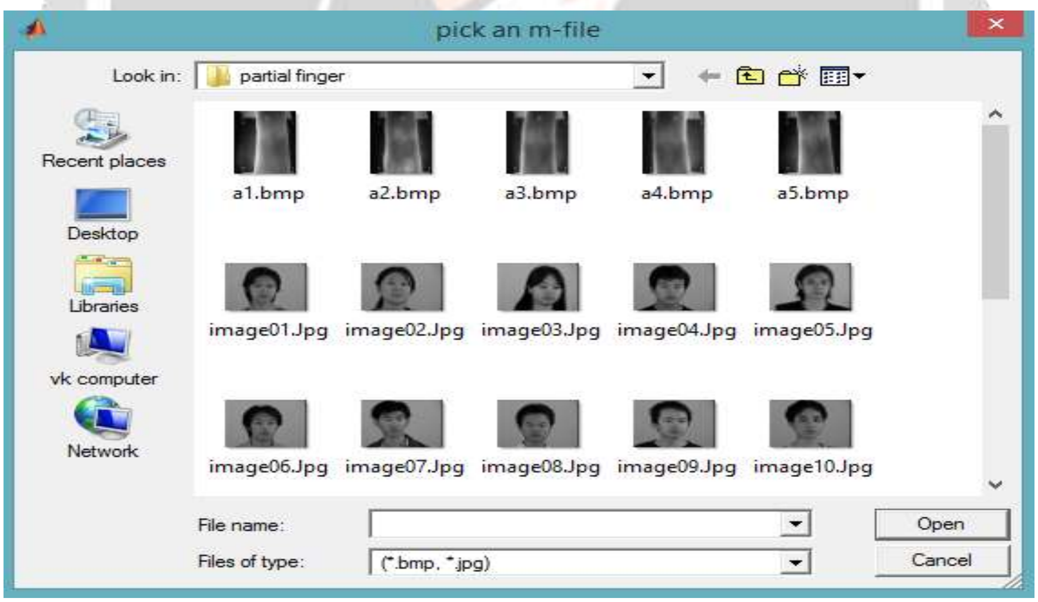


Fig-4.1: Selecting a finger vein image

The finger vein image after browsing is shown which is an input image for further processing.

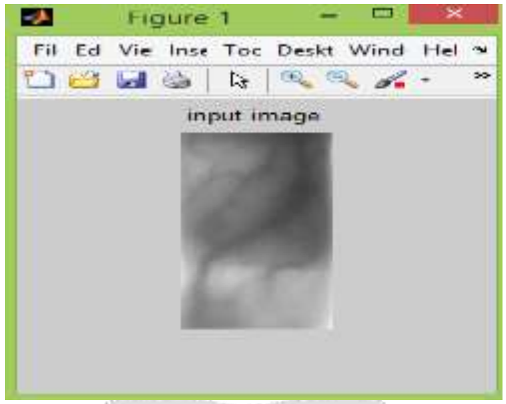


Fig-4.2: Selected image of finger vein

The filtered image is used for the comparing the test image and the database image and check whether the person is authenticated or not. After completing this process dialog box appears.

