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Real Time Dynamic Signature Verification

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ABSTRACT: This paper discusses about a method to develop a real- time dynamic signature verification system as a means of identity verification and authentication of individuals requiring admittance to places, objects or services with restricted access. It extracts dynamic features such as the coordinates of the signature, time taken to complete the signature and uses template extraction as a method for creation and storage of signature templates in a database to be used for verification of real-time test signatures

KEYWORDS: dynamic, biometric, slope, template, real-time.

I. INTRODUCTION

Signatures are widely accepted all over the world for validation of documents, making computerized verification of signatures as a means of authentication and authorization imperative. Signature verification may be offline or online. While offline signature verification is performed on signatures on ordinary paper, online verification is done in real-time with the help of a tablet and stylus. Also, the signature verification can be done using static features or dynamic features of the signature. Static features refer to height, thickness, length of the signature whereas dynamic features refer to the speed of signing and time taken for signature. The online signature verification proves to be more advantageous than the offline verification system since it includes the extraction of dynamic features of the signature which are not very easy to forge. Forgery is the real threat to private documents and authorization for a person which needs to be prevented. In today's life, when everything is digitized, majority of our banking transactions, employee identity information working in high profile institution or government offices, electronic transactions, authorization of personnel for access to confidential information and authentication of persons needing access to devices or buildings have become online. So, access to a person's confidential information has come under a threat.

This important authentication can be done using the signatures of the individual which is the biometric feature and is unique for every individual thus forgery can become difficult if a strong authorization system is developed. 'Real Time Dynamic Signature Verification' is the system discussed in this paper. The objective of this project is to develop a signature verification system as a means of identity verification and authentication of individuals which will verify the signature of an individual which is the behavioural biometric feature. The person is made to sign on a touch screen and data is serially transmitted to the laptop using an USB port. The signature is verified against the stored database and depending upon the matching percentages access is granted.

Section II discusses about the related work, Template extraction method is explained in section III, section IV talks about the methodology used, section V describes about the results achieved and section VI concludes the work.

II. RELATED WORK

Arth Koeri [1] proposed a system where matching is done by using embedded c technology. Static and dynamic features of signature were used by Mayank Vatsa et al. [2] where 1D - log Gabor wavelet and Euler numbers are used to analyse the textural and topological features of the signature respectively. Verification using feature representation

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presents a method based on self-taught learning in which a sparse auto encoder attempts to learn discriminative features of signatures from a large unlabelled signature dataset done by M.Fayazz et al. [3]. Biometrics is used by Fincy Francis et al. [4] for the verification of signature.

Signature verification using 2D colour barcodes where template is stored in the form of barcode is the method proposed by M.Querini et al. [5], Texture segmentation in Gabor space where gabor algorithm is used for matching is the method discussed by Bigun J et al. [6]. Verification using segment level fuzzy modelling where signature verification is done by using neural networks and fuzzy logic method is given by A.Q Ansari et al. [7]. Distance based technique where each signature is represented as a feature vector is mentioned by Mohit Arora et al. [8]. Approach based symbolic representation where online signatures are represented by interval valued symbolic features is developed by D.S Guru et al. [9]. A.Grillo et al. [10] talks about the high capacity 2D barcodes for the signature verification.

III. TEMPLATE EXTRACTION

The method used in this paper is template extraction. This method generates a template for the database and later during recognition of signature it is the source to which to real time generated template is compared. This method determines the speed of the signature in terms of time taken by the user to sign and the slopes between the consecutive points in the signature is calculated and stored as a template. The GUI of the system shows the speed of the signature in terms of the time taken, space for entering the name of person, box at the left corner which will show the signature signed on the touch screen, bottom box which shows the extracted co-ordinates and the right sided box shows the matching percentage and time against the name of the person requiring the verification. It is advantageous as compared to other methods because it extracts less features like co-ordinates of the signature and speed and not the angle and pressure so that the system can work in the real time by taking less computation time for recognition and the user will not have to wait for longer time to get the signature verified. The signature co-ordinates which are extracted has a limit of 1000 points. If the limit exceeds then the signature is not considered for the verification. The problem of varying signature sizes is also solved by using this method because irrespective of size of signature the slopes of the signature remains the same. Programming is done in such a way that if the signature obtained is small in size then it is expanded by repeating the co-ordinates and if the obtained signature is large in size then some of the co-ordinates are skipped. This procedure is carried out to bring the required number of co-ordinates which can give accurate results and no extra time is consumed for computation of results.

