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Biometric Online Signature Verification with added Security of unique ID

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ABSTRACT: Biometrics refers to metrics related to human characteristics. In this paper we discuss the Biometric Online Signature Verification with added security of unique ID using coordinates methods. Various Biometric techniques are now available which is helpful in personal identification. Among all those verification system signature verification is one of the important biometric system. Here we capture the signature by a special device such as touch screen. In this system we implement the signature verification using advance RISC processor. Here each signature is protected with a separate UID.

KEYWORDS: Biometrics; Touch screen; authentication; database; verification.

I. INTRODUCTION

Biometric system is the most secure and convenient authentication tool. Biometric systems are automated by hardware and software, allowing for fast, real-time decision making in identification situations. Biometric technology gives the potential for automatic personal verification. The two patterns of the biometric are the biological and behavioral [1],[2]. For verification of personal identity, the biological characteristics such as face, fingerprints, iris is used. Where as in behavioral characteristics such as voice, keystroke, signature is used. Handwritten signature is a common type to declares the accepts and take responsibility for a signed document. Signature verification is a behavioral biometric that is developed over the course of a person's lifetime [3]. A biometric system is essentially a pattern recognition system which makes a personal identification by determining the authenticity of a specific physiological or behavioral characteristic possessed by the user. These characteristics are measurable and unique. These characteristics should not be duplicable. Many people are very accustomed to the process of signing their name and having it matched for authentication. Depending on data acquisition process signature verification system are divided into two types first is the Off-line and second is the On-line signature verification. In off-line signature verification systems, a signature written on a piece of paper is captured optically with a camera or scanner. This means the off-line mode allows generating a handwriting static image from a scanning documents and used for analysis[8]. As in On-line signature verification uses special hardware, such as a touch screen, digitizing tablet or a pressure sensitive tablets, to acquire the input data in the form of signature[6]. Biometric Online Signature Verification with added security of unique ID is used in various applications such as used in Banks, ATMs, Lockers, Computer room, Secure sites such as research centre, nuclear site, passport, driving license, residence permit e.t.c.

The major factors affecting in signature verification is that the same persons signature variation in the shape over time .This means after a time period Signature may be changed, and get the totally new signature[1].

The goal of this paper is the implementation of Biometric Online Signature Verification with added security of unique ID with minimum cost. Dynamic signature verification is an automated method of examining an individual's signature. This method of verification is preferred with involving UID numbers in association with the signature. In this system, Firstly signature is acquired on touch screen and after preprocessing it is stored in a database and assign different UID

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to the each signature for security purpose. In the next step of verification here, we again acquire the signature and entered the UID and verification process started. The results were displayed as "signature verified" or not[7].
This paper is constructed in Five sections; Section I is the introduction part, Section II gives the related work. Section III describes the Block Diagram of Biometric Online Signature Verification with added security of unique ID. Section IV presents the Logical view Biometric Online Signature Verification with added security of unique ID. In section V, the Results are discussed. Finally the conclusion of the paper is reported in Section VI.

II. RELATED WORK

Security plays important role in human life. Nowadays it is the basic fundamental of all systems developed. Because of that, biometric authentication system has got a more of importance. Biometric authentication systems are secure, easy to use, uses basic techniques of signal processing and cheap to build. In this part we discuss the related work on signature verification. In [1], A. P. Malode, Dr. P. T. Karule proposed the Online Signature Verification by Slope Calculation Method. The algorithm is developed on slope calculation method. In this he acquire a signature, preprocess and stored in a database memory. At the time of verification signature is again captured and compared with the previously stored memory. In [9], Digital signature verification algorithm using the relative slope method is introduced. In this he gives an algorithm based on slope calculation which uses digital pen input signature. This system signature is captured through digital pen to identify that the person is genuine or forgery through the handwriting of that particular person.

III. BLOCK DIAGRAM BIOMETRIC ONLINE SIGNATURE VERIFICATION WITH ADDED SECURITY OF UNIQUE ID

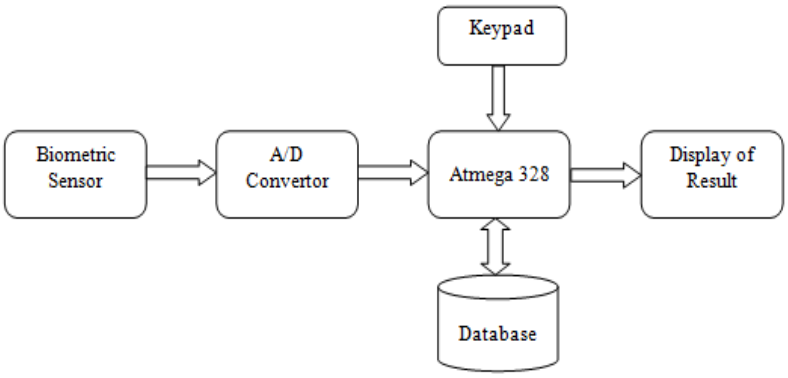

Fig 1: Block Diagram of Biometric Online Signature Verification with added security of unique ID

