UGC - MINOR RESEARCH PROJECT

PERFORMANCE OF BIO-METRIC PATTERN RECOGNITION IN AADHAAR CARD

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Summary of Report

Report Submitted To

The Joint Secretary and Head
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University Grants Commission
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INTRODUCTION

Authentication in any process by which you verify that someone is who they claim they are. This usually involves a username and a password, but can include any other method of demonstrating identity, such as a fingerprint, iris recognition, retina scan or voice recognition. In aadhaar card also authentication is done using fingerprints and iris recognition. Among all the biometric techniques, fingerprint-based identification has been successfully used in numerous applications. So in this project first, the analysis on fingerprint patter identification was done.

OBJECTIVES OF THE PROJECT

- ✓ Evaluating the performance of biometric-pattern recognition (Fingerprint, Iris) in aadhaar card.
- ✓ The overall performance of a biometric system is assessed in terms of its accuracy, speed, and storage.
- ✓ Find the efficiency of other factors, like cost and ease-of-use.
- ✓ Evaluating the Biometric systems which are not perfect, and will sometimes mistakenly accept an impostor as a valid individual (a false match) or conversely, reject a valid individual (a false non match).
- ✓ Performance of biometric pattern recognition (Fingerprint, Iris) using artificial neural network.

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FINGERPRINT

Fingerprints are the best and most widely used form of biometric authentication. Everyone is known to have unique, immutable fingerprints. Fingerprints are secure to use because they do not change in one's lifetime. Since fingerprints are unique, even between identical twins, they are perfect for various security uses. The goal of biometric authentication system is to compare two fingerprint images. The authentication in aadhaar card is done by this comparison. Human fingerprints are rich in details called minutiae, which can be used as identification marks for security purposes. Fingerprint authentication systems are based on local ridge features known as minutiae extraction, marking minutiae accurately and rejecting false ones.

The fingerprint images are the important data's for this project. The fingerprint images are collected by image acquisition systems based on the technology such as FTIR, CMOS, Ultrasound, etc.. However, fingerprint images get degraded and corrupted due to variations in skin and impression conditions. To get accurate minutiae, image enhancement techniques are employed prior to minutiae extraction. Fingerprint minutiae detail is shown in Figure 1**.**

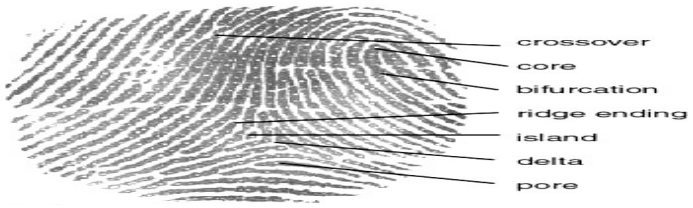

Figure 1. Fingerprint image with minutiae details

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IRIS

The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by iris recognition system, their eye is first photographed and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is identified or no match is found and the subject remains unidentified. A front-on view of the human eye is shown in Figure 2.

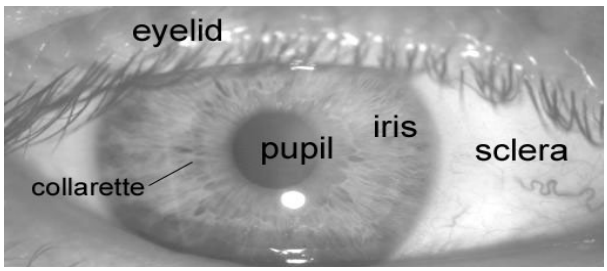

Figure 2. A front-on view of the human eye.

Compared with other biometric technologies, such as face, speech and fingerprint recognition, iris recognition can easily be considered as the most reliable form of biometric technology. There is a lack of publicly available datasets for testing and research and the test results published have usually been produced using carefully imaged irises under favorable conditions.

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METHODOLOGY

The implementation of this project is an effort to understand how fingerprint and iris identification is used as a form of biometric to recognize identities of human beings. This project discussed about the classification fingerprint and iris images to verify the identity of fingerprint an iris.

The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as by features called Minutiae. Minutiae are divide two types such as, Bifurcation and Termination. The Minutiae extraction process includes image enhancement, image segmentation and final Minutiae extraction using the operations such as Ridge Thinning, Minutiae Marking, False Minutiae Removal and Minutiae Representation. Then the extracted minutiae are classified using Support Vector Machine (SVM). Fingerprints are classified into five classes (arch, tented arch, left loop, right loop and whorl).