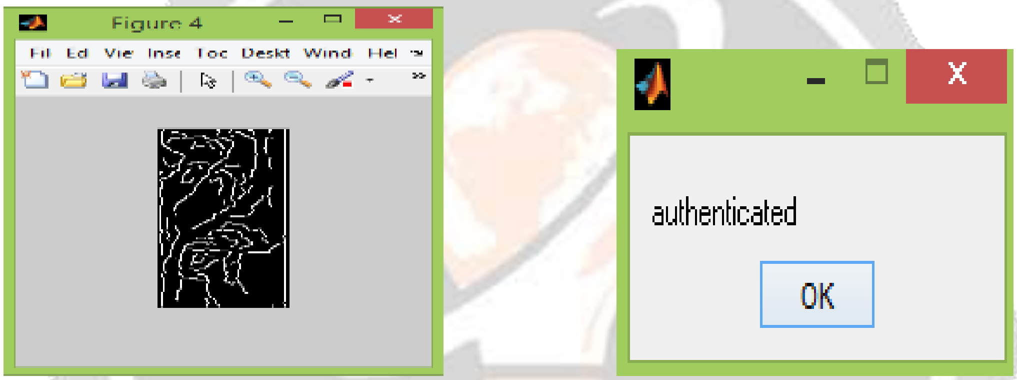


Fig-4.3: Authenticated

The above is the case for authenticated person whose finger vein is already registered, trained and updated in the database. These are sufficient to prove that a person is authenticated. But if the ATM is used by some unauthenticated person or if the finger cannot be used by the person due to some severe damage then that person becomes unauthenticated. Let us see the process for the finger image which is not in the database and untrained and been loaded in some other path. The browsing process is same as done for authenticated one. Let us select the finger image apart from the database as in figure 4.4

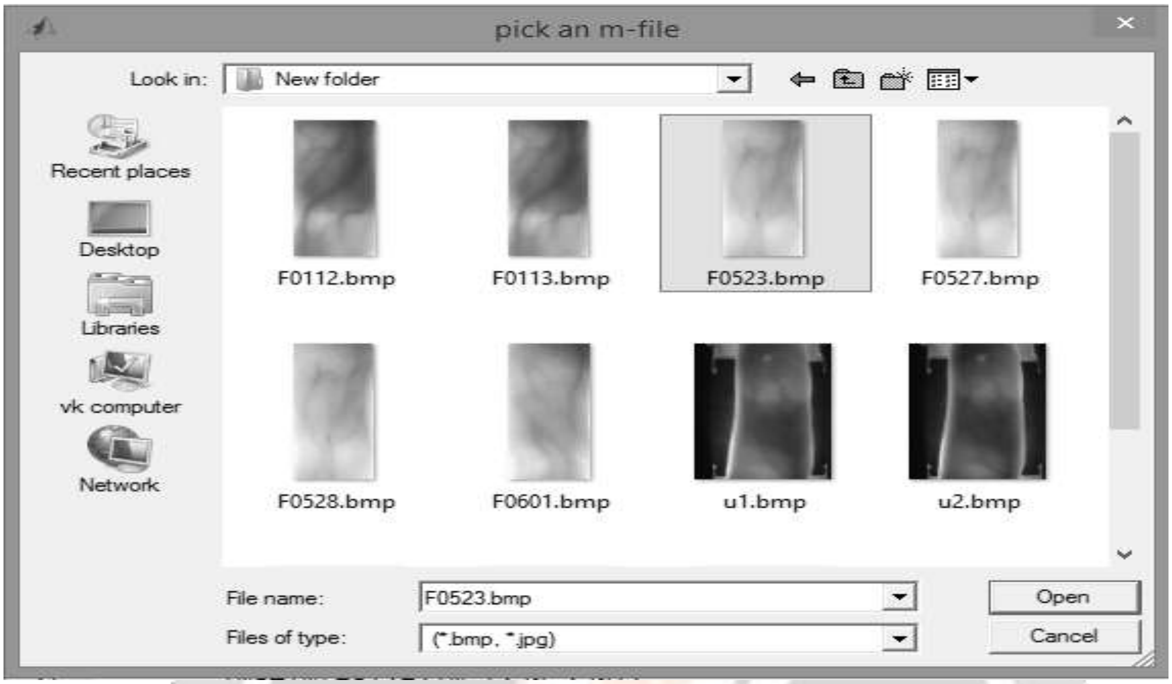


Fig-4.4: Browsing the finger vein image

The finger vein image after browsing is shown in Fig-4.5. It is an input image for further processing.

Fig-4.5 Selected image

The image is now checked with the trained images in the database and identified whether it is authenticated or not .Since the image we selected is not from the trained images in the database, we get the result as un-authenticated as shown in the below

