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A Novel Approach for Person Authentication Using Finger Knuckle Print Based Biometric System

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Abstract: The identification and authentication are done by passwords, pin number, which is easily cracked by others. Biometrics is a powerful and unique tool based on the functional and behavioral characteristics of the human beings in order to prove their authentication. One of the current trends in biometric human identification is the development of new developing modalities. Knuckle biometrics is one of such favorable modalities. This thesis proposes a novel identificationmethod of biometrics named as Finger Knuckle Print (FKP). The texture pattern produced by the finger knuckle bending is highly unique and makes the surface a distinctive biometric identifier. At the preprocessing stage the gray scale values generate from the original image. The generated gray scale values are then passed to prewitt edge detection technique for the purpose of edge detection. The output of the image of edge detection process is used to increase the intensity values of the original image. The extraction of features of FKP using Scale Invariant Feature Transform (SIFT) and key points are derived from FKP using Support Vector Machine (SVM). The performance of the system for recognition of knuckle achieves 88.75 % accuracy rate.

Keywords: Finger Knuckle Print (FKP), Scale Invariant Feature Transform (SIFT), Support Vector Machine (SVM), Biometrics, Human Identification.

1. INTRODUCTION

1.1. Motivation

Authentication based on biometrics technique are demanding in educational, research and industrial applications because of their reliability, high accuracy in the modern e-world. The need for dependable computerized user authentication techniques has been important. Many researchers have thoroughly explore the different biometrics traits like fingerprint, face, iris, palm print, hand geometry and voice etc[1]. Finger knuckle print highly useful for user identification. FKP as a new biometric modality provide wide scope for researchers. One of the current trend in biometric person recognition is the development of new emerging modalities. Knuckle biometrics is one of such promising modalities[2]. Texture pattern produced by the finger knuckle bending is highly unique and makes the surface a distinctive biometric identifier. Among all the traits the hand based modalities like palm print, hand geometry, hand vein, finger print, finger knuckle and finger vein, create a centre of attention. Such traits are highly accepted and user friendly[3][4]. As per the study it had been seen that researchers have less focus on the FKP and finger vein which is actually provide high level security to identifier[5]. Finger knuckle print (FKP), the image pattern of skin present on the back surface of finger. Compared with fingerprint, FKP is more accurate.

1.2. Finger Knuckle

Choosing the biometrics is the challenging task for researcher. Biometrics authentication must provide the security level, unattended system, Spoofing and Reliability. Among all the modalities FKP broadly explored which has not yet attracted significant attention of researchers. Finger knuckle is user-centric, contactless

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and unrestricted access control. As it is contactless hence no chance of proof of physical presence i.e. antispoofing. Finger knuckle has High textured region. Many samples are available per hand and independent to any behavioral aspect[6][7].

Table 1
Comparison Of Biometrics Traits

Biometric Technology	*accuracy*	*Devices*	*Social Accept*	*Interference*
FKP	High	contactless	High	
Iris recognition	High	Camera	Medium low	Glasses
Retinal scan	High	Camera	Low	Irritation
Facial recognition	Medium low	Camera	High	Accident, etc
Voice recognition	medium	telephone	High	Noise, cold
Hand geometry	Medium low	Scanner	High	Arthritis, Rheumatism
Fingerprint	High	Scanner	High	Dirtiness, injury, Roughness

Finger knuckle is the back surface of finger, it is also known as dorsum of the hand. The inherent skin patterns of the outer surface around the phalange joint of one's finger, has high capability to discriminate different individuals. Such image pattern of finger knuckle is unique and can be obtained online / offline for authentication[8]. Extraction of features of knuckle for identification is totally depends upon the user. Some of the researcher extracted the features for authentication. Features are centre of phalange joint, U shaped line around the middle phalanx, Number of lines, length and spacing between lines. Knuckle has patterns and stray marks as a means of photographic identification[10]. Such features are unique and can use for identification.

