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Palmprint Authentication Using SIFT

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Abstract—Palmprint identification has proven to be one of the popular and promising biometric modalities for forensic and commercial applications. In recent years the contactless system emerged as a viable option to address hygienic issues and improve the user acceptance. The presence of significant scale,rotation,occlusion and translation variations in the contactless palmprint images requires the feature extraction approaches which are tolerant to such changes. Therefore the usage of traditional palmprint feature extraction methods on contactless imaging schemes remains hot topic of search and hence all/popular palmprint feature extraction methods may not be useful in contactless frameworks. This paper we systematically perform the feature extraxtion method using SIFT related to the contactless palmprint authentication and presents performance evaluation on the IITD public database. Our experimental results on more than 300 images from databases It suggests that the Scale Invariant Feature Transform (SIFT) features perform significantly better for the contactless palmprint images than other approach employed earlier on the more conventional palmprint imaging.The achieved error rates show a good performance of these features.

Index Terms— Biometrics,Palmprint imaging,SIFT,Matlab basics,ROI,Edge detector**.**

I. INTRODUCTION

The hand based biometric authentication systems have achieved very much attention since last decade.Hand geometry based identity authentication like DNA,fingerprint,vein pattern and finger knuckles are among other biometrics apart from palmprint but later is considered better and efficient as earlier systems were costly as it required sensors and not much demanding in security applications like home security systems,computer systems,restricted entry control,etc.Hand based systems goes from earlier systems based on guiding pegs to the systems which are pegfree.To address hygienic issues and improve user acceptance,the contactless systems emerged as an viable option.Using the palmprint features is one of the personal authentication system suitable for network based applications.The authentication system consists of enrollment and verification stages.In enrollment,the training samples are collected and processed by pre-processing,feature extraction and modeling modules to generate the matching templates.In verification,a query sample is also processed by pre-processing and feature extaction method and then is matched with reference templates to decide whether it is sample or not.A setup system consisting of a palmprint based authentication system can work with multipurpose camera in an uncontrolled circumstances like mounted on a laptop,mobile device.These systems have got significant practical value and features can be extracted with less computational effort.Unlike earlier biometric systems,it does not require equipment and have attained higher accuracy value equivalent to fingerprint.We used SIFT method,Scale-invariant feature transform (or SIFT) is an algorithm in computer vision to detect and describe local features in images. Applications include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition, video tracking, and match moving. For any object in an image, interesting points on the object can be extracted to provide a “feature Applications include object recognition, robotic mapping and navigation, image stitching, 3D modeling, gesture recognition, video tracking, and match moving.

For any object in an image, interesting points on the object can be extracted to provide a “featurethis is not only to detect but also characterized by values in order to recognize (to match) these areas or points of interest in other images of the same scene. This algorithm has had considerable success in the community vision

II.Our Work

In this paper,we have investigated Feature extraction method using SIFT features.we implemented SIFT algorithm , where purpose of using this is to have a set of images and find the best match against a single image which are kept it as 'template image' , SIFT gives us matches and scores in return , where 'matches' represent the descriptors that were found to be same in both image, and 'scores' determined by euclidean method, we evaluated the best match amongst all the images with template image,when there is a exact match between two

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images the 'score' turns out to be zero , because descriptors position in both the images are same,we found best match or the second best match against template using 'scores'.
This approach was adopted to address the large intra-class variations from contactless imaging.

III.System Design

A palmprint recognition system generally consists of four parts: palmprint scanner, preprocessing, feature extraction and matcher. Palmprint scanner is to collect palmprint images. Preprocessing is to setup a coordinate system to align palmprint images and to segment a part of palmprint image for feature extraction. Feature extraction is to obtain effective features from the preprocessed palmprints. Finally, a matcher compares two palmprint features