A model of SVM is to be designed and trained to recognize the finger code of the databases that are actually used. An imaging system that converts each fingerprint image in finger code or minutiae matrix code. The result is that each fingerprint images is represented as a vector of 256 real values. Support vector machines classifies data by finding the best hyper plane that separates all data points of one class from those of the other class.

Moreover Hough transform and Hamming distance are implemented in iris recognition system in order to verify the claimed performance of the technology. The development tool used will be MATLAB®, and emphasis will be only on the software for performing recognition, and not hardware for capturing an eye image. A rapid application development (RAD) approach will be employed in order to produce results quickly.

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RESULTS AND OBSERVATION

- **PERFORMANCE OF FINGERPRINT PATTERN IDENTIFICATION**

A fingerprint database from the NIST-4 (National Institute of Standards and Technology Special Database) is used to test the program's performance. The fingerprint classifications are considered as arch, left loop, right loop, whorl and tented arch. Support Vector Machine (SVM) algorithm has been applied for the classification of fingerprint. In this paper 30 dataset are used to train the algorithm. In this algorithm a two-step procedure is used for fingerprint image classification. The first step computed the singularity points on the fingerprint image based on the maximum variation of its local orientation and the second step classified the fingerprint based on the location of the detected core and delta points. Finally, classified the fingerprints into five groups, that is, whorl, right loop, left loop, arch and tented arch. The experimental result of fingerprint image achieved 93.3.% correct classification of fingerprint is shown in Table 1 and Figure 3.

S.no.	Type		Output	
	Name	Code	Target	SVM
1	Arch	1	9	9
2	Left loop	2	9	8
3	Right loop	3	2	2
4	Whorl	4	8	7
5	Tented arch	5	2	2
		Total	30	28
		Accuracy	28/30 = 93.3%	

Table:1 Accuracy of Fingerprint Identification

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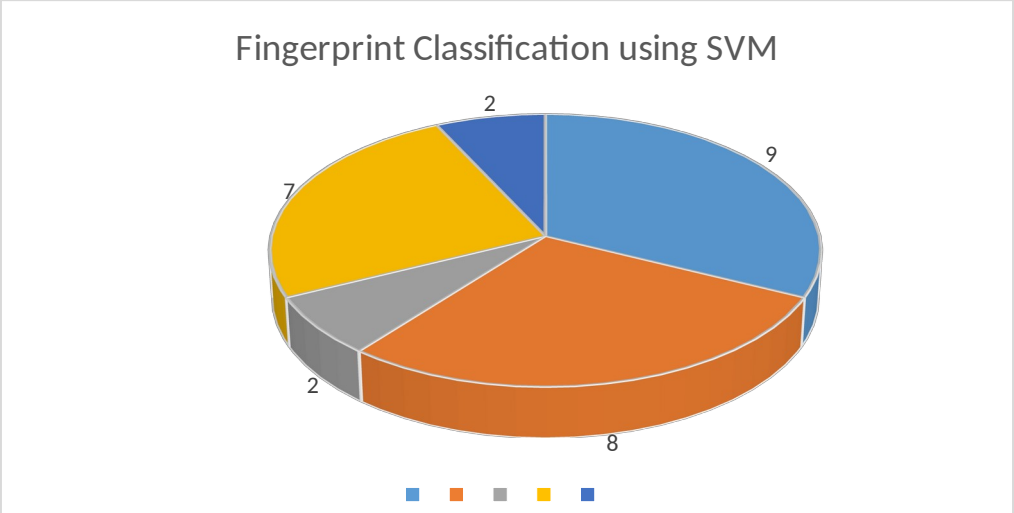

Figure 3. Fingerprint types Classification

Figure 3 represents thirty datasets trained for minutiae extraction using SVM algorithm. The number of termination orientation values for applied for false minutiae removal and applied for region of interest then create the mask and suppress the minutiae values. Twenty eight datasets in the table were properly classified the fingerprint types and two datasets were not suitable for this algorithm.