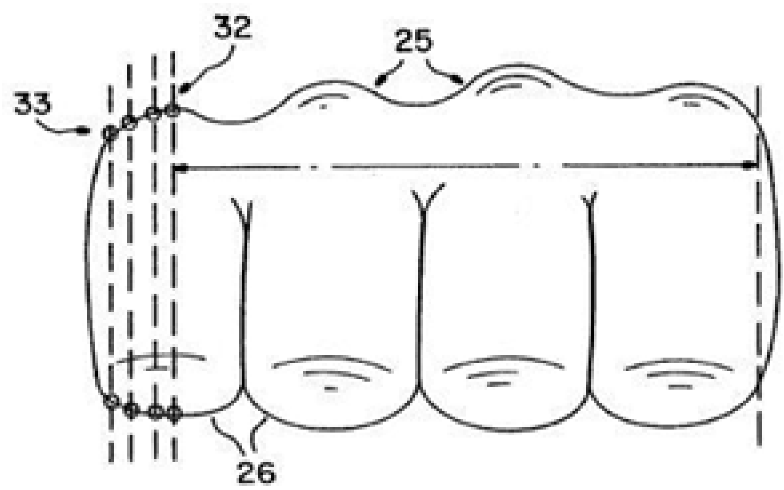

Figure 1: Finger Knuckle Features

2. PERSON AUTHENTICATION USING FINGER KNUCKLE PRINT

2.1. Existing System

A novel software based fake detection method that can beutilized as a part of numerous biometric frameworks to recognize distinctive sorts of fake access endeavors.In the system one or two knuckle images are taken from a person, if there is any defect in those knuckle then authentication is difficult. Attacks are performed in the analog domain and the interaction with the device is done following the regular protocol, the usual digital protection mechanisms (e.g., encryption, digital signature or watermarking) are not effective.The position of the finger knuckle is fixed, if there is any change it may cause error.

2.2. Proposed System

The finger knuckle authentication is more effective and secured compared to the existing system.In this system four knuckle images are taken from a person, if two knuckles are defected the authentication is possible using remaining knuckles.

Any pose variations is possible for authentication, due to the feature extraction of the finger knuckle using Scale Invariant Feature Transform.Support Vector Machine method is used to classify test knuckle image which is to be identified.

3. METHODOLOGY

3.1. Block Diagram of Proposed System

A Novel Approach for Person Authentication Using finger knuckle print Based Biometric system are described in this work. The various modules are explained in Block Diagram of FKP Recognition as shown in fig 2.