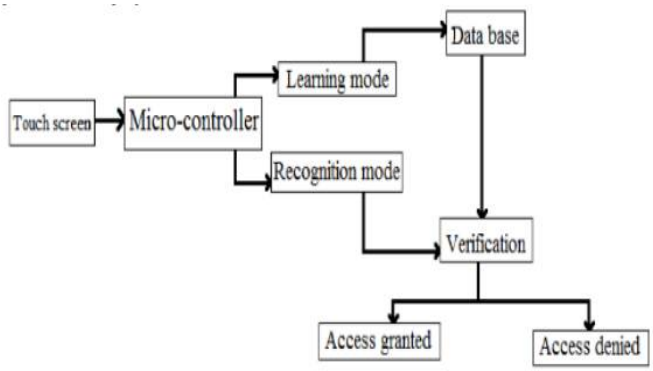

Figure 1: Overview of system

Figure 1 shows the overview of the proposed system. The touch screen takes the input signature from the user on the touch screen and the extracted x-y co-ordinates are transmitted serially to the micro-controller. The system works in two modes i.e. Learning mode and Recognition mode. In learning mode, the input signature is processed and the calculated slope values between the successive points of the signature are stored as a template in database. In recognition mode, the same learning mode procedure is repeated and then the system enters in the verification mode

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and the template generated in the real time is compared with the database template. The less the difference between them, the more is the matching percentage and accordingly the access is granted or denied.

The proposed system block diagram is as shown in Figure 2.

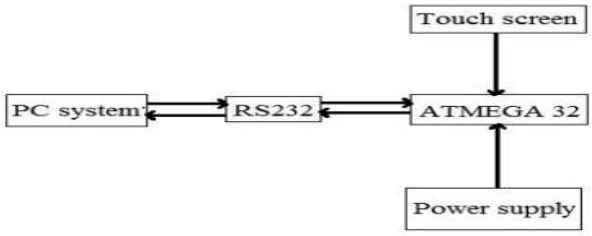

Figure 2: System block diagram

As per the block diagram in Figure 2, the complete system is divided into five parts. The parts are explained as follows:-

1. **PC system:** The PC is the system where the signature verification is done with the help of software Ms Visual Studio. It takes the input serially from USB port RS232. It shows the output on the screen in GUI of the project.

2. **RS232:** RS232 is the interface between the PC and the micro-controller. It requires +5V for its working. It does the conversion of TTL logic to RS232 logic and vice versa. TTL logic 1 is +5V and logic 0 is 0V. The RS232 logic 1 is -10V and logic 0 is +10V.

3. **Atmega32 micro-controller:** Micro-controller is the heart of the system. In this system, micro-controller of the AVR family is used. It monitors and controls all the peripheral devices connected to it. It receives the co-ordinates of the signature in parallel manner and sends it to the PC in serial manner through the USB RS32. It works on +5V power supply.

4. **Touch Screen:** The touch screen used in the system is resistive. It is a 4-wired touch screen in which the 2 screen layers are separated by small distance. The voltage is generated whenever the screen is touched. The electrodes are located on the top and bottom of one sheet and along the left and right of the other sheet. To measure the vertical co-ordinate, voltage is applied to the top electrode and bottom electrode is grounded. To measure the horizontal co-ordinate, voltage is applied to the left electrode and right electrode is grounded. The touch on the screen causes the 2 sheets to short and the voltage is read from the bottom sheet. This supply of voltage is managed in this system by programming the micro-controller.

5. **Power supply:** The power supply system used in the project consist of full wave rectifier, transformer, filter and regulator. This circuit converts the input 9V supply from an adapter to desired 5VDC.

IV. METHODOLOGY

The system developed and discussed in this paper mainly uses two programming languages that is embedded c and vb.net. Embedded c is used to program the micro-controller used in the system and our main project GUI is programmed in vb.net language. The softwares used to implement these programming languages are AVR studio for embedded c and MS Visual Studio 2008 for vb.net language. Another important software used in the system is for collection and preservation of database required for the signature verification is SQL software.

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V. RESULTS

The database has been generated for the implementation of the system. The generated database consist of 16 subjects with 10 sample signature templates for each required for the verification.

In learning mode, the co-ordinates of the signature are extracted from the resistive touch screen, digitized by the Atmega32 integrated circuit and accepted serially into the computer through the RS232. Slopes between consecutive points are then calculated to be stored along with the username and time taken for completion of each signature database. These templates are to be compared with test signatures to produce the percentage of matching of test signatures, which is then tested against a threshold of 65% to grant/deny the access to the test users.

In recognition mode, the slope and the time are calculated but not stored instead, the generated real time template is compared with the stored template. The verification procedure is carried out for 1 subject out of the total generated database. The signature picture on GUI, the recognition mode picture and the denied signature picture obtained as results are discussed here.

