
FINGERPRINT RECOGNITION SYSTEM

Sankalp Bhalerao^{*1}, Lakshya Vyas^{*2}, Rishal Gedam^{*3}, Rajat Soni^{*4}

^{*1,2,3,4}Electronics and communication, Medicaps University, Indore, M.P, India

DOI : <https://www.doi.org/10.56726/IRJMETS36450>

ABSTRACT

For a long time it has been observed that security is a major concern regarding privacy may it be local or global. Technology is growing rapidly and with this rapid growth breaching of security has been observed. The transformation consist from security or pincode to design pattern. Nowadays fingerprint recognition is emergent technology. This paper implement the Histogram of Gradient Algorithm and check if one can use it for Fingerprint Recognition. Fingerprint Recognition is very important in today's world and is used as security measure in a lot of things. Another reason for the popularity of fingerprints is the relatively low price of fingerprint sensors, which enables easy integration into PC keyboards, smart cards and wireless hardware. And in this study we explore HOG which is usually used in face recognition while fingerprint uses minutiae based algorithm. We also try to explore the optimal settings of Fingerprint image to receive the best accuracy in the model.

I. INTRODUCTION

Fingerprints are virtually unique to every individual, consistent across a lifetime and are mostly ubiquitous. These factors make fingerprint identification a useful biometric for identifying a person, as it is incredibly unlikely to be duplicated, have a false positive or brute force. Fingerprint recognition requires a minimal effort from the user, does not capture 55 other information than strictly necessary for the recognition process, and provides relatively good performance. Another reason for the popularity of fingerprints is the relatively low price of fingerprint sensors, which enables easy integration into PC keyboards, smart cards and wireless hardware. We have different techniques to uniquely identify a fingerprint some are:

- Correlation-based matching,
- Minutiae-based matching
- Non-Minutiae feature-based matching.

The “minutiae” – a pattern of ridges and valleys in a finger – are the most notable and distinct feature of a fingerprint, which makes them ideal to be captured in fingerprint identification. A human fingerprint consists of ridges and valleys on the finger's surface which are distinctive for every person and used to identify a person. The upper skin layer segments of the finger are called ridges and the lower skin layer segments are called valleys. The various patterns of ridges and furrows, the minutiae points, decide the uniqueness of a fingerprint.

II. METHODOLOGY

Major ways in Fingerprint Recognition applying Matlab

- Specifics Absorbition from Fingerprint Image
- Various Patterns of Features/Details
- Conventional Style of specifics Extraction
- Thinning
- Quality
- Detection
- Fingerprint Image Segmentation
- Specifics Extraction from Fingerprint Image
- Specifics Matching between Fingerprint Images

operation increases the contrast of the output image.

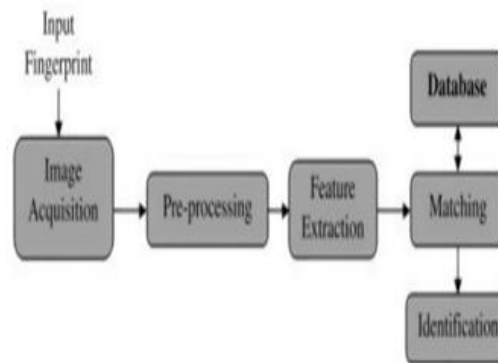


fig.1 (Steps in fingerprint recognition)

III. HISTOGRAM OF GRADIENT WITH FINGERPRINT

Feature Based technique using HOG Feature represents a fingerprint by dividing it into blocks and computing histogram of the orientation field of each block. HOG uses point based gradient to compute the orientation field of each block, which is not robust against noise and not adapted to the ridge patterns. Ridge orientation plays the key role in all fingerprint recognition systems and if there is any error, the performance of the system will degrade. In view of this, modification of the HOG descriptor that captures the ridge orientation field in a better way and is robust against noise. The downloaded data is present in the Zip file, extract the data from the zip file and then data is moved to the current directory, from where data is read using the MATLAB program for preprocessing. Preprocessing includes converting the image into double, resizing the image etc. We divide data into 2 parts, one for training and one for testing. We use 50% of the data. That is 4 for training and 4 for testing. The database contains 8 images of fingerprints of 10 persons. For Reading Image use `A = imread(filename)` reads the image from the file specified by filename, inferring the format of the file from its contents. And convert it to Grayscale to make processing faster and easier using, `I = im2gray(A)` converts the specified true color image RGB to a grayscale intensity image I. The `im2gray` function accepts grayscale images as inputs and returns them unmodified. The `im2gray` function converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance. 25 Now convert it double from default unsigned int 8 type for images to perform calculation using, `I = double(I)` converts the values in X to double precision. double is the default numeric data type (class) in MATLAB, providing sufficient precision for most computational tasks. Numeric variables are automatically put up as 64-bit (8-byte) double-precision floating-point values. Then we fit the intensity of the image using another MATLAB function, `J = imadjust(I)` maps the intensity values in grayscale image I to new values in J. By default, `imadjust` saturates the bottom 1% and the top 1% of all pixel values. This operation increases the contrast of the output image J. This helps by making the feature points sharper and clearer for detection. After this we resize the image to a standard 1:2 ratio to pass it for feature extraction. The setting 128:256 as it provides us the best results. The function, `img = imresize(J,[numrows numcols])` returns image B that has the number of rows and columns specified by the two-element vector [numrows numcols]. For `a=101:110` for `b = 1:4` `fname = strcat('DB3_B\','int2str(a),'_',int2str(b),'.tif')`; `img = im2gray(imread(fname))`; Code snippet for reading the image into MATLAB from the database.

IV. FEATURE EXTRACTION

HOG, or Histogram of Oriented Gradients, is a feature descriptor that is often used to extract features from image data. It is widely used in computer vision tasks for object detection. Let's look at some important aspects of HOG that makes it different from other feature descriptors:

- The HOG descriptor focuses on the structure or the shape of an object. Now one might ask, how is this different from the edge features we extract for images? In the case of edge features, it only identify if the pixel is an edge or not. HOG is able to provide the edge 26 direction as well. This is done by extracting the gradient and orientation (or you can say magnitude and direction) of the edges.

- Additionally, these orientations are calculated in 'localized' portions. This means that the complete image is broken down into smaller regions and for each region, the gradients and orientation are calculated.
- Finally the HOG would generate a Histogram for each of these regions separately. The histograms are created using the gradients and orientations of the pixel values, hence the name 'Histogram of Oriented Gradients'

The inbuilt MATLAB function is used to extract features. `features = extractHOGFeatures(I)` returns extracted HOG features from a truecolor or grayscale input image, `I`. The features are returned in a 1-by-N vector, where N is the HOG feature length. The returned features encode local shape information from regions within an image. one can use this information for many tasks including classification, detection, and tracking. `[_, visualization] = extractHOGFeatures(I,_)` optionally returns a HOG feature visualization, using any of the preceding syntaxes. You can display this visualization using `plot(visualization)`. To show how HOG feature works visualization of a fingerprint is shown in figure below it shows how precisely it identifies the shape of fingerprint and saves the features in an 1*15120 matrix. It is a global fingerprint technique in which you do not have to identify individual identification points. The features do that work.

V. RESULT AND DISCUSSION

The highest accuracy achieved by the model is 75%, using the settings which are listed as Final Settings. The optimal settings like image size, binarization, normalization, these settings can be used in further models to get the best results. In this study the usability of Histogram of Gradient in Fingerprint Recognition has been checked. It shows 75% accuracy without enhancement algorithm so this algorithm can be used in further fingerprint recognition. Thus in conclusion HOG can be used for fingerprint recognition in future by the optimal settings.

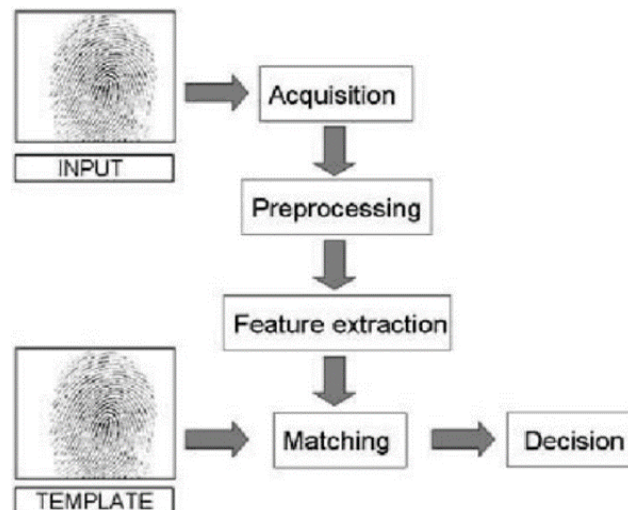


fig.2 (data flow diagram)