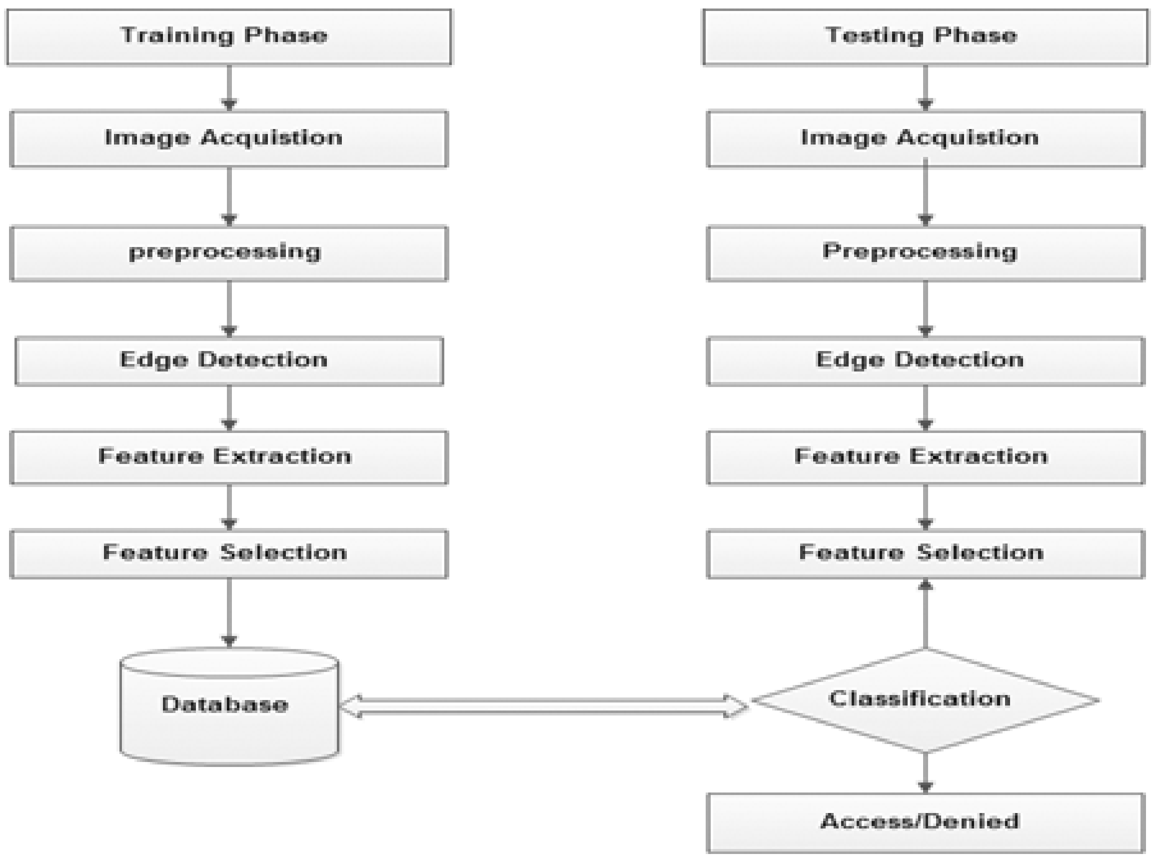

Figure 2: Block Diagram

i) *Image Acquisition*

In image acquisition, The image database is obtained directly either from the public domain or through the real time acquisition system.Experiment is carried out using IIT Delhi Finger knuckle Database version 1.0.20 images has been taken from database. The resolution of these images is 80*100 pixels.

ii) *Preprocessing*

The original image contains noise that generates spurious results.Preprocessing is the initial step of image processing. The gray values generated from the original image converted in to binary image.Binary image is filtered by using Gabor filter. It preserve the edge structures while reducing noise.

Filters such as: Median Filter, Mean Filter, Gaussian Filter, Range Filter, Gabor Filter were used to remove noise. In the above filters Gabor Filter has higher PSNR and lower MSE value.

Table 2
Comparison Of The Performance Of Various Filters

S. No	*Filter Name*	*PSNR*	*MSE*
1.	Mean	-20.2509	953.5125
2.	Median	28.7124	10.7609
3.	Gaussian	17.8477	131.3176
4.	Range	9.15478	7.8903
5.	Gabor	60.6057	0.0069

iii) *Edge Detection*

Edge detection are local image processing methods designed to detect edge pixels. Prewitt operator is used to detecting edges horizontally and vertically. Prewitt technique is applied to filtered image to extract the lines or patterns of finger knuckle. The output of the image of prewitt process is used to increase the intensity values of the original image.

iv) *Feature Extraction*

Feature extraction to extract the key points from finger knuckle print using scale invariant feature transform(SIFT). The SIFT algorithm mainly used in matching purpose. SIFT is used for extracting features of an image. Scale invariant feature transform is used for detection and extracting local features of an image. The first step of SIFT process is to find the difference of Gaussian function convoluted with the finger knuckle print image to detect the key point locations which is invariant to scale change. The difference of Gaussian is calculated by Eq.(1) and Eq.(2).

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y)$$

$$D(x, y, \sigma) = G(x, y, k\sigma) * I(x, y) - G(x, y, \sigma) * I(x, y) \quad (1)$$

$$D(x, y, \sigma) = L(x, y, k\sigma) - L(x, y, \sigma) \quad (2)$$

$$G(x, y, \sigma) = \frac{1}{2\pi\sigma^2} e - (x^2 + y^2)^{/2\sigma^2} \quad (3)$$

In the above equation $I(x, y)$, $G(x, y, \sigma)$, $L(x, y, \sigma)$, and $D(x, y, \sigma)$ are represents the image, Gaussian function, scale-space of image and Difference of Gaussian function respectively. The Gaussian function is calculated by using Eq.(3).The next step is to detect the local maxima and minima of $D(x, y, \sigma)$ by comparing the each pixel value of FKP image with the neighbor pixel values.

They are selected, if the pixel value is higher or lower related with the neighbor pixels.

v) *Classification*

Support Vector Machines(SVM) classification method is used to classify test knuckle image which is to be identified. If identified the person to compared to stored database is access otherwise denied.Support Vector Machine(SVM) classifier is useto recognize a Object. Support vectors are used to find hyper plane between two classes. SVM has linear and non linear classifier. Nonlinear SVM converts nonlinear data into linear data using kernel function. It maps the input space into a higher dimensional feature with kernel function to find the separating hyper plane.