Figure 3 shows a picture of a signature in recognition mode when the subject has just signed on the touch screen.

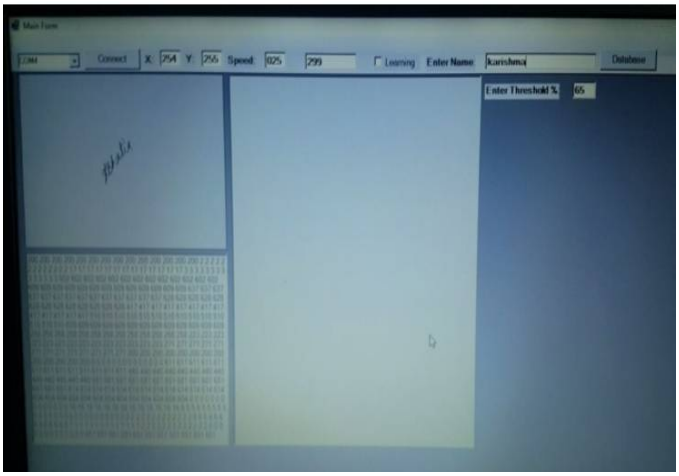

Figure 3: Image of Signature on GUI

After the picture of signature been displayed on the screen of the computer for some time , the signature disappears and the real time template is generated. This template is compared with the database and then results are generated. If the difference between the stored and the real time generated template is less, then the matching is more and if the percentage of matching crosses the threshold percentage, a welcome message with the username is displayed.
Figure 4 shows the picture of the verified signature along matching percentage, time taken for signature and a welcome message.

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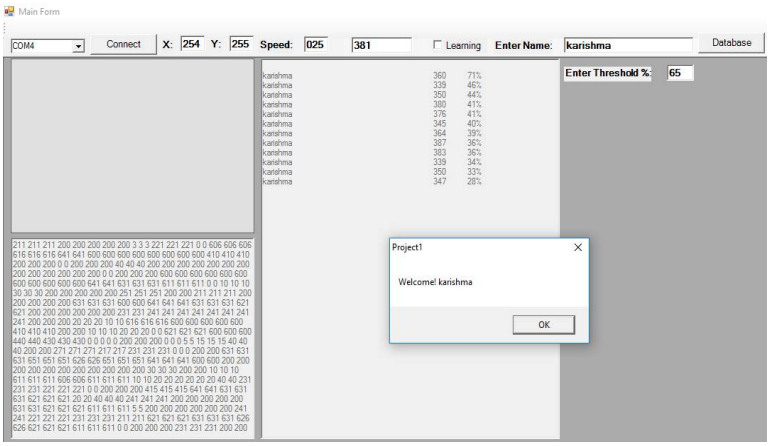

Figure 4: Verified signature

But if the difference between the stored and the real time generated template is more, then the matching is less and if percentage of matching falls below the 65% threshold, the message that no match found is displayed is as shown.

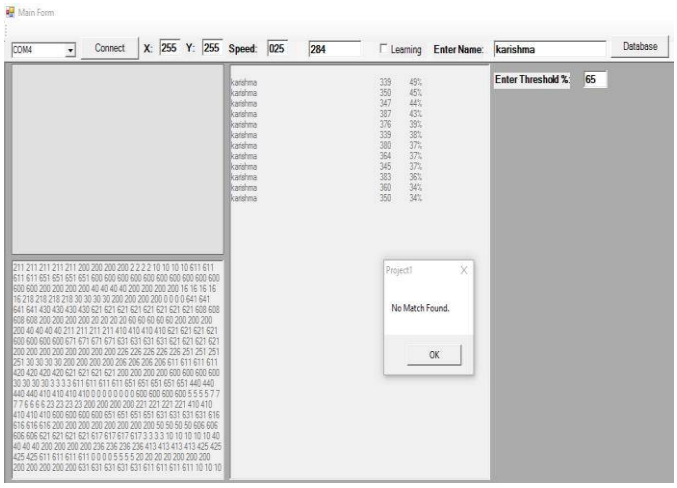

Figure 5: Unverified signature

VI.CONCLUSION

A reliable system has been developed for authentication and authorization of signatures using the slopes of the points which are stored as template. The coordinates of the samples are used to calculate the slope to be stored as templates in an extensive database. This template is used to calculate the difference between the stored template and real time generated template and the percentage of matching of signature accepted in real-time in recognition mode. A global threshold is used to grant or deny access to users. The accuracy of the system depends upon the quality of the screen and the person's signature similarity as compared to that stored in database. Signature verification as an identification measure can find applications in both public and private sectors such as in e-banking, examination centers, attendance system in offices and other work places.

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