The Above figure shows the block diagram of Biometric Online Signature Verification with added security of unique ID. In this system following blocks are used.

i. Input Device for signature (Resistive Touchscreen)
ii. ADC
iii. Microcontroller
iv. Keypad
v. Database
vi. Display of Result

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i. Input Device for signature (Resistive Touchscreen) :

Here we are using touch screen as an input device. It is used to captured the signatures which are in the form of analog signals. These signals are converted into a digital signal by using analog to digital converter [4]. Resistive touch screens consist of a glass or acrylic panel that is coated with electrically conductive and resistive layers made with indium tin oxide (ITO) as in above figure [8]. Any type of pen, probe, including fingers, gloved fingers, credit cards, pens, etc., that can be used to apply on the top film then this will activate the screen.

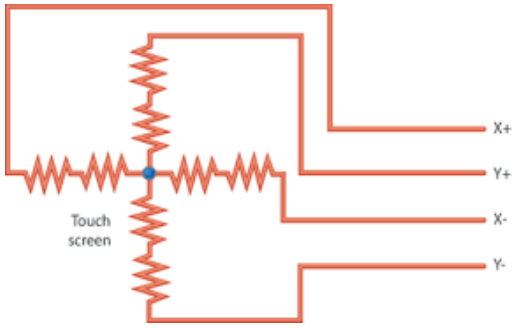

Fig 2: Internal structure of Resistive touch screen

Here we are using 4-wire Resistive Touchscreen having terminal X+, Y+,X-,Y-. Resistive touch screen is so named because they are basically resistive voltage dividers when we touches for the signature. Touch screen provides the signature information to the microcontroller.

i. Analog to Digital Converter:

An Analog to Digital Converter (ADC) is a very useful feature that converts an analog voltage to a digital [4]. This Arduino has inbuilt function of conversion of analog to digital. On the Arduino board, these pins have an 'A' port in front of their label (A0 through A5) to indicate these pins can read analog voltages. ADCs can vary greatly between microcontroller. The ADC on the Arduino is a 10-bit ADC meaning of that is, it has the ability to detect 1,024 (2^{10}) discrete analog levels[4].

ii. Microcontroller:

The ATMega328 is Atmel's high performance, low power 8-bit AVR Microntroller. Here we using Arduino Uno is a microcontroller board based on the ATmega328 [9]. It has 14 digital input/output pins, 6 analog inputs. Operating voltage of its is 5v. The Arduino Uno has a number of facilities for communicating with a computer. The Arduino Uno can be programmed with the Arduino software. An open source design. The Arduino Uno can be powered via the USB connection or with an external power supply[9].

iii. Keypad:

A keypad is a set of buttons arranged in a block or "pad" which usually bear digits, symbols and usually a complete set of alphabetical letters. If it mostly contains numbers, then it can also be called a numeric keypad. Here by using keypad we can entered the unique ID to the each signature. Here we are entering four digit UID to each signature.

iv. Database:

A database is a collection of information that is organized so that it can easily be accessed, managed, and updated. Here we are using EEPROM 24C08IC to save the coordinates of the signature.

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v. Display of Result:

As this is the signature verification system so the result of signature matching or not, as well as UID is also correct or not is given on the LCD display. The data lines D7-D0 of LCD are connected with the port B, control signals RS,R/W,EN are connected with the PD0,PD1,PD2 pins of the AVR microcontroller respectively.