4. RESULT AND DISCUSSION

Execution of the proposed framework is tried on openly accessible “IIT Delhi finger knuckle database Performance of the proposed system is tested on publicly available “IIT Delhi finger knuckle database version 1.0” [9]. This database has been acquire from 158 clients in IIT Delhi grounds utilizing advanced camera. All the subject in the database are in the age bunch 16 to 55 years. Images are in bitmap design. Determination of these images is 80 × 100 pixels. Test knuckle images are as appeared in figure 3. In proposed work is viewed as four knuckle images tests of same individual and are relegated to the same class. More than such classes are formed and considered for testing the experimental results. The proposed framework is completely executed in MATLAB 8.1.0

Experimental results of Finger knuckle Authentication is as shown in Figure 4. Preprocessing is the initial step of image enhancement. The first step, input image converted in to binary image by the approximate threshold value is shown fig 5. Next the binary image is filtered using Gabor filter is shown fig 6. Figure 7 shows the result of preprocessing.Figure 8Shows the Prewitt edge detection technique is applied to filtered image to extract the lines or patterns of finger knuckle.Figure 9shows the features extracted from knuckle image using SIFT Key points. Figure 10 shows the Graphical User Interface used for the recognition of person. The localized key points are selected from the input image. The selected key points are plotted in a graph for recognition of correct person. Figure 11 shows the performance test images of the database.

4.1. Performance Measures

The correctness of a classification can be evaluate by computing the number of correctly recognized class examples (true positives), the number of correctly recognized examples that do not belong to the class (true negatives), and examples that either were incorrectly assigned to the class (false positives) or that were not recognized as class examples (false negatives).

