Fingerprint Detection Technique using SURF, PHOG & PCA Feature Extraction Process

R.Balamurugan, S.Mythili, S. Perumal

Abstract: *The biometric way of identifying a person are wildly spared around many industries and organizations. The identification techniques followed for the biometric are mostly common in using fingerprint detection for individual identification. Basically password based security systems are cracked through many techniques, which makes many problem to the organization using password for security purpose. The spoof fingerprint way of identifying a person is becoming very famous in providing security to the users. The research work focuses on proposing a novel approach in merging fingerprint features all together in one static software approach. The features identified from the fingerprints are extracted using histogram equations in initial step of fingerprint security system. The Gabor wavelet transformation techniques is one of the images processing technique used for identifying features. The features are maintained carefully with applying dynamic score level integration. The efficiency of proposed work is checked with LivDet 2011 dataset. The rate of classification shows 9.625% and error rate is 2.27%.*

Keywords: Gabor filters, Pyramid Histogram of Oriented Gradients (PHOG), Speeded up robust features (SURF), Principal Component Analysis (PCA), texture analysis, Biometric Security,

I. INTRODUCTION

System authentication system is very essential part for making a valid entry into the system. The developers use many different techniques to access into the system for providing a secured way of accessing. Basic way of providing security to any system starts from generating password for identification. The evaluation of model era not only increases the technology of providing security to a system, it also gives a platform to many hackers to break the system illegally. The software developers are very keen to provide necessary support to the users in providing a best solution to solve the problem. The biometric way of system entry is mostly used technique for enhancing the security. Providing fingerprint for authentication process may solve some of serious issues in unauthorized user's entry. The security improvisation should also reduce the cost spent on implementation process. The organization and some of business process spent most of time and effort in deploying the secured way of authentication in identification process.

The organizations needs a best solution, which makes the security process very adaptive, easy way of response and flexible in different platform. The biometric way of authentication in analyzing the fingerprint of person is widely spread in different fields such as government sectors, schools, industries, healthcare centers, organizations, research centers, etc. The basic principal behind the process is to analyze the person's entry and avoid the unauthorized entry into the sectors. Some of different magnetic card entry and password entry are deployed in fingerprint authentication process. The system developed through fingerprint biometrics is also used for calculating hours spent by the employee in organization.

The image processing plays a major role in developing a biometric system based on fingerprint of a person. Different stages followed in image processing are very useful in categorizing the fingerprint into different parts and giving the validation process in secured way. The stages of image processing starts from collecting the necessary fingerprint images from the database and converting the images into system understandable mnemonics or coding. The first stage of image processing states from preprocessing of collected fingerprint images. The noise present in the images are removed along with the irrelevant parts of the collected images. The colored images are converted into system understandable gray scale images, which makes easy categorization in foremost image processing stages.

The second stage of image processing begins with resizing the images and enhancing the collected images. The resizing of collected fingerprint images are very useful identifying the different objects present in images. The resizing makes the image comfortable for processing the images through some of image processing tools such as MATLAB. The quality of the resized fingerprint image are improved with implementing the image enhancement technique [1].

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The filtering techniques are also implemented in quality enhanced images for selecting the varied object for authentication process.

Image processing uses various techniques such as wiener filter, Median filter, Gaussian Filter, etc. The fingerprint images undergone various filtering techniques for selecting particular sections in fingerprint images [2].

The feature extraction process in image processing are mostly avoided in many research work based on image processing, but this research work uses the feature extraction process as an important technique in selecting the necessary objects from fingerprint images.

The feature extraction process followed in this research work are Speeded up robust features (SURF), Pyramid Histogram of Oriented Gradients (PHOG) and Principal Component Analysis (PCA), which plays an important part in segmentation of fingerprint images.

II. RELATED WORKS

The authentication process with the use of biometric system are increasing more in number all because of its reliability and uniqueness in identification with security [3]. The fingerprint scanning system is most commonly used way of biometric way of identification system. The collected fingerprint information's from each and every employees are taken and stored for comparison process in every system of organization. Basic idea behind the fingerprint identification process is giving an unbreakable security system as well as it is easy to implement the portable password. The person don't have to remember password, because the password is fetched from the fingerprint of his own hand. The researchers are working hard in solving some of serious problems in security system of fingerprint authentication system. The False rejection ratio, false acceptance ratio for fingerprint images are useful in identification process [4]. Some of present system in authentication process have problems in identifying a correct persons, because of smart attacker's entry into the system.

The researchers are keen to take live fingerprint samples as well as samples from benchmark data base for creating and testing the security system of developed biometrics system. The facial biometric information's are also used for authentication process, which makes very similar approach to fingerprint detection system [5]. The fingerprint images are taken and converted into grayscale for easy way of conversion. The images are to be segmented before analyzing the difference in objects in fingerprint of different persons.