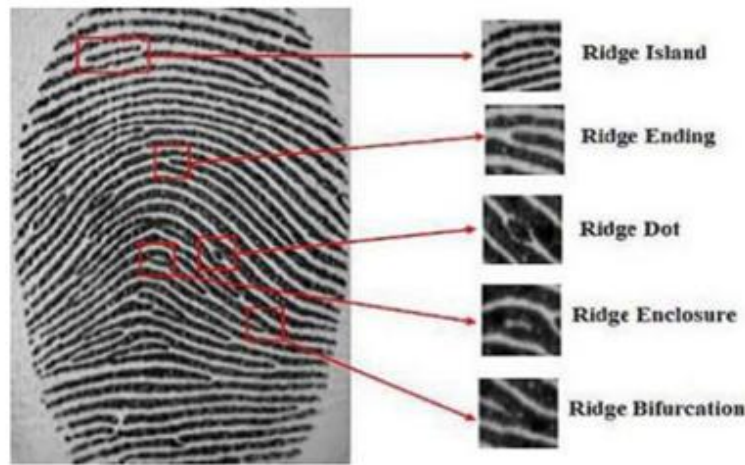


fig.3 (fingerprint with features)

Name	Value	Name	Value
a	110	a	110
accuracy	0.6000	accuracy	0.6333
b	4	b	5
c	110	c	110
classifier	1x1 Classification...	classifier	1x1 Classific...
confMat	10x10 double	confMat	10x10 double
d	8	d	8
filename	'DB3_B\110_8.tif'	filename	'DB3_B\110_...
fname	'DB3_B\110_4.tif'	fname	'DB3_B\110_...
hogsz	1728	hogsz	1728
i	41	i	51
img	480x300 logical	img	480x300 logi...
j	41	j	31
labels	40x1 double	labels	50x1 double
numimg	40	numimg	50
predictedLab...	40x1 double	predictedLab...	30x1 double
rszimg	64x128 logical	rszimg	64x128 logica...
testft	40x1728 double	testft	30x1728 dou...
testimg	480x300 logical	testimg	480x300 logi...
testLabels	40x1 double	testLabels	30x1 double
trainingft	40x1728 double	trainingft	50x1728 dou...

fig4 (Results in Different setting)

Different settings along with accuracy achieve

• With Binarize: 60%	}	Block 8:8 Image Size 64:128
• Without Binarize: 67%		
• Image Size 128:256 = 70%	}	No Binarize Block 8:8
• Image Size 64:128 = 67%		
• Block 8:8 = 70%	}	No Binarize Image Size 128:256
• Block 2:2 = 72%		
• Block 4:4 = 75%		
• Block 4:4 = 62%	}	Image Size 64:128

No significant changes from adjust function.

VI. CONCLUSION

It can be used as image improvement algorithms which include contrast stretching, slicing, histogram equalization, and some algorithms grounded on the retinex [5–11], etc. Optimization algorithms may be grouped into those that use derivatives and those that do not. Classical algorithms use the first and occasional alternative outgrowth of the objective function. Optimization algorithms can also be used. Dimensionality reduction refers to ways for reducing the number of input variables in training data. Dimensionality algorithms can be used to drop the size of feature table and make the processing quick. Eg. of Dimensionality Reduction algorithms :LDA,PCA,GDA.

VII. REFERENCES

- [1] F. Saeed, M. Hussain, and H. A. Aboalsamh, "Classification of Live Scanned Fingerprints using Histogram of Gradient Descriptor," 2018 21st Saudi Computer Society National Computer Conference (NCC), 2018, pp. 1-5, doi: 10.1109/NCC.2018.8592949.

-
- [2] A. P. Srivastava, S. Awasthi, A. K. Kaushik and S. Shukla, "Fingerprint Recognition System using MATLAB," 2019 International Conference on Automation, Computational and Technology Management (ICACTM), 2019, pp. 213-216, doi: 10.1109/ICACTM.2019.8776680.
- [3] Tian and Y. Peng, "Research of the Matlab application in the fingerprint identification system," 2012 International Conference on Image Analysis and Signal Processing, 2012, pp. 1-5, doi: 10.1109/IASP.2012.6425005.
- [4] T. Sarala, N. S. Ashwini, N. Swathi, and K. V. Anil, "Fingerprint Authentication by Image Processing using Hartley Discrete Wavelet Transform," 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT), 2018, pp. 1709-1714, doi: 10.1109/RTEICT42901.2018.9012100.
- [6] [https://in.mathworks.com/help/matlab/creating_plots/image-types.html#:~:text=An%20RGB%20MATLAB%C2%AE%20array,1\)%20is%20displayed%20as%20white](https://in.mathworks.com/help/matlab/creating_plots/image-types.html#:~:text=An%20RGB%20MATLAB%C2%AE%20array,1)%20is%20displayed%20as%20white).
- [7] <https://www.intechopen.com/chapters/1774>
- [8] <https://www.sciencedirect.com/topics/computer-science/fingerprint-recognition>