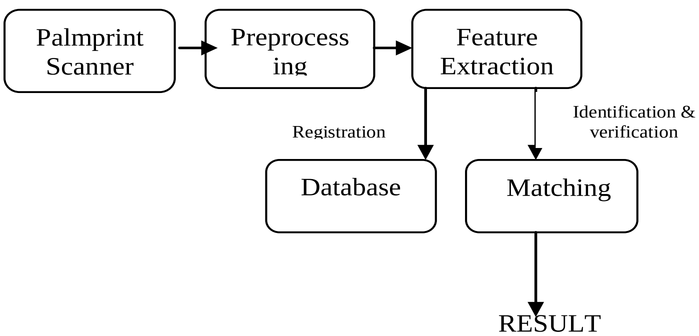

Fig.1:An Illustration of typical palmprint recognition System

1. **Preprocessing**

Preprocessing is used to align different palmprint images and to segment the central parts for feature extraction. Most of the preprocessing algorithms employ the key points between fingers to set up a coordinate system. Preprocessing involves generally five common steps,
(a)ROI segmentation:
1) Read an image
2)binarizing the palm images,
(b)Feature Extraction
1) extracting the contour of hand and/or fingers
2) detecting the key points,
3) establishing a coordination system and
4) extracting the central parts.
(c) Region Classification:By using Euclidean Distance to measure distance between two points.
The first and second steps in all the preprocessing algorithms are similar. However the third step has several different implementations including tangent-based , wavelet-based and bisector-based to detect the key points between fingers. Furthermore, Han detects points in the middle of fingers and constructs lines passing through fingertips and the points to setup a coordinate system . All these approaches utilize only the information on the boundaries of fingers, while Kumar et al. propose to use all information in palms . They fit an ellipse to a binary palmprint image. According to the orientation of the ellipse, a coordinate system is established. After obtaining the coordinate systems, central parts of palmprints are segmented.

Comparing with image collection and preprocessing, the research of feature extraction and matching is more diverse.