The converted fingerprint images are resized and undergone some of enhancement techniques for improving the quality of fingerprint images. The resizing process the method followed in image processing for better processing of the image processing tool such as MATLAB [6]. The techniques used in the research work produce best result in extraction process as well as in analyzing process.

The enhancement is another important image processing technique followed usually after the resizing stage. The quality of image have to be improved before going into the processing of image. The enhancement stage creates a platform for image processing tool to generate an accurate

results for segmentation and analyzing process [7].

Filtering technique is the next process followed after the enhancement process of fingerprint images. The necessary parts of fingerprint image are taken for consideration, hear some of important parts of fingerprint images are extracted with the help of filtering technique [8]. Gabor filtering technique, whiners, median filtering and Gaussian filtering are mostly used image processing technique for fingerprint images. Applying histogram equation and finding spoof in fingerprint are most essential part of the fingerprint authentication process [9].

The segmentation process followed after the enhancement techniques is essential part in finding out the parts of images. The objects are identified based on the technique and each and every spoof of fingerprint are also identified carefully. Feature extraction techniques used in many research work are common in using Principal component analysis for extracting necessary fingerprint features from images [10].

III. PROPOSED METHODOLOGY
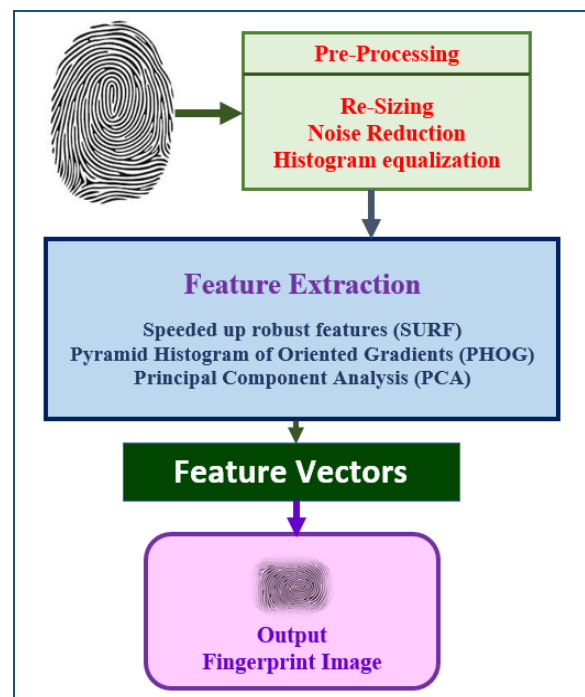
Figure 1 Proposed Fingerprint Classification Technique

A. Image preprocessing

The techniques used for cleaning unwanted parts of images and irrelevant noises are removed initially using image preprocessing techniques. The image collecting techniques implemented are used for reclaim an image from a rare places, commonly it is depend upon the hardware source, thus it can be accepted through whatsoever processes require to come about later. It perform image gaining in image processing is all the time, the main step in the workflow order because, exclusive of an image, no processing is achievable.

The image that is reached is entirely untreated and is the result of whatever hardware was used to produce it, which can be very important in some areas to have a reliable standard from which to work.

B. Feature Extraction

In impression verification systems, the image is generally captured from various subjects by using the dissimilar scanners. Hence, impression images are usually obtained to be of different scales and rotations. In definite situations, the fingerprint images are partly taken caused by human errors. Sequentially to acquire features that are invariant to these troubles, various geographies use which capture properties of live impression images. In this work, choose to employ SURF as it is invariant to explanation, scale and rotation. SURF is also utilized because of its brief descriptor length. Although SURF is invariant to object alignment and scale alteration, it is not invariant to geometric transformations. Therefore, sequentially to recompense the restrictions of SURF, PHOG descriptors are used to extract local shape information to achieve more different features. Additionally, Gabor wavelet geographies are also combined for texture analysis.

C. Feature Reduction using PCA

Extreme structures increase totaling times and storage memory. Moreover, from time to time they make classification more difficult that is called the curse of dimensionality. It is necessary to decrease the number of features. PCA is an efficient tool to diminish the measurement of a data set comprising of a large number of consistent variables although keeping most of the variations.

D. Classification Algorithms

This technique procedure is done over the mined features. Here, key innovation is the acceptance of SVM and Random Forest. RF and SVM classifier is practical over the features and the classification.

IV. RESULTS AND DISCUSSION

The Fingerprint images taken are gone various stages of simulation using MATLAB analyzing tool. The tool helps in classifying fingerprint images into various sections and implementing various image processing techniques. The existing algorithms and proposed algorithm are tested with benchmark fingerprint images.

Initial step of image processing follows noise removal, applying filtering techniques and enhancing image quality. The necessary features are identified and used for classification techniques. The classification algorithms are applied and results are gathered. The proposed algorithm techniques are checked for accuracy with other existing classification algorithms in analyzing stage.

Image enhancement is follows usually after the preprocessing techniques in Image Processing. The enhancement techniques followed in the research work helps in improving the clarity of the fingerprint images. Some of enhancement technique followed in this research work are discussed as follows.