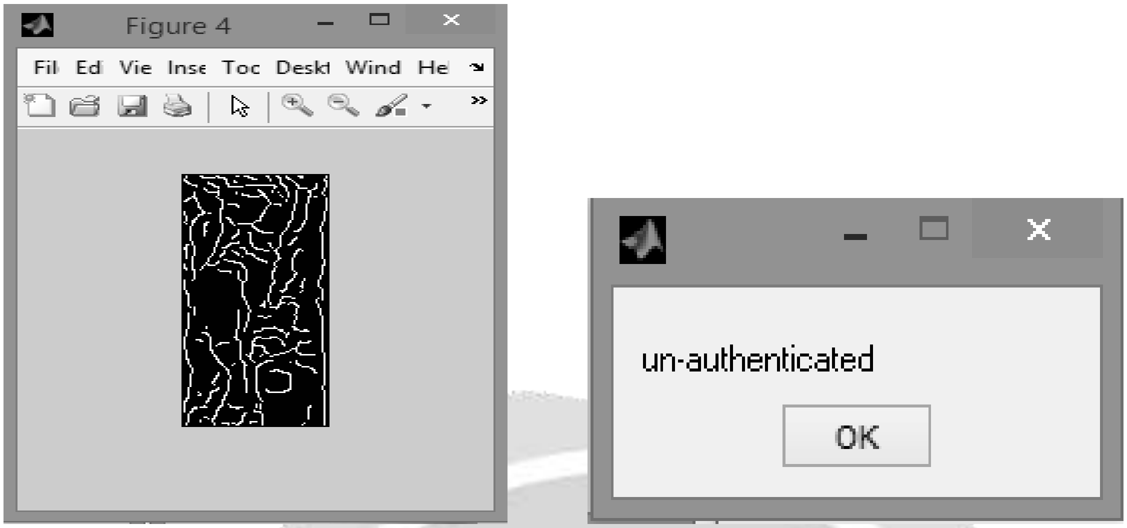


Fig-4.6: Un-authenticated image

The above un-authenticated notification may be due to the usage of damaged finger by the user. In this case, the user can proceed or continue with the transaction by using the face which would have been registered, trained and saved in the database as follows