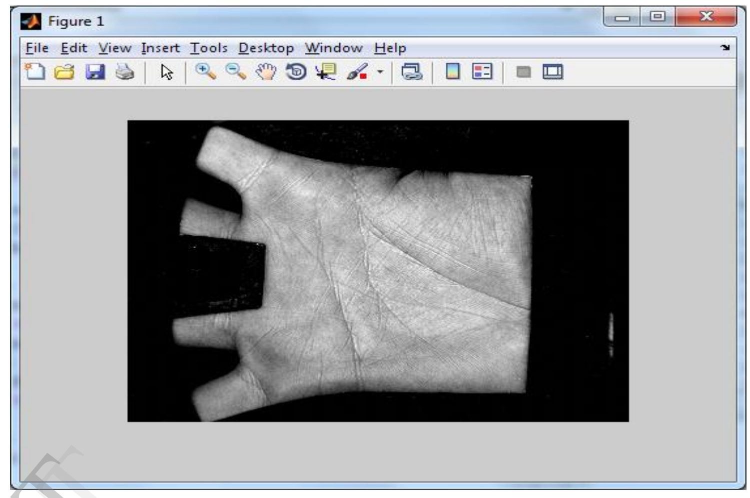

Fig.2:Read an image

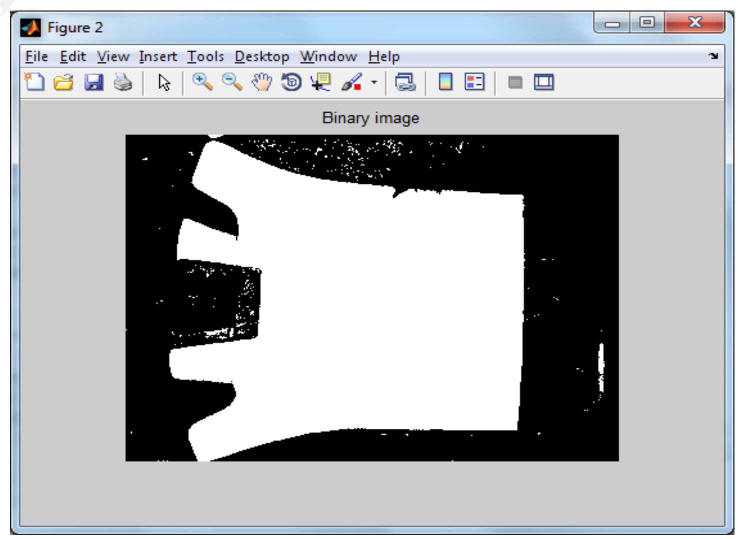

Fig.3:Binarizing an image

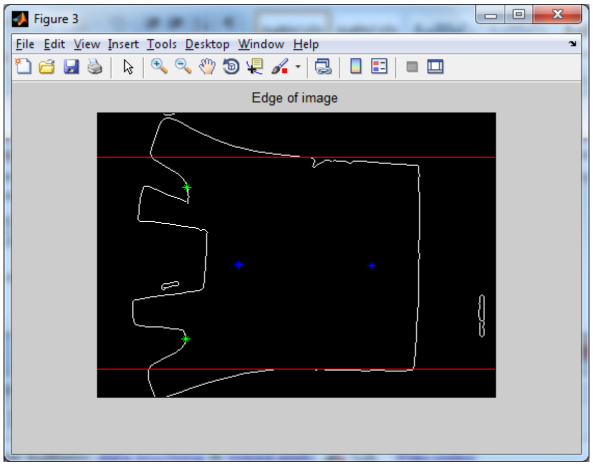

Fig.4: Edge Detection:

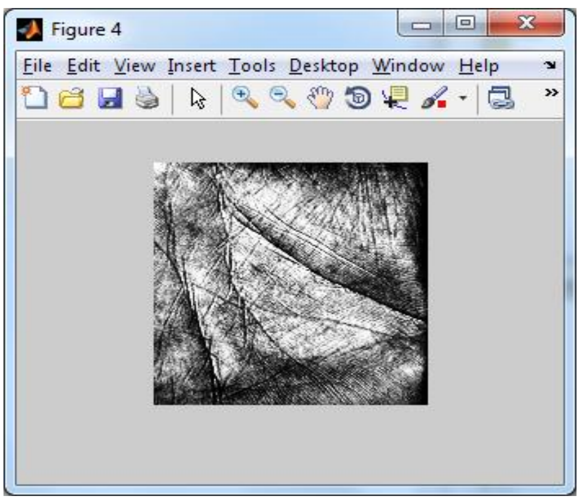

Fig.5:Region Of Interest of a Palm

IV.Feature extraction using SIFT Algorithm:

1.Detection of scale extrema points:

In this first stage,keypoints in SIFT have been detected.Keypoints are such that they are invariant to change in scale and various views of same object .In order to get such scale-space of an image, the image $I(x,y)$ and Gaussian blurs blur $G(x,y,k\sigma)$ are convolved at different scales and then difference of consequent Gaussian blurred image is taken for efficient detection of stable key points.

$L(x,y,k\sigma)$ is convolution of input image with the Gaussian blur at scale $k\sigma$, i.e.,$L(x,y,k\sigma) = G(x,y,k\sigma) * I(x,y)$
finally the Difference of Gaussians(DoG) at multiple scale is calculated by subtracting two near-by scales of image separated by constant multiplicative factor k $D(x,y,\sigma) = L(x,y,k_i\sigma) - L(x,y,k_j\sigma)$,

2.Localizing keypoints:Above stage produces many unstable keypoint candidates which have low contrast/poorly aligned on edges.In this stage those are eliminated.To do this,first we have to find the interpolated locations of extrema by employing taylor series expansion of scale-space function.The interpolation is possible by employing taylor series expansion of DoG scale-space function, $D(x,y,\sigma)$ with the candidate keypoint as the origin. This Taylor expansion is given by:

$$D(\mathbf{x}) = D + \frac{\partial D^T}{\partial \mathbf{x}}\mathbf{x} + \frac{1}{2}\mathbf{x}^T \frac{\partial^2 D}{\partial \mathbf{x}^2}\mathbf{x}$$

where D and its derivatives are evaluated at the candidate keypoint and $\mathbf{x} = (x,y,\sigma)$ is the offset from this point.

3.Low-contrast keypoint are discarded: In the above method,low contrast keypoints are found ,which are eliminated in this step.

$$D(\hat{\mathbf{x}}) = D + \frac{1}{2}\frac{\partial D}{\partial \mathbf{x}}^T \hat{\mathbf{x}}.$$

To discard low contrast keypoints,the value of the second-order Taylor expansion D(x) is computed at the offset $\hat{\mathbf{x}}$. If this value is less than 0.03, the candidate keypoint is discarded. Otherwise it is kept, with final location y+x and scale σ, where y is the original location of the keypoint at scale σ.