IV. LOGICAL VIEW BIOMETRIC ONLINE SIGNATURE VERIFICATION WITH ADDED SECURITY OF UNIQUE ID

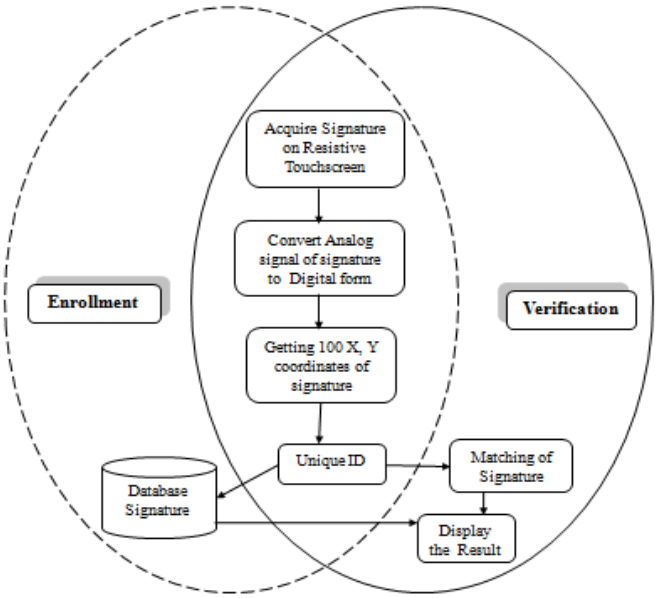

Fig 3: Logical View of Biometric Online Signature Verification with added security of unique ID

A biometric system can be classified into two modules-

i. Database Module
ii. Verification Module

i. Database Module:

The Database Module is a for collecting and organizing information about the signature. Then user signed his/her signature on the four wire resistive type touchscreen. Then the microcontroller unit will convert this signature in digital form as well as coordinates of signature is stored in memory location.

The Database stored information of signature in the form of coordinates. This is the first step in which signature is acquired by using the touch screen. In database creation, we have to generate the reference signature. After that we have to assign the Unique ID to the each signature. Then the reference signature is stored in the EPROM IC. These both signature coordinates and UID are stored in the database. Here for the testing purpose we created four signature database which are stored in the different memory location.

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ii. Verification Module:

Verification module matches the coordinates with the database. As well it gives the decision that the signature is verified or not. This is the second step in which signature is verified. Same as in database stage signature is acquired on the touch screen. Then this signature is matches with the reference signature, which is already stored in the database. Then entered the UID of that assigned signature. This takes the decision that signature and UID both are correct then result displayed that is "signature verified" or "signature is not verified". If signature is correct but UID is incorrect then also signature is not verified and system will go to first level and message is displayed on LCD as "incorrect UID".
Array Arranged in memory IC24C08 of the database are as follows [4].

Table1: Array of signature coordinates

Sign 1 Array	**Sign 2 Array**	**Sign 3 Array**	**Sign 4 Array**	**Verification Sign**
Memory Location	Memory Location	Memory Location	Memory Location	Memory Location
X_0	X_{200}	X_{400}	X_{600}	X_{800}
Y_1	Y_{201}	Y_{401}	Y_{601}	Y_{801}
X_2	X_{202}	X_{402}	X_{602}	X_{802}
Y_3	Y_{203}	Y_{403}	Y_{603}	Y_{803}
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Y_{199}	Y_{399}	Y_{599}	Y_{799}	Y_{999}

Here we use the Coordinate method. In that each signature is split into 100 x, y points. This means here we get the 100 coordinates of each signature with respect to x and same as for the y. So this 200 location is stored in the EPROM memory IC 24C08. Likewise, each signature is stored in this fashion. Here we are creating four signature databases. The fifth location is for the verification phase.
In this biometric system for online signature verification, we were using one to one matching of coordinates

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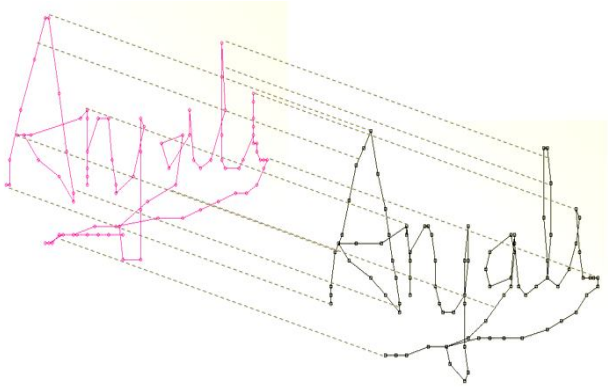

Fig 4 : One to one matching of Signature

The above figure shows the one to one matching of the coordinates points. Here we show the two signature, which are captured for the database as well as verification phase. In an experimentation of biometric online signature verification with added security of unique ID every time we are getting the 100 points of each signature. So here we were getting 100 x coordinates and 100 y coordinates of each signature. These 200 x,y coordinate's are stored in the memory location of the sign 1 as shown in the above table. Likewise, other signature is stored in sign 2, sign 3 and sign 4 because here we are using four signatures for the database. The fifth is the verification sign array.

Here for the X coordinates:

X_D is the coordinates of database signature.
X_V is the coordinates of verification signature.