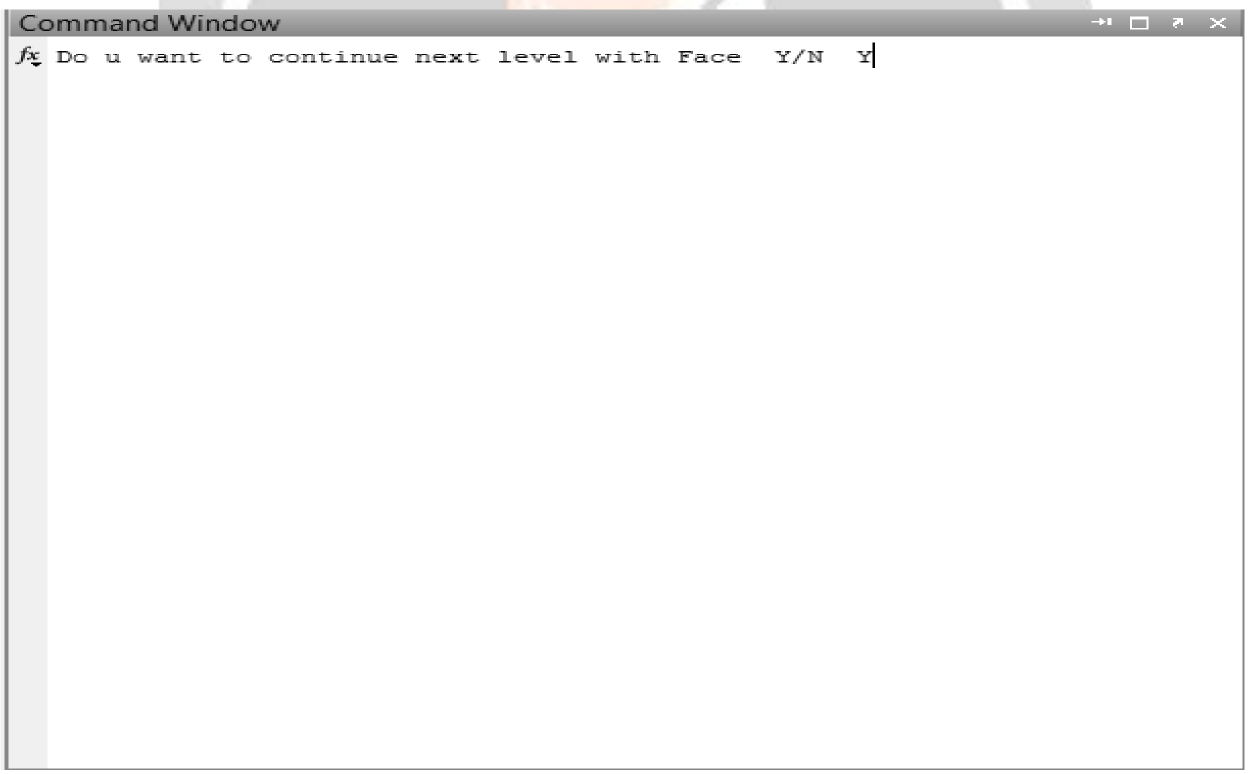


Fig-4.7: Command window

The face of the user is selected and the processing of the face image is done as follows. The image is browsed for further processing of cash transaction as shown

Figure 4.8 Selecting a face image

Various images are displayed and the image of the user is selected as shown

Fig-4.9 Selected face image

The required part of the face for further process is selected and checked

Fig-4.10 Feature selection

Thus the authenticated person is identified for further cash transaction by processing the input face image and the result is obtained because the selected image of the person is available in the database and hence he is an authenticated person for transacting cash from the ATM as shown

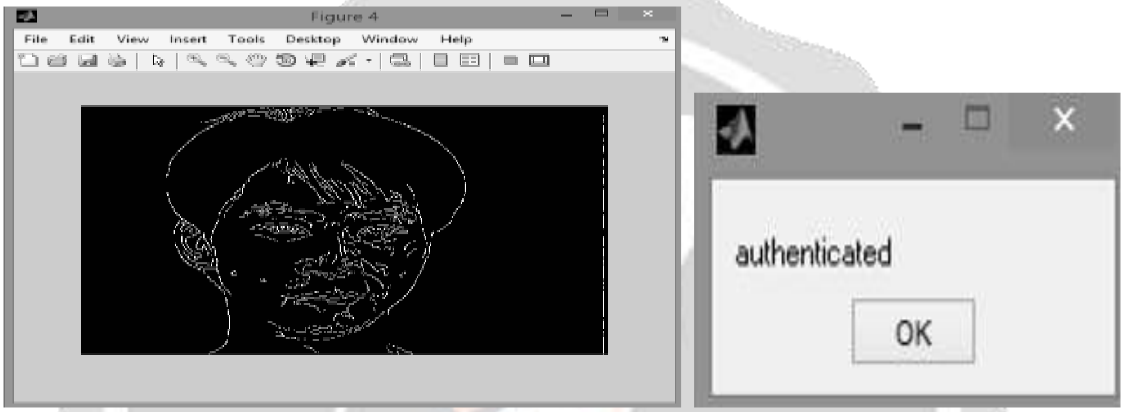


Fig-4.11: Feature detection and authentication

If the user does not want to continue with face,then the entry 'N' is given

Fig-4.11: Command window

The dialogue box if the user does not wish to continue appears below

Fig-4.12: Warning dialog box

The hardware part of our project is shown below in the fig-4.13.It consists of 16x2 LCD display which is used to display whether the person is authenticated or not, to display the pin and amount entered . The 4X4 keypad is the numeric keypad used to enter the pin number.The UART is the serial communication port which connects the system with the ATMEL microprocessor with the help of RS232 cable.The motor used in our project is used to indicate the cash transaction that operates when the authenticated image is selected or the buzzer buzzes if any other image apart from the trained image is selected which indicates that the person in un-authenticated.