4.Eliminating edge responses

Even if the candidate keypoint is not robust enough to small amounts of noise,the DOG function have strong responses along edges. Therefore, to enhance the stability, keypoints with poorly determined locations but have high edge responses are eliminated.

5. Orientation assignment:

In this step, each keypoint is assigned with one or more orientations based on local image gradient directions.With this step,invariance with rotation is achieved as the keypoint descriptor is represented relative to this orientation and therefore achieve invariance to image rotation.

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$$m(x,y) = \sqrt{(L(x+1,y) - L(x-1,y))^2 + (L(x,y+1) - L(x,y-1))^2}$$
$$\theta(x,y) = \mathrm{atan2}(L(x,y+1) - L(x,y-1), L(x+1,y) - L(x-1,y))$$

The magnitude and direction calculations for the gradient are done for every pixel in a neighboring region around the keypoint in the Gaussian-blurred image L.

6.Keypoint descriptor

Previous steps found keypoint locations at particular scales and assigned orientations to them. This ensured invariance to image location, scale and rotation. Now we want to compute a descriptor vector for each keypoint such that the descriptor is highly distinctive and partially invariant to the remaining variations such as illumination, 3D viewpoint, etc.

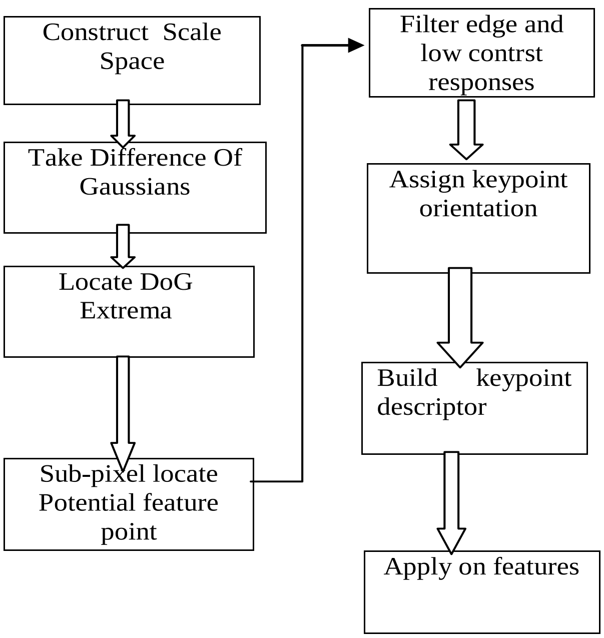

Fig.6:Steps of SIFT Algorithm.

MATLAB SIMULATION:
Our simulation required:
a.Code to segment ROI
b.SIFT algorithm
c.Databse with IITD palm images
d.Database with Roi images of all palms
e.Matlab 2010B installed in PC

TABLE1: RELATED WORK ON CONTACTLESS PALMPRINT AUTHENTICATION

Reference	Methodology	Database	Subjects	EER
[7]	CohortInformation	IITD [3]	235	1.31%
[9]	Palm and Knuckle	Proprietary	136	1.97%
[10]	2D and 3D Palm	Proprietary	177	2.6%
[13]	Multispectral Palmprint	Proprietary	165	0.5%
This paper	SIFT	IITD [3],	280	0.2%

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Table 1: Simulation parameter

Fig below shows the simulation using MATLAB.
SIFT robustness against rotation (20°) and scale variance (20% reduction). First row matches two images from same subject in contactless imaging; Second row matches the second image with a rotation of 20°; In third row the second image of same subject has 20% scale/size reduction