$X_D = X_1, X_2, X_3 \ldots\ldots\ldots\ldots X_{100}$

$X_V = X'_1, X'_2, X'_3 \ldots\ldots\ldots\ldots X'_{100}$

Same for the Y coordinates:

Y_D is the coordinates of database signature.
Y_V is the coordinates of verification signature.

$Y_D = Y_1, Y_2, Y_3 \ldots\ldots\ldots\ldots Y_{100}$

$Y_V = Y'_1, Y'_2, Y'_3 \ldots\ldots\ldots\ldots Y'_{100}$

For the verification of the signature we are taking the difference of the coordinates of the database and verification.

Difference Coordinates (DC) = $[(X_D), (Y_D) - (X_V), (Y_V)]$

If $(DC) \leq 10$…….then the signature point is verified otherwise not.
From the above formula we can verify the signature

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V. RESULTS

In the following figure, first row shows the enrollment signature and second row gives the verification signature.

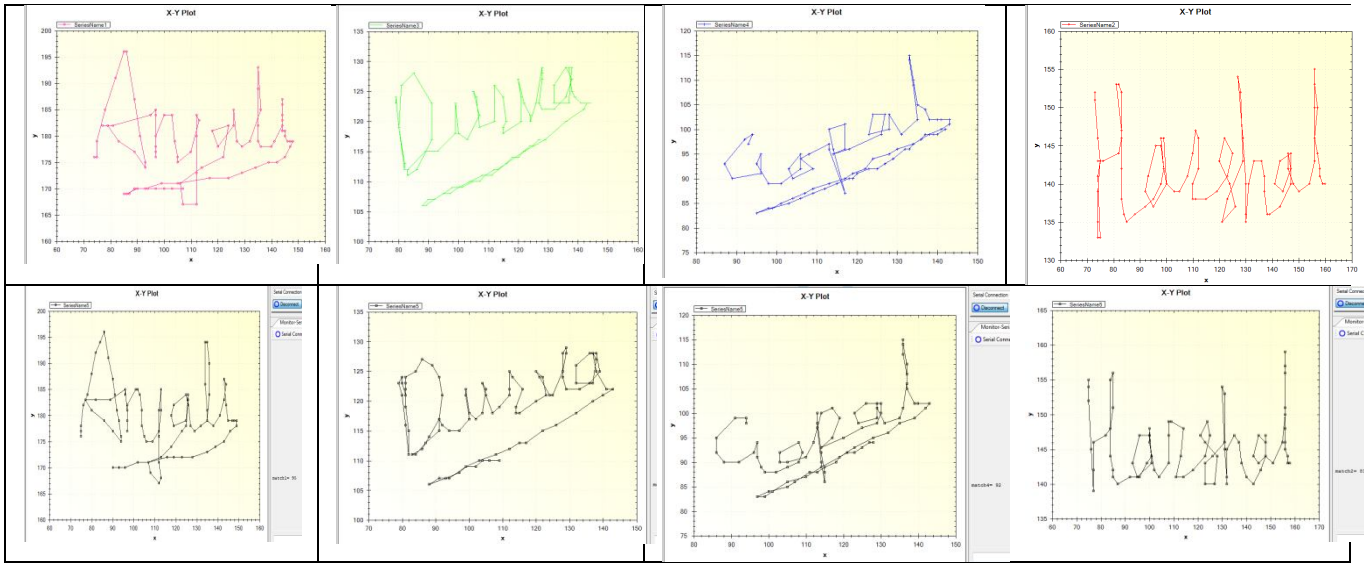

Fig 5: Verification Signature with result

The result table shows the matching percentage of the signature. As here we are created four signature database. Here we are setting 70% threshold for the verification of the signature. The following table shows the verification of the signature. In this if coordinates matches above the 70% then signature is verified that is shown in bold fig. The other are the matching percentage with the other stored database. The below table shows the matching percentage of various database signature.

Table 2: Results of signature Verification

No. of Signature	**Matching percentage of Signature with Database**			
Signature1	**95**	43	59	10
Signature2	23	**81**	12	23
Signature3	23	46	**78**	30
Signature4	17	34	11	**92**

VI. CONCLUSION

This implementation introduces the Biometric Online Signature Verification with added Security of unique ID with the coordinates method. Here we are giving additional security of the system by adding UID to the each signature. This means that the system gives the signature verification as well as UID too. In this system each signature has got 200 coordinates, that is about 100 for the x coordinates and 100 for the y coordinates. Above 70% signature matches, then the signature is verified or vice versa. The advantage of this implementation is that, we are getting signature verification with UID for additional security.

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