- **PERFORMANCE OF IRIS PATTERN IDENTIFICATION**

The automatic segmentation model proved to be successful. The CASIA database provided good segmentation, since those eye images had been taken specifically for iris recognition research and boundaries of iris pupil and sclera were clearly distinguished.

The significance of this methodology is in identifying accurately the iris of the corresponding gender based on the comparison of iris features. The performance of a gender classification categorization system is usually measured in terms of accuracy or error rate. The accuracy is defined as per the expected result and the actual result based on the classification. The accuracy of the gender detection shown in Table 2 and Figure 4.

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Pattern Type	No. of Images	Expected result	Actual result
Female	25	25	22
Male	25	25	25
Total	50	50	47
			Percentage : 47/50*100 = 94

Table:2 Accuracy of Gender Detection

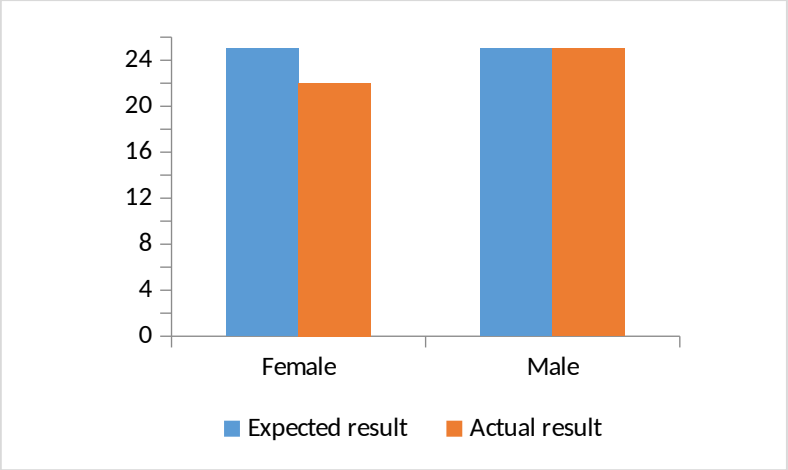

Figure 4. Iris Image Classification

In this paper, the eye images used for processing are obtained from the camera. Performance of the work can be enhanced if the system uses only the quality images. This proposed methodology uses canny edge detection with Circular Hough transform to segment iris images for locating the iris. Then the featured values such as mean and standard deviation are extracted from the segmented image. Finally, the gender was detected based on the featured values using Hamming distance. The gender is detected with an accuracy rate 94.00%. In the near future neural network based classification developed using SVM.

CONCLUSION

This project discussed about the identification of Fingerprint and Iris pattern images which is used in Aadhaar card as a form of biometric to recognize identities of human beings. The project was an effort to analyses the performance of fingerprint and iris pattern identification. In fingerprint identification, various standard techniques are used in the intermediate stages of processing and extract minutiae from fingerprints and classified into five classes.

In Iris identification, an automatic segmentation algorithm circular Hough transform was presented, which would localize the iris region from an eye image and isolate eyelid, eyelash and reflection areas. Next, the segmented iris region was normalized to eliminate dimensional inconsistencies between iris regions. Finally, features of the iris were encoded by convolving the normalized iris region. The Hamming distance was chosen as a matching metric, a failure of statistical independence between two templates would result in a match.

The taken work in this project has reached its success in accuracy. Better result has been achieved in the identification of fingerprint pattern with 93 percent precision, using the SVM and in iris pattern with 94 percent precision with Circular Hough transform. So the identification pattern of fingerprint and iris will do better in aadhaar card also. This work will help in the research progression as much as possible. The result offers hope for the more research works related to this subject. Future research work can be carried out to improve the quality of the image by improving the image enhancement technique and develop a better matching technique.

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PUBLICATIONS

S.No.	TITLE	JOURNAL	STATUS
1.	High Sensitive Approach For Gender Detection Based On Human Iris	International Journal Of Engineering Research In Computer science And Engineering(IJERCSE), Vol 5,Issue 3, March 2018, pp.137-141	PUBLISHED
2	Performance Of Fingerprint Enhancement and Classification using Neural Network	International Journal Computer Application (IJCA), Volume 1, Issue 8, Jan - Feb 2018, pp. 193-206.	PUBLISHED
3.	Biometric security Analysis using Neural Network	Indian Journal of Engineering, 2016, 13(34), pp.557-571.	PUBLISHED

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