Personal Authentication System with High Acceptability and Reliability

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***Abstract*- With the growth of information world, several authentication techniques have arrived very fast, but signature has long been considered most natural method for personal authentication. But authentication by signature is not as reliable as other biometric features. The main goal of this paper is to develop an authentication system which one high acceptable & also maintain reliability with use of digital signature with fingerprint authentication in one shot. Thumb impression is taken as biometric authentication feature. The combination of digital signature and thumb impression is more practical than other combinations as authentication techniques. Initially only digital signatures are matched with the previously stored samples and thumb impression is checked only when digital signature is matched successfully.**

***Keywords*- Authentication system, Biometric security**

I. INTRODUCTION

A. Introduction to Biometrics [1]

Authentication of identity is very critical task in various security related applications such as e-commerce. This can be implemented using various methods and techniques. Biometric is becoming one of these techniques for authentication. Various security systems after realizing the value of Biometrics use it for Verification (online process) and Identification (offline process) of users. For different application we have different biometrics.

Biometric features cannot be borrowed, forgotten, stolen and forging is also practically not possible so it is most secure and convenient way of authentication. Every individual has some unique features and biometric security is based on these features. *Fingerprints, Hand Geometry, Palm prints, Retina, Iris and Facial* features are some of the common biometric properties. There are some additional behavioral biometric properties like *signature, voice, keystroke pattern, and gait* and among this class signature and voice are most developed.

- **Uni-Modal Biometrics:** Uni modal biometric system is very fast and cost effective. Figure shows some basic features possessed by a biometric system and their comparison. We can see in the Table1 that none of the single biometrics provides us complete security so need of multi modal system is felt.
- **Multimodal Biometrics [2]:** In the present scenario multimodal systems are more popular because of their advantages like high security and high reliability. But there are some unavoidable

drawbacks with multimodal biometrics such as its complex nature and high operational cost and apart from this its acceptability is low.

TABLE 1
COMPARISON OF VARIOUS BIOMETRIC TECHNOLOGIES [3]

Biometric characteristic	Universality	Distinctiveness	Permanence	Collectability	Performance	Acceptability	Circumvention
Facial thermogram	H	H	L	H	M	H	L
Hand vein	M	M	M	M	M	M	L
Gait	M	L	L	H	L	H	M
Keystroke	L	L	L	M	L	M	M
Odor	H	H	H	L	L	M	L
Ear	M	M	H	M	M	H	M
Hand geometry	M	M	M	H	M	M	M
Fingerprint	M	H	H	M	H	M	M
Face	H	L	M	H	L	H	H
Retina	H	H	M	L	H	L	L
Iris	H	H	H	M	H	L	L
Palmprint	M	H	H	M	H	M	M
Voice	M	L	L	M	L	H	H
Signature	L	L	L	H	L	H	H
DNA	H	H	H	L	H	L	L

B. Introduction to Fingerprint [4]

Fingerprint authentication is oldest biometric method which has been successfully used in various applications. Every individual have unique and immutable fingerprints. Fingerprint is a combination of ridges and furrows on the surface of the finger. The pattern of ridges and furrows as well as minutiae points ensures the uniqueness of fingerprint. Minutiae points are local ridge characteristics that occur at either a ridge bifurcation or a ridge ending.

There are basically two categories of fingerprint matching: minutiae-based and correlation based. Minutiae-based is done by finding minutiae points and mapping these points relatively on the finger. Correlationbased is done by finding precise location of a registration point but this technique is affected by rotation and image translation.

C. Leading Companies working on Fingerprint:

Fig. 1 Various commercial sensors available for live capture of fingerprints

D. Introduction to Electronic Signatures [5]

Signatures are used almost in every business scenario. Official signing of various contracts or deals are still being done through signing printed papers. This is a costly procedure and signatory authority should also be there for signing.

Electronic signature verification is developed to fulfill increasing need of organizations to find a automatic and secure way of document verification and to reduce the cost of operation of traditional paper based system. In the current scenario when every system including web-based environment, banks, insurance companies and credit card companies are vulnerable to breaches in document security. Computer fraud has become internal and external problem for organizations. Electronic signatures are answer to every problem and apart from traditional signature authenticity, it consist of security features like pressure measurement, speed of hand movement and variations. Electronic signatures are effective, efficient, practical, cost saving and easily installable procedure.

Digital signature authentication is of two types:

1. Off-line [6]: ubiquitous (pen and paper).

2. On-line [7]: inexpensive and already integrated in some devices (Tablet PC).

Fig. 2 Electronic Signature Example

E. Leading Companies working on Digital Signature Devices

- On-line:
  - SOFTPRO(http://www.signplus.com/)
  - CYBERSIGN(http://www.cybersign.com/)
  - CIC (http://www.cic.com/)
- Off-line:
  - APPDAVOS(http://www.appdavos.ch/)
  - NUMEDIA(http://www.sapura.com.my/NuMedia/check.htm)

F. Prior Work

Online signatures and voice modalities [8] have been used together for the security of medical records. But this approach consists of some major drawbacks:

- Environmental conditions like noise can be there
- Age factor of a person
- Health conditions of the individual

Another system is a combination of iris and signature [9] for personal authentication. Major drawbacks of such system are:

- User acceptance is low
- More Complex
- Health Conditions
- Difficult to capture

G. Our System

The advent of Electronic signatures has not yet replaced the paper based signature methodology even when paper based methodology has proven to be costly and forgeable. The reason for this is limitations of Electronic signature in providing complete personal authentication. Using another authentication method along with electronic signature will effect in more costly and time consuming process when we use more than one device.

Our idea is to merge the Fingerprint identification along with electronic signature devices as authentication system. As the person will hold the pen for electronic signature the tiny device attached with the pen will capture the Fingerprint instantly. The grip of the pen for this process is also improved by making it square like marker pens from previously popular round shaped pens.