- Applying Histogram Equalization
- Implementing De-correlating Stretching technique
- Dynamic range for remapping
- Gamma value for size adjustment
- Applying filtering techniques with linear and median filters
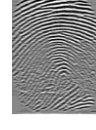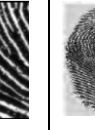
A. Analyzing Fingerprint Images

Analyzing fingerprint images is most important part of the research work, which works with features identified after the enhancement techniques. The statistical analyzing techniques followed in this research work are as follows.
Statistical functions for fingerprint analysis

- Calculating the Standard Deviation and Mean for fingerprint images
- Determining line segment and intensity values.
- Histogram image Display
- Intensity value Plotting

Edge-detection Technique for fingerprint identify boundaries of fingerprint images. The edge detection techniques contains the Sobel, Prewitt, Roberts, Canny, and Laplacian of Gaussian methods, which helps in identifying each and every corners of fingerprint images.

Table 1 Fingerprint images with various stages

Original Image	Gray Conversion	Image Resize	Noise Reduction

Gabor wavelet	Spoof fingerprint	Histogram Equations

B. Detected Fingerprint

The collected Fingerprint images undergone various image processing techniques for detecting objects and parts of finger print. Figure 2 shows the features identified after applying the features identification techniques. The green lines shows the identified parts of spoofs in fingerprint images. The blue lines indicates the accurate feature plotting rate with spoof detection of fingerprint.

C. Detected Features

The identified features of fingerprint are shown in figure 3. Difference in color indicates the variations in features identified from fingerprint images. The difference in color can be a main factor taken for comparison process while taking different fingerprints samples.

D. Feature Plot

Identified features from fingerprint images are separated with depth value as shown in figure 4. The depth values differs from person to person, which makes massive difference in fingerprint identification process.
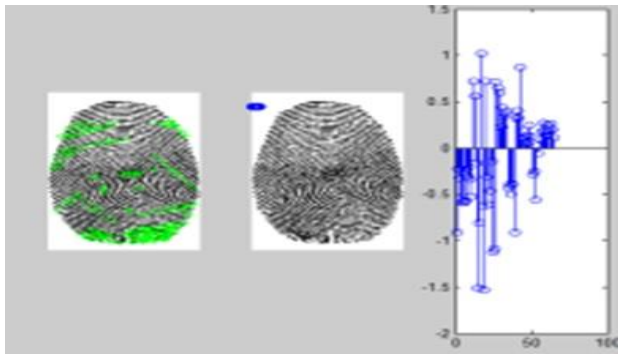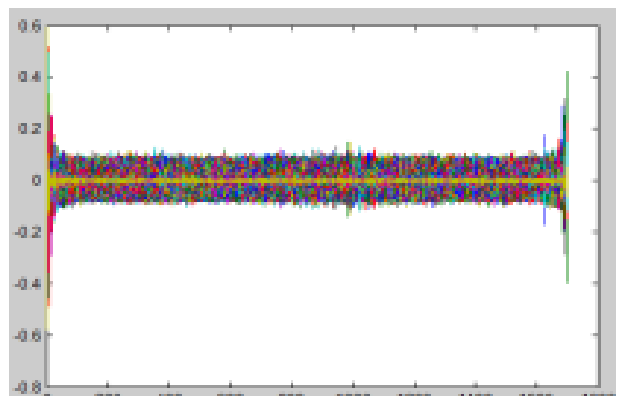
Figure 2 Fingerprint feature plotting

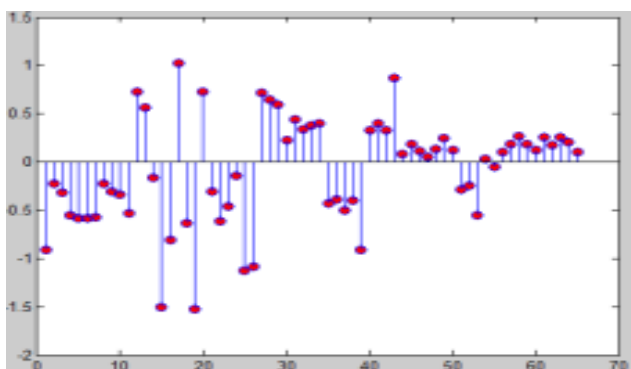**Figure 3 Fingerprint identified features**

Figure 4 Features plot depth value

V. CONCLUSION

The fingerprint detection techniques followed in this research work are unique in using various image processing technique in feature identification and classification process. The existing work in fingerprint identification process are minimal in using few filtering techniques and feature classification techniques. This research work shows the importance in using the proper preprocessing techniques and feature extraction process before analyzing the fingerprint images. Some of wavelet transformation process used in this research work helps in resizing the fingerprint images. The classification process are also carried after identifying the features makes the detection process very efficient. The proposed work shows very less error rate while comparing the process with few existing classification techniques.

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