

Touch-less Biometric Fingerprint Authentication

Anushri Chourasiya
Dept. of Computer Science & Engineering
Oriental Institute of Science & Technology
Bhopal, Madhya Pradesh, India
anushrichourasia@gmail.com

Rakesh Pandey
Dept. of Computer Science & Engineering
Oriental Institute of Science & Technology
Bhopal, Madhya Pradesh, India
rakeshpandey@oriental.ac.in

Abstract— In recent years, there is new technique which has been introduced i.e. touch-less fingerprint authentication system which may replaces the biometric device or scanner which is considered as unhygienic as well as costly. As we know that authentication system possess by a combination of username and password and this combination may be hacked because anyone of your friends or relative may perform brute force attack by guessing your password which may related to your personal details. But fingerprint cannot be stolen or copied that is why fingerprint authentication is the best authentication system. Everyone has distinct fingerprint and no one can authenticate or unauthorized access without your existence. So, on having this feature biometric device or scanner has been introduced in past years and now it is to be replaced by the touch-less fingerprint authentication or recognition system. This recognition can be perform either by webcam or by hand held device i.e. mobile. Here the system which has been proposed in this paper is able to enhance your fingerprint image through camera's features such as autofocus, conversion through 3D print to 2D or resolve the curved area to flat image through which features can be extracted and make authentication system more powerful and portable.

Keywords— Touch-less, Fingerprint, Mobile, Minutiae, Authentication.

I. INTRODUCTION

Biometric fingerprint authentication system suppose as best authentication system in the field of digital world. Each and every person has distinct fingerprint and it can't be stolen or cannot access without your existence. To achieve fingerprint there is biometric devices are available. Touch-less fingerprint system has been introduced which reduces the cost of forming this kind of system without any biometric devices instead of that it uses mobile's camera to acquire fingerprint images and process it for authentication.



Fig. 1 Acquiring Fingerprint image through mobile's fingerprint scanner

Today almost every mobile phone has inbuilt devices for acquiring fingerprint image for authentication but the cost of this device is included with your mobile's cost.



Fig. 1.2 Acquiring Fingerprint image through mobile

But there are so many mobiles phones which have been using are still don't have fingerprint scanner so, here

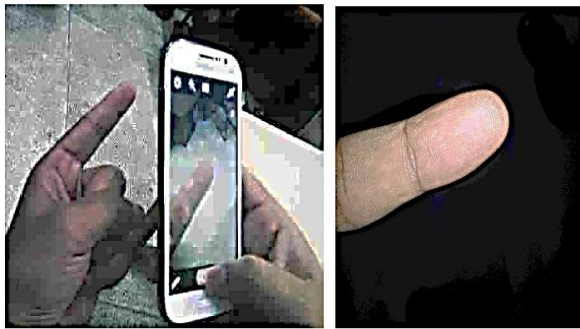
authentication through this kind of scanner is not feasible for every user. Instead of that if we use mobile's camera for authentication then every mobile phone has a camera feature and can be used for authentication system.

II. PROBLEM STATEMENT

Existing system is not intelligent enough to sense whether the image which is acquiring is appropriate or not at real time. We need a system that increases the camera performance and took appropriate image of finger through which minutiae can be extracted with highest accuracy. But existing system are based on image processing, it enhances the image after acquisition. That is why these systems are lacking somewhere which is required to overcome.



Fig. 3 Biometric Fingerprint Scanner



(a) Fingerphoto Acquisition (b) Fingerphoto Image
Fig. 4 Present Touch-less Based Fingerprint Authentication

III. PROPOSED WORK

The system which has been introduced in this paper is based on touch-less fingerprint authentication for mobile based login. As we know that each mobile phone has a front and rear camera, what quality of camera it is does not matter because autofocus is feature which makes your photo more visible and sharper as compare to normal images. Here the system uses auto focus feature of your mobile camera along with flash light to get enhanced minutiae focused images with high quality.