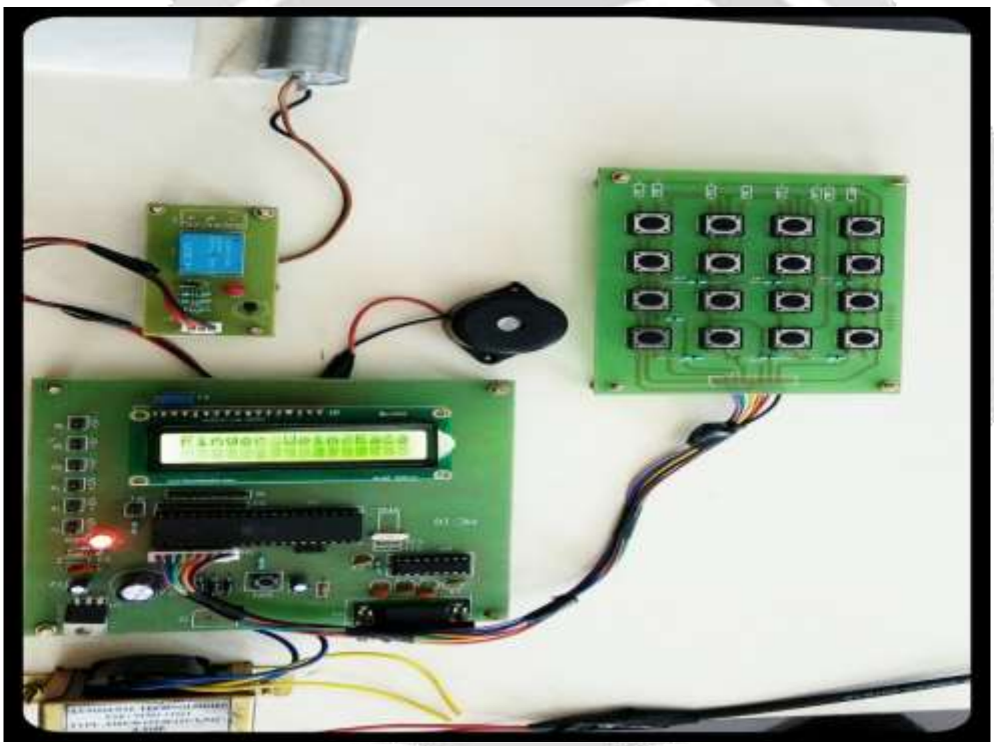


Fig-4.13: Hardware part

5. ADVANTAGES OF PROPOSED SYSTEM

The various advantages by using this proposed system is given in the following

- Veins are hard to duplicate or tantamount since they are present in the internal body and are unique for all humans, even for twins and does not change with age.
- Finger vein can be captured using low resolution camera hence its cost also low.
- Face recognition can be used if any damage occurs to the finger vein accidentally.

6. CONCLUSIONS

The main intention of the project is to implement biometric authentication system in ATM for cash transaction replacing cards using finger vein and if any situation arises where the finger of a person cannot be used, then the face of the same person can be used to proceed with the cash transaction. We use Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for extracting features of finger vein image and face image respectively. Thus finger vein and face recognition are combined in the proposed system for high security of the system. This system assures high security because the biometric authentication is taking over traditional passwords or card based authentication.

7. REFERENCES

[1]. Ajay Kumar and Yingbo Zhou (2012) 'Human Identification Using Finger Vein' IEEE Transaction on image processing, Vol.21, No.4.

[2]. Arun Ross, Sarat C. Dass, Anil k. Jain (2006) 'Fingerprint warping using ridge curve correspondences' IEEE.

[3]. Beining Huang, Yang gang Dai, Rong feng Li, Darun Tang and Wenxin Li (2010) 'Finger-Vein Authentication Based on Wide Line Detector and Pattern Normalization' International Conference on Pattern Recognition.

[4]. Dongjae Lee, Kyoungtek choi and Jaihie kim (2002) 'A robust fingerprint matching algorithm using local alignment', IEEE

[5]. D. Wang, J. Li, and G. Memik (2010) 'User identification based on finger vein patterns for consumer electronics devices' IEEE Transactions on Consumer Electronics, vol. 56, no. 2, pp. 799-804.

[6]. Jinwoo Kang, David V. Anderson, Senior Member (August 2016) 'Face Recognition for Vehicle Personalization with Near Infrared Frame Differencing' IEEE, and Monson H. Hayes, Life Fellow, IEEE, Vol. 62, No. 3.

[7]. P. Viola and M. Jones (2004) 'Robust Real-Time Face Detection' International Journal of Computer Vision, vol. 57, no. 2, pp. 137–154.

[8]. R. S. Ghiass, O. Arandjelovic, A. Bendada, and X. Maldague (2014)' Infrared face recognition: A comprehensive review of methodologies and databases, Pattern Recognition' vol. 47, no. 9, pp. 2807–2824.