Our system is also as fast as other Uni-modal biometric system in the manner that it first check for Electronic signature authentication and Fingerprint will only be checked when Electronic signature is authorized one.

II. THE PROPOSED SCHEME

A. System Setup and Image Acquisition

Digital Signature Capture Device or Pen Tablet is a device which capture digital signature by use of a pen, stylus, or puck that is programmed to work with the tablet.

TABLE 2
COMBINED ANALYSIS OF MERGED FEATURES

Biometric characteristic	Universality	Distinctiveness	Permanence	Collectability	Performance	Acceptability	Circumvention
Fingerprint	M	H	H	M	H	M	M
Signature	L	L	L	H	L	H	H
Our System	M	H	H	H	H	H	H

Fig. 3 Finger Print scanner merged with device

The incorporation of electronic signature with fingerprint will fulfill almost every requirement to qualify as a biometric system.

B. Block Diagram

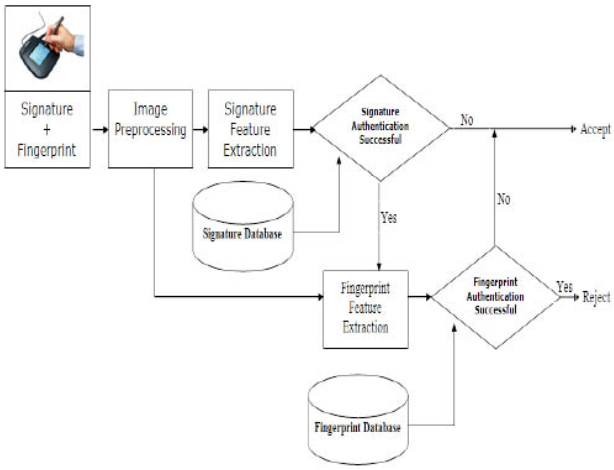

Fig. 4 Block Diagram of Proposed System

III. ELECTRONIC SIGNATURE PROCESSING

Electronic signature captured by the pad is processed and matched with stored templates for authentication. Various Companies have developed the instruments for electronic signature authentication. These instruments are capable of capturing and storing user templates and verify them at the time of authentication. There are two type of signature matching which can vary depending upon the application:

- Off-line [6]
- On-line [7]

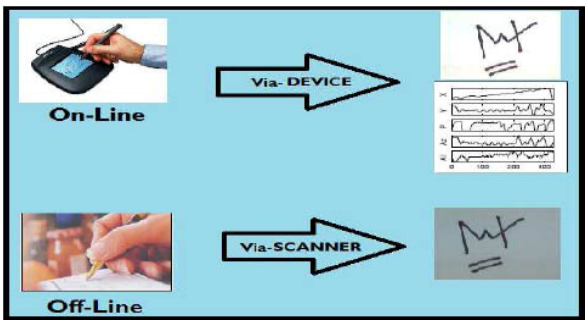

Fig. 4 Off-Line/On-Line Verification System

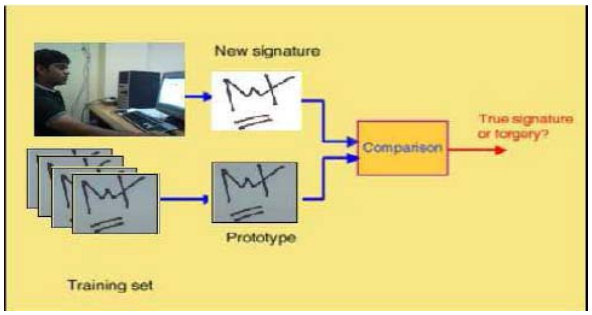

Fig. 5 Signature Verification

IV. FINGER PRINT PROCESSING

Acquired fingerprint image through acquisition procedure is now matched for authentication with images stored in fingerprint database. There are many techniques for fingerprint matching. Few popular fingerprint Matching Techniques are:

- Minutiae-based [10]
- Correlation-based [11]
- Ridge Feature-based [12]

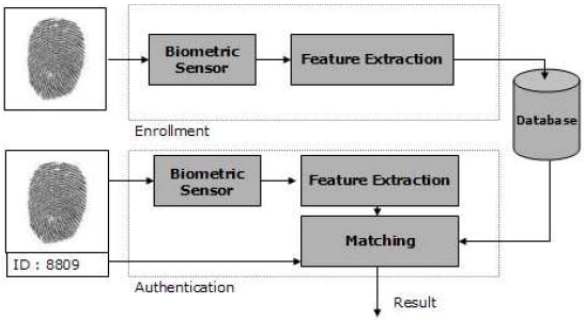

Fig. 6 Fingerprint Verification System

V. SYSTEM FUNCTIONING

There are three modes of operations in multimodal Biometrics systems:

- **Parallel**: Two or more modalities are used in parallel in authentication.
- **Serial**: Modalities are used one after the other in authentication.
- **Hierarchical**: The combination of modalities is used in hierarchical manner.

In this paper, we have proposed serial mode of operation using Fingerprint and Electronic Signature. The reason behind using these two modalities out of various others is their popularity in various authentication system due to their high acceptability based on seven biometric characteristics which can be seen in Table 1. The result of ANDing characteristics of electronic signature and fingerprint is shown in Table 2. The good fusion result proves the practicality of proposed system.

VI. CONCLUSION

This paper presents combination of Electronic signature and Fingerprint, which is a Personal Authentication System with High Acceptability and Reliability. It qualifies as a highly acceptable since both the biometric features are most popular features and it can be considered as reliable system because both are oldest features. Realizing the need of current banking and other official systems where authentication is mandatory, proposed system is most suitable.

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