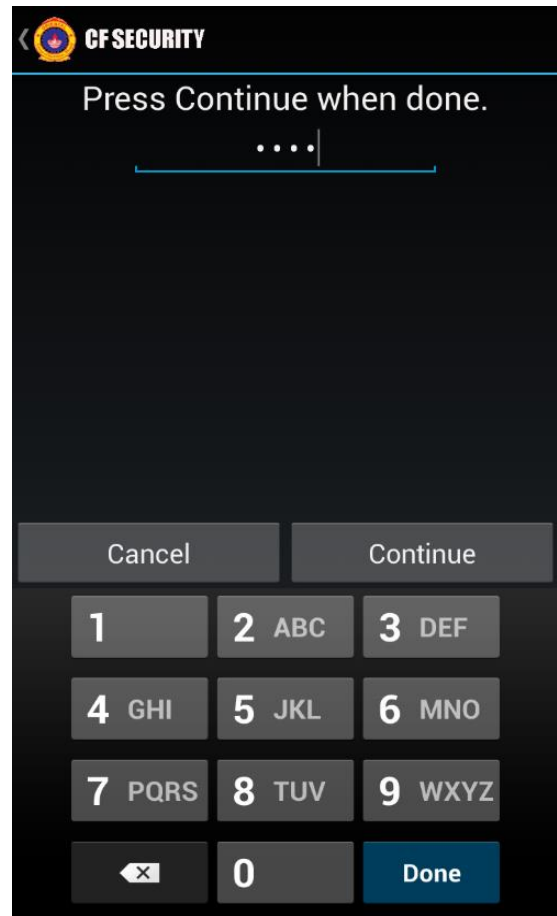


Fig. 5 PIN Enrollment

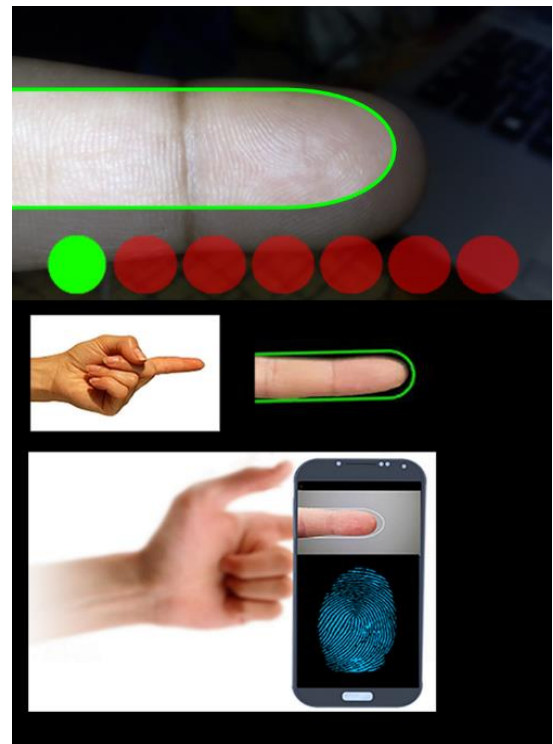


Fig. 6 Fingerprint Enrollment

Here first of all we require setting pin code for emergency or failure purpose. After pin code enrollment, it requires to enroll your fingerprint. Once the enrollment of fingerprint has been done, now system becomes ready to use and verify fingerprint of authentic user. The proposed system captures clear focused fingerprint as similar as a biometric device does. 3D fingerprint convert into 2D HD print and minutiae features extracted accurately and FAR (False Acceptance Rate) is negligible.

IV. PROPOSED METHODOLOGY

The major minutiae features of fingerprint ridges are ridge ending, bifurcation, and short ridge (or dot). The ridge ending is the point at which a ridge terminates. Bifurcations are points at which a single ridge splits into two ridges. Short ridges (or dots) are ridges which are significantly shorter than the average ridge length on the fingerprint. Minutiae and patterns are very important in the analysis of fingerprints since no two fingers have been shown to be identical.



Fig. 7 Minutiae Identification

Pattern based algorithms compare the basic fingerprint patterns (arch, whorl, and loop) between a previously stored template and a candidate fingerprint. This requires that the images can be aligned in the same orientation. To do this, the algorithm finds a central point in the fingerprint image and centers on that. In a pattern-based algorithm, the template contains the type, size, and orientation of patterns within the aligned fingerprint image. The candidate fingerprint image is graphically compared with the template to determine the degree to which they match. Let it be more precise with an algorithm.

A. TLF Algorithm (Touch-Less Fingerprint Algorithm)

1. F_i is an input fingerprint
2. m_i is the minutiae & m_i has four parameters $m_i = (x_i, y_i, \theta_i, t_i)$
where
 x_i, y_i - are coordinates of the minutiae point
 θ_i - is minutiae direction

t_i - is type of the minutiae point (ridge ending or ridge bifurcation)

3. Calculate Crossing Number (CN) ; which is defined as half the sum of the differences between pairs of neighbouring pixels p_i and p_{i+1}

$$CN_{(x,y)} = \frac{1}{2} \sum_{i=1}^8 |p_i - p_{i+1}|, \quad p_1 = p_9$$

4. Calculate orientation estimation and the local orientation at pixel (i, j) can then be estimated using the following equations:

$$V_x(i, j) = \sum_{u=i-\frac{w}{2}}^{i+\frac{w}{2}} \sum_{v=j-\frac{w}{2}}^{j+\frac{w}{2}} 2\partial_x(u, v)\partial_y(u, v),$$

$$V_y(i, j) = \sum_{u=i-\frac{w}{2}}^{i+\frac{w}{2}} \sum_{v=j-\frac{w}{2}}^{j+\frac{w}{2}} \partial_x^2(u, v)\partial_y^2(u, v),$$

$$\theta(i, j) = \frac{1}{2} \tan^{-1} \frac{V_y(i, j)}{V_x(i, j)},$$

Where ; $\theta(i, j)$ - is the least square estimate of the local orientation at the block centered at pixel (i, j) ,

∂_x, ∂_y - are the gradient magnitudes (the Sobel operator) in the x and y directions. Further, orientation field need to be smoothed in a local neighbourhood using a Gaussian filter

5. Matching algorithm compares two minutiae sets: template $T = \{m_1, m_2, \dots, m_j\}$ from reference fingerprint and input = $\{m_1, m_2, \dots, m_i\}$ from the query and returns similarity score $S(T, I)$

$$sd(m_i, m_j) = 1 \Leftrightarrow \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2} \leq r_0$$

$$dd(m_i, m_j) = 1 \Leftrightarrow \min(|\theta_i - \theta_j|, 360 - |\theta_i - \theta_j|) < \theta_0$$

$$S(T, I) = \max \left(\forall \sum_{i=1}^n md(m_i, map_m(m_i')) \right)$$

$$md(m_i, m_j) = sd(m_i, m_j) \cdot dd(m_i, m_j)$$

n - is the number of minutiae points in I input set,
 m - is the number of transformation equal to the number of minutiae in T template set,
 It reflects the FRR (False Reject Rate) and FAR (False Accept Rate) and on the basis of that it return the result with score.

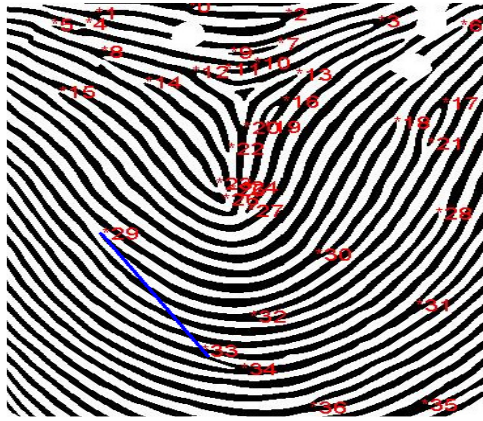


Fig. 8 Minutiae Feature Extraction for fingerprint Verification

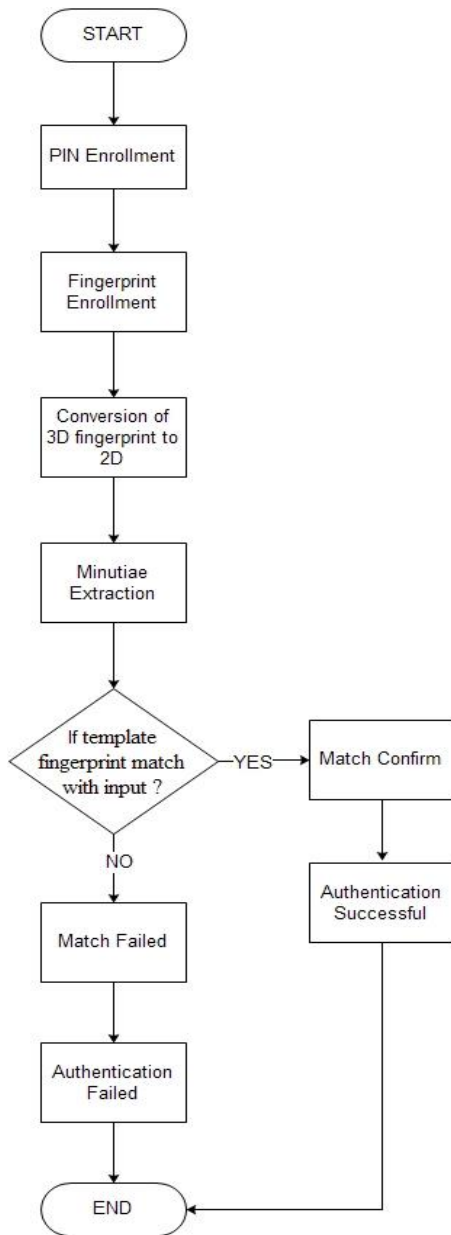


Fig. 9 Flow Chart

TABLE I RESULT ANALYSIS

Users	Atte mpts	FRR	FAR	TAR
U ₁	20	20	0	19
U ₂	20	20	0	20
U ₃	20	20	0	20
U ₄	20	20	0	20
U ₅	20	20	0	18
U ₆	20	20	0	20
U ₇	20	20	0	20
U ₈	20	20	0	19
U ₉	20	20	0	20
U ₁₀	20	20	0	20
Total	200	200	0	196