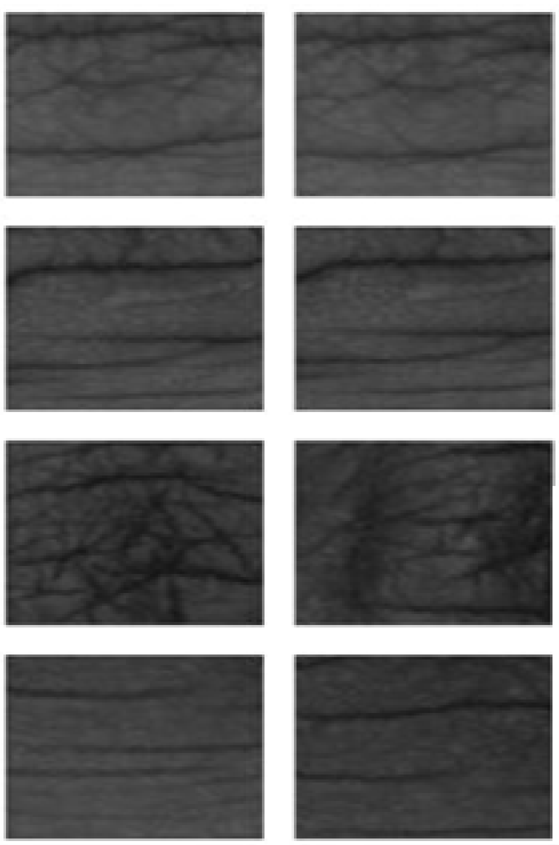

Figure 3: Sample knuckle images from database

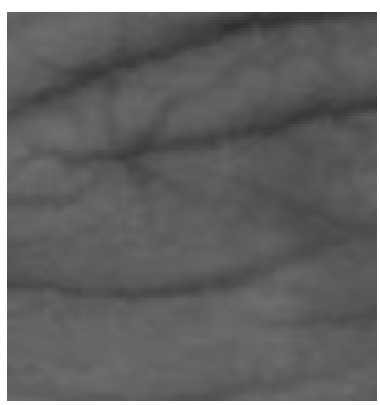

Figure 4: Input Image

Figure 5: Binary Image

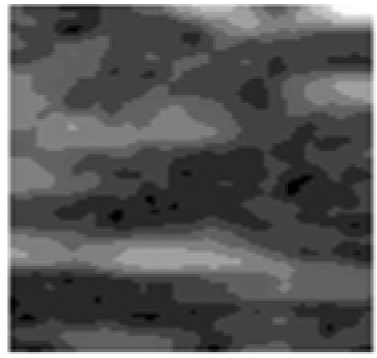

Figure 6: Gabor Image

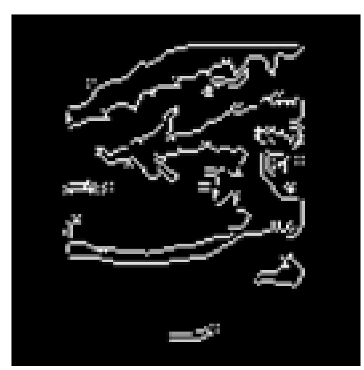

Figure 7: Result of Preprocessing

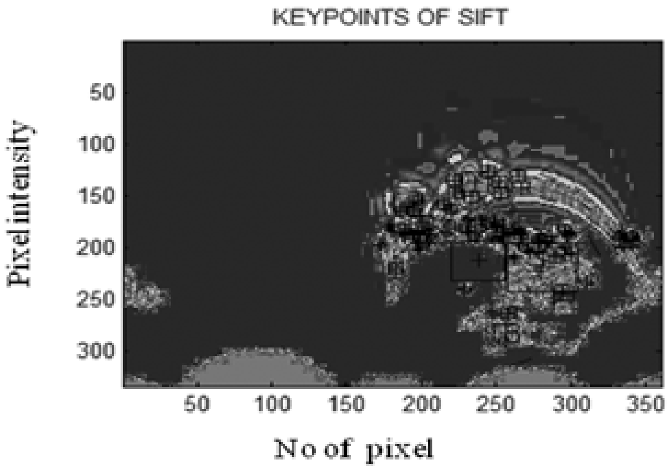

Figure 8: Result of Prewitt Image

Figure 9: Feature Extraction Using SIFT

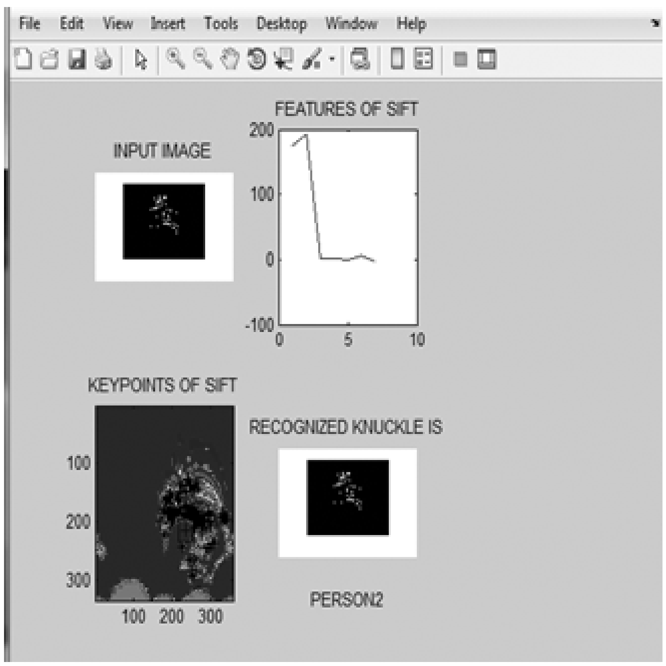

Figure 10: Recognition of Person with Knuckle Image

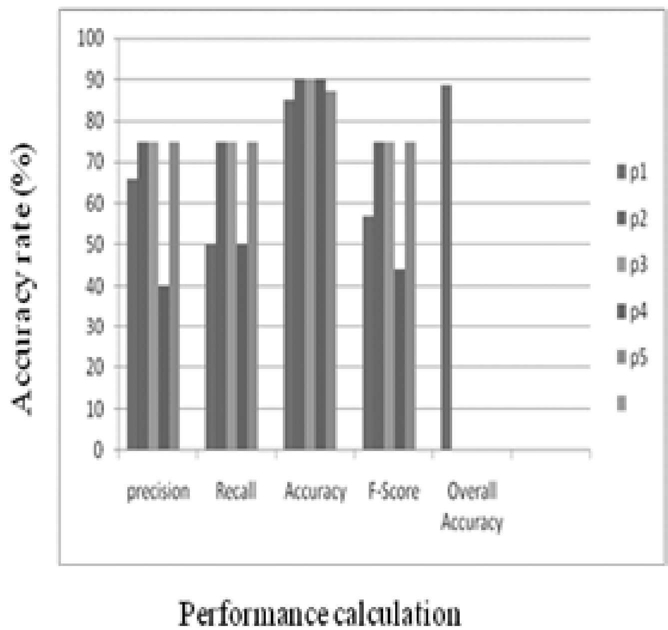

Figure 11: Performance Analysis

5. CONCLUSION

This Paper Presented a novel approach for person authentication using finger knuckle image. Appearance based method namely Scale Invariant Feature Transform for feature extraction is presented in detailed. Support Vector Machine classification method is employed to classify knuckle images. Experimental results showing working of SVM classification are presented in section 4. The proposed methods for feature extraction and classification have been quite effective in achieving high performance in knuckle classification. Proposed work consider single finger knuckle image for identification. In future this can be extended by considering multiple finger knuckle images. Finger geometry and knuckle blending information may also be combined and used for person identification. Variations in knuckle creases due to some disease may degrade the performance, this requires further investigation. In near future we plan to test this method. It has been observed that SVM is producing better results at an accuracy rate 88.75.

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