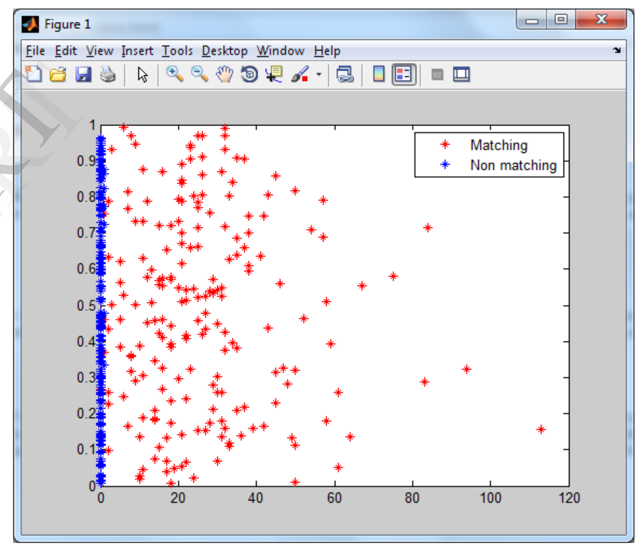
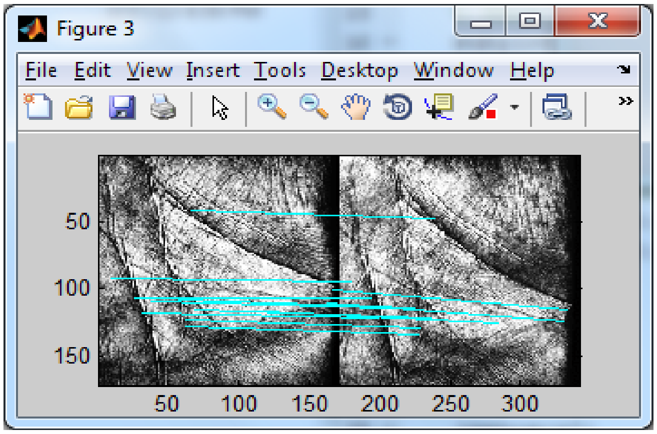


Fig.7: Simulation

I. SIMULATION RESULTS.

Fig.8 : describes the matching between two palm images.



Analysis: In this experiment using SIFT,about 390 folders with each folder containing 9 images of first hand and 9 images of second hand.Each person has a folder,like this altogether 390 plus folders are there.Matching scores of two images with same folder of same person and two images from different folder of different person is got by simulation.fig 9 and 10 shows the maximum matching and occurance of high performancw

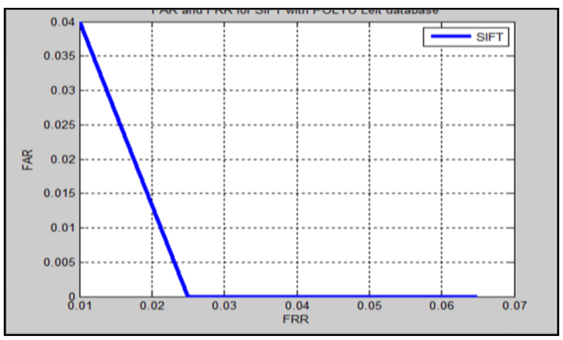


Fig.9:Performance graph using SIFT method

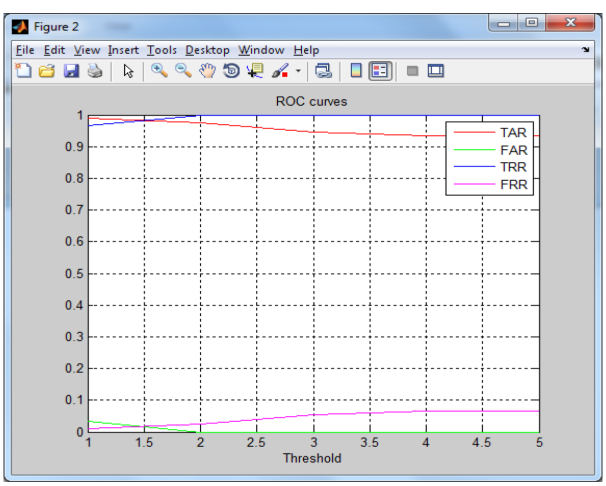


Fig.10: shows the following parameters
FAR:false acceptance rate
TAR:true acceptance rate
TRR:true rejection rate
FRR:false rejection rate

V.CONCLUSION.

This work presents for low resolution contactless palm image recognition system.Feature extraction using SIFT method has been deployed.Compared to other extraction approaches,this is efficient and have higher matching scores rate.It works better for images invariant to rotation,scaling.The proposed method have several advantages like accuracy with low Cost and flexibility.We described the acquisition of palm image without use of expensive acquision device like infrared sensor.we have achieved higher performance using SIFT technique. This feature vector introduces a few complications. We need to get rid of them. Further progress can be made by performing live experiments as our experiments results are not adopted for Rotation dependence and illumination variations.This can be the future work subsequent to our experiments.

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