Accuracy – 98%

FRR: False Rejection Rate

FAR: False Acceptance Rate

TAR: True Acceptance Rate

TABLE III
RESULT COMPRISON

	Approa ch	Req uire d Size in MB	Accura cy	CRR (%)	EER (%)
Stein et.al. [11]	Minutia e points features	41	-	-	
Ravi et.al. [10]	Minutia e points features	20	93.63	-	-
Kumar et.al. [9]	Localize d Texture pattern	156	-	93.9 7	3.95
NIST [12]	Minutia e points features	50	91.80	92.6 6	8.21
Kamle sh et.al.[5)	Non- conventi onal scale invarian	50	97.42	96.6 7	3.33

	t features				
Proposed	Minutiae points features	49.15	98	98	0.1

CRR: Correct Recognition Rate
EER: Equal Error Rate

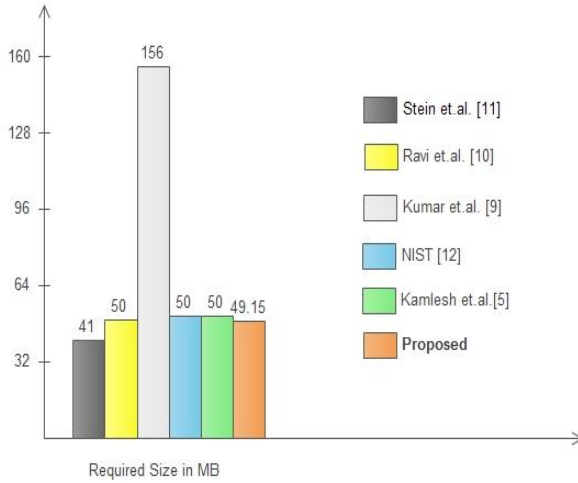


Fig. 10 Result Comparison for Database size

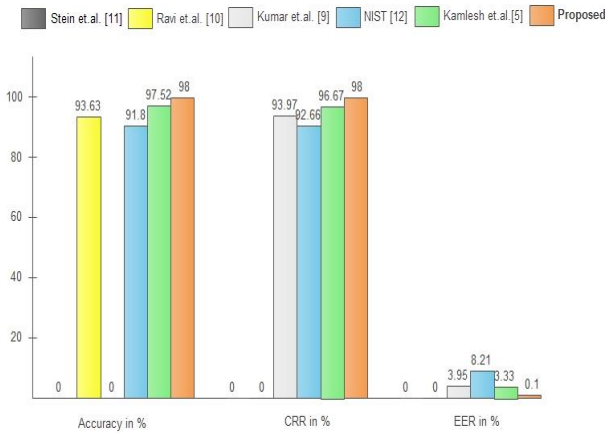


Fig. 11 Result Comparison for Accuracy, CRR & EER

V. CONCLUSION & FUTURE SCOPE

The current proposed concept of touch-less fingerprint recognition or authentication system get enhanced by improving the real time vision of mobile camera in term of stabilization, autofocus, region of interest etc. The digital world requires cost effective and best security system which proposed system provides. As per the future scope of current proposed system of touch-less fingerprint authentication system gets applicable in future in different places such as online banking, mobile attendance, mobile phone security and many more.

VI. REFERENCES

- [1] Hareesh Ravi and SabarishKuduwaSivanath, "A Novel Method for Touch-Less Finger Print Authentication", IEEE Transaction, 2013.
- [2] G.Vinoth Kumar, K.Prasanth, S.Govinth Raj and S.Sarathi, "Fingerprint Based Authentication System with Keystroke Dynamics for Realistic User", IEEE Transaction, 2014.
- [3] Anju Mohan1 and Prof. Shilpa P. Kodgire2, "Touchless Fingerprint recognition using MATLAB", IEEE Transaction, 2014.
- [4] Ruggero DonidaLabati, "Toward Unconstrained Fingerprint Recognition:A Fully Touchless 3-D System Based on Two Views on the Move", IEEE Transaction, 2015.
- [5] Kamlesh Tiwari and Phalguni Gupta, "A Touch-less Fingerphoto Recognition System for Mobile Hand-held Devices", IEEE Transaction, 2015.
- [6] Marcin Piekarczyk and Marek R. Ogiela, "On Using Palm and Finger Movements as a Gesture-based Biometrics", IEEE Transaction, 2015.
- [7] Marcin Piekarczyk and Marek R. Ogiela, "Usability of the Fuzzy Vault Scheme Applied to Predetermined Palm-based Gestures as a Secure Behavioral Lock", IEEE Transaction, 2015.
- [8] Erol Ozan, "Password-free Authentication for Social Networks", IEEE Transaction, 2017.