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.

Revised Manuscript Received on September 15, 2019
Mr. R. Balamurugan, Department of Computer Science, School of computing Sciences, VISTAS, Chennai, India. Email: balaphd09@gmail.com.

Mrs. S. Mythili, Department of Computer Science, School of Computing Sciences, VISTAS, Chennai, India. Email: dhanarblitha@gmail.com.

Dr. S. Perumal , Department of Computer Science, School of Computing Sciences, VISTAS, Chennai, India. Email: perual_70@rediffmail.com.
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 collected fingerprint 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

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 |
|----------------|-----------------|--------------|----------------|
| ![Image 1](image1.png) | ![Image 2](image2.png) | ![Image 3](image3.png) | ![Image 4](image4.png) |

Gabor wavelet | Spool fingerprint | Histogram Equations

B. Detected Fingerprint

The collected Fingerprint images undergone various image processing techniques for detecting objects and parts of fingerprint. Figure 2 shows the features identified after applying the features identification techniques. The green lines shows the identified parts of spools in fingerprint images. The blue lines indicates the accurate feature plotting rate with spool 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.
Fingerprint Detection Technique using SURF, PHOG & PCA Feature Extraction Process

V. CONCLUSION

The fingerprint detection techniques followed in this research work are unique in using various image processing techniques 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.

REFERENCES

1. S. Arunanarai, R. Gobinath, “A survey on multimodal biometrics for human authentication”, International Journal of Engineering & Technology, vol. 7 (2.33) (2018) 273-278, 2018.
2. K. Nandakumar, Ychen, S.C. Dass and A.K. Jain, “Likelihood Ratio – based Biometric Score fusion”. IEEE Transaction on Pattern Analysis, Vol 30 Feb 2008. PP -342-347.
3. Mohammad Imran, Hemantha, “Accurate Person recognition on combining signature and fingerprint”, International Journal of Machine Intelligence ISSN: 0975-2927 Volume 3, Issue 5, 2011 PP277-281.
4. Shi – Jin Horng, Kevin OctavisSentosla, “An Improved Score lev-el fusion in Multimodal Biometric systems” IEEE ISSN 7695 -3914. 2009.
5. Dharmarajan, K., and M. A. Doniarangaswamy. “Discovering User Pattern Analysis from Web Log Data using Weblog Expert”. Indian Journal of Science and Technology 9.42 (2016).
6. A.K.Jain, Arun Ross, S.Prabakar, “An Introduction to bometric recognition”, IEEE Trans. Circuits and Systems for Video Technol-ogy Special issue on image and video based biometrics, vol 14, PP 4-20, January 2004.
7. A.Ross and A.K. Jain “Information fusion in, Pattern recognition letters” vol-24, 2003 PP.2115-2125.
8. Kames Vishi, SuleYildirimYayilgen. “Multimodal Biometrics Au-thentication using fingerprint and IRIS” IEEE 2013 PP.334-341.
9. MingxingHea, Shi-Jinhorng, “Performance evaluation of score level fusion in multimodal biometric systems” Volume 43 Issue 5 (2010) 1789 – 1800.
10. KamelAizi, Mohamed ousslim, Ahmed sabri “Remote multimodal Biometric identification based on the fusion of the iris and the fin-gerprint”. IEEE 2015 ISSN: 4673-6673.

AUTHORS PROFILE

Mr. R. BALAMURUGAN obtained M.C.A from M.K. University and submitted Ph.D thesis in Bharathiyar University. Having 18+ years of experience in teaching and currently working as Assistant Professor in Department of Computer Science, Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai. Published 5 Scopus indexed Journals and more than 10 publication in peer reviewed Journals. The area of interest include Data Mining, Business Analytics, Machine learning.

Mrs. S.Mythili, Research Scholar, Department of Computer Science, School of computing Sciences, Vels Institute of Science Technology and Advanced Studies (VISTAS). Now working as Teacher, Department of computer science, SBOA Global School, Chennai. She guiding students in the Projects for CBSE; Developing App; Learning New Languages in Computer Science and Techniques. Having an experience of teaching young minds for 15 years and molding them with the necessary skill need for current scenario both academically and life skills.

Dr. S.PERUMAL is working as an Associate Professor in Department of Computer Science, School of Computing Science, Vels Institute of Science, Technology and Advanced Studies(VISTAS) Deemed to be University, Chennai. He holds a Ph.D. Degree in Computer Science from Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai. M.Phil. degree in Computer Science from Periyar University, Salem, Tamil Nadu, Master of Science in Computer Science from Bharathidasan University, Tiruchirappalli, Tamil Nadu, and Bachelor of Science in Computer Science from Madras University, Chennai, Tamil Nadu, India. He has published more than 25 research articles in both national and international levels including conference proceedings. He has guided more than 40 M.Phil. Research Scholars in Computer Science. Published by refereed international journals. He has more than 23 years of experience in teaching. His current research interests include Image Processing, Big Data Analysis, Data Mining and Advanced Networking.

Figure 3 Fingerprint identified features

Figure 4 Features plot depth value