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A Review: Embedded System for Biometric Online Signature Verification

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***Abstract*—** In Biometric authentication system Signature is an important characteristics to verify the identity of person. Signature is the type of behavioral biometrics. In Signature Verification system, signature is split into two types: Online(dynamic) and Offline(static). In Offline (static) signature verification image is taken as an input of a signature and which is useful in signature verification. Where as in Online (dynamic) signature verification uses signatures which are captured by touch screen, pressure-sensitive tablets that gives the dynamic properties of a signature. The aim of this work is to design an authentication based system on handwritten signatures. Signature verification is an important research topic in the area of biometric authentication. This article presents the review of research achieved in the past in online signature verification and also gives the proposed method for the Embedded system for Biometric Online Signature Verification.

Keywords- *Biometrics; Touch screen; authentication; databases; verification; MATLAB*

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I. INTRODUCTION

Biometric is the most secure and helpful authentication tool. It cannot be borrowed, stolen, or forgotten and forging one is practically impossible. The biometrics measure individual's unique physical or behavioral characteristics to recognize or authenticate their identity. Common physical biometrics include fingerprints, hand or palm geometry, retina, iris, and facial characteristics. Behavioral characters's characteristics include signature, voice, keystroke pattern, and gait[4]. Of this class of biometrics, technologies for signature and voice are the most developed. The Signature verification system has many different characteristics of an individual's signature in order to identify that individual. The one of the most important advantages of the signature over other biometric is of its long standing tradition in many commonly encountered verification tasks. It has been used for decades in civilian applications while other methods such as face recognition, fingerprints, hand geometry has still the stigma of being associated with criminal investigations. In other words, signature verification is already accepted by the general public[9].

Signature verification is a very important research area because the information required is not sensitive. Forging of one's signature does not mean a long-life loss of that one's identity. The basic idea is to investigate a signature verification technique which is not costly to develop, is reliable even if the individual is under different emotions, user friendly in terms of configuration. In signature verification system, the signatures are processed to extract features and that are used for verification purpose. Normally signature verification is divided into two types: offline and online also referred as static and dynamic signature, which is based on data available in the input[2].

Offline signature (static): The input of offline signature verification is the form of image as a signature and which is useful in automatic verification signature found on bank check and account.

Online (Dynamic): In dynamic signature verification system signatures that are acquired by data acquisition devices such as pressure-sensitive tablets, touch screen and webcam that extract dynamic features of a signature in addition to its shape (static), and this can be used in real time applications like credit card transactions, protection of small personal devices (e.g. PDA), authorization of computer users for the accessing sensitive data, and authentication of individuals for access to physical devices[2].

The signature verification has three benefits over other biometric techniques. First these days it is a socially accepted method which is present days used in banks and credit card transaction. Second, it is very much helpful for the new generation of portable computers and personal digital assistants (PDAs) used. Third, a signature may be changed by the user. Likely to a password while it is not conceivable to change finger prints iris or retina patterns. The signatures of the each person cannot be same, it varies with time. This factor is not considered in offline signature verification system, For online signature verification system these basics are studied to implement the system more accurate and reliable. Numbers of techniques have been proposed to authenticate forgeries. Some of them are discussed in this paper to provide the performance analysis in the field of online handwritten signature verification system[1].

Here we design this paper in six sections; Section I is the introduction part, Section II describes the Factors affecting on Embedded system for Biometric online handwritten signature verification system. Section III presents the basic aspects of data acquisition, preprocessing stage and feature extraction . The brief description of Literature review is given in Section IV. In the Section V Proposed System of this work Finally the conclusion of the paper is reported in Section VI.

II. FACTORS AFFECTING ON EMBEDDED SYSTEM FOR BIOMETRIC ONLINE SIGNATURE VERIFICATION

The major of factors affecting in signature verification is that the same persons signature variation in the shape over time [1]. For that, the skilled forgers can perform forgery with the same as that of the user's signature. The variability occurred for the same is nothing but the inter-person variability. The Signature of user taken at different times is the intra-person variability. This is the major factor to differentiate both and to getting the best result. The signature is a practiced, very quick and repeatable motion. Over a time period Signature may be changed, and get the totally new signature.

DATA ACQUISITION AND PREPROCESSING AND FEATURE EXTRACTION

A. Data acquisition

One of the signature verification system subdivided is data acquisition that is required to obtain the signature of the user which can be supported by different types of input tools to collect the signals for classification and it deals with the real time input of the signature[2]. In the signature verification system, signature is acquired from a special input device such as digitizer, touch screen[1]. The touch screen to obtain signature images for testing purposes. It is used to sense signature, which are in the form of analogue signal. This is a resistive type touch screen as an input device. Resistive touch screen also named because they resistive voltage dividers. The four wires of touch screen are X+, X-, Y+, Y- are connected.

B. Signature Pre-processing

The main function of pre-processing is to reduce the noise[1]. When data acquisition is over then preprocessing steps are performed to improve the performance of a verification system. The preprocessing stage also helps to reduce noise and normalized the signature stroke[4]. Typically, there are two stages in the preprocessing phase. These include smoothing and normalization.

Smoothing

Because of digitizer as an input device, the input data have noisy point and which have to be removed. So to remove this noise here we are applying smoothing in signature verification system.

Normalization

In signature verification systems where tablets of different dynamic areas are used, signature size normalization is used frequently as a preprocessing technique. Comparing two signatures having the same shape with different sizes would result in low similarity scores. Size normalization is given to remove this effect.

C. Feature Extraction

In Signature verification system various features are being used to achieve the better result. Feature extraction is one of the most important step in signature verification. In Signature verification system various features are being used to achieve the best result. The feature extraction plays very important role in signature or handwriting verification system. The features are dependent on the shape of the signature and it is independent of the data acquisition device that is the input device.

Two types of features can be used for signature verification: parameters or functions. When parameters are used as features, the signature is characterized as a vector of elements, each one representative of the value of a feature. When functions are used as features, the signature is characterized in terms of a time-function, whose values constitute the feature set. In general, function, features allow better performance than parameters, but they usually require time-consuming matching procedures[7].

Global and local are the two types of parameter based features. The Global features gives the entire signature image in the form of Signature area, width, height, aspect ratio. Global features are less sensitive to noise. Local features gives the properties of signature image in specific parts that is in the form of a segment. Local features are obtained from by partitioning the signature image into parts. The performance of signature verification systems is nothing but the accuracy of the genuine and forged signature. The evaluation parameters are False Acceptance Rate(FAR) and False Reject Rate(FRR).

III. LITERATURE REVIEW

This section gives reviews some of the existing signature verification systems such as Online Human Signature Verification System, Digitizing Tablet and digitalize pen, Hidden Markov Models (HMM's), and Neural Networks and FPGA.

A. Online Human Signature Verification System

Luan L. Lee, Toby Berger, and Erez Aviczer [8]developed a Reliable Online Human Signature Verification System. In this he developed an On-line dynamic signature verification system. Here he designed and tested of data base having more than 10,000 signatures in (x(t), y(t)) form and these signature was captured by using a graphics tablet. Here he extracted a 42-parameter feature set at first, and advanced to a set of 49 normalized features that tolerate inconsistencies in genuine signatures while retaining the power to discriminate against forgeries. Here he Used a PC with a 486-processor, the verification algorithms require less than 1.5s verification time, even without any effort at optimizing the algorithm code. Chip-based special purpose hardware in a commercial realization of the system would run considerably faster. A smart card implementation also appears feasible[8].

B. Digitizing Tablet and digitize pen

Here we studied Several works related to information fusion for signature verification have been presented. However, few works have focused on sensor fusion and sensor interoperability. He implemented online signature verification systems are using the Tablet PCs and its pen. For capturing the signature Tablet PC is a used. It captures both the dynamic and static characteristics of a signature at the same time. Here commonly used data acquisition device is a digitizing tablet. However, the signing process using digitizing tablet is

different because the signer instantaneously cannot see what he has written, which may cause inconvenience [5]. Digitize pens with touch-sensitive screens and digital-ink technologies are developed to avoid signer disorientation by providing immediate feedback to the writer. In a digitize pen several electronic components are used to detect pen motion, velocity, inclination, and other dynamic features which are extracted during the signing process[6].

Alonso-Fernandez [5] implemented a system for securing access and securing document application using the Tablet PC system. Here he evaluated two different commercial Tablet PCs are which includes information of interest for signature verification systems that is sampled and pressure statistics. In this work he used the two different PC are Hewlett-Packard TC 1100 with Intel Pentium Mobile 1.1 GHz processor and Toshiba Portege M200 with Intel Centrinto 1.6GHz processor. The signature verification systems based on the pressure statics of the signature. The experiment reported in showed that both Tablet PCs samples at a mean frequency of about 133 Hz, but the instantaneous sampling period is not constant. Particularly in the HP Tablet PC, sampling period oscillates during the entire signature. To cope with this problem, the position and pressure signals have been down sampled to a constant sampling frequency of 100 Hz by using linear interpolation. Also, the two Tablet PCs provide 256 pressure values[7]. The experiments were tested against both random and skilled forgeries by using database containing 3000 signatures.

A. K. Jain, Friederike D. Griess, Scott D. Connell [3] utilized a digitizing tablet to get the dynamic information of writing signature. He implemented the system using a digitizing tablet which is The IBM Cross Pad has a sampling rate of 100–150 samples per second and records the x- and y-coordinates of the points in the signature. The pen has a touch sensitive switch in its tip such that only pen-down samples are recorded. IBM Cross Pad from A.T. Cross Company is used for the data acquisition. He implemented and evaluated with 1232 signatures from 102 different writers. The two datasets are called as DB1 and DB2, These are used for evaluation. The first dataset, DB1, contains 520 signatures from 52 writers, approximately one-fifth female[3].

C. Hidden Markov Models

Hidden Markov Models have been used in a multitude of application areas such as signal processing, speech recognition, pattern recognition and is successfully implemented in signature verification as well. HMM is an effective statistical modeling approach in which an observable sequence is generated by the underlying process. HMMs models have found to be well suited for signature modeling since they are highly adaptable to personal variability. HMM performs stochastic matching of the two signatures using a sequence of probability distributions of the features along the signature.

Mohammad M. Shafli and Hamid R. Rabiee [9] made a signature verification system using variable length segmentation and Hidden Markov Models. In this system he proposed a system that segments each signature based on its perceptually important points and then computes for each segment a number of features that are scaly and displacement invariant. The signature was represented by using the HMM as a sequence of vectors of values which are associated to each point of signature in its paths. To separating the each segment of the signature seven parameters were extracted for each person, mean (μ) and variance (σ) of the log-likelihood are obtained from its HMM model divided by average segments number for his/her signatures in the training set and these values were saved beside the HMM model as a template for his/her signing process. These two values show the acceptable range of log likelihood value for genuine signature. In the verification phase to test the signature, he give the log-likelihood score and this signature is accepted if the resulting value of log likelihood (p) is satisfied[9].

D. Neural Network and FPGA

Sami Ei Moukhlish, Adbessamad and Abdellatif Hamdoun[10] designed, handwritten signature recognition system based on neural networks and FPGA implementation. The designed architecture is described using Very High Speed Integrated Circuit Hardware Description Language. In his proposed application consist of feature extraction from handwritten digit image, and classification is based on Multi Layer Perception. The training part of neural network has been done using MATLAB program. Here they developed single neuron and proposed a solution for connecting neurons into a multilayer feed forward BP neural network[10]. The architecture of the network is modular and possible to increase or decrease the number of neurons as well as layers. The aim of his work is to be able to use the weights calculated in a software environment in the hardware implementation in FPGA. The main obstacle in the proposed system is the hardware implementation for the approximation of sigmoid activation function.

IV. PROPOSED SYSTEM

Here we proposed a system for Embedded System for Biometric Online Signature Verification. This circuit is wired around the Atmel's AVR microcontroller .The algorithm in this work is based on coordinates method. In that the signatures are generated & stored in the permanent memory in the form of lookup table. During runtime, the signatures are again generated in real time and compared with the stored signatures.

Here we used resistive type touch screen as an input device. The four wires of touch screen are X+, X-, Y+, Y-. Resistive touch screen also named because they are resistive voltage dividers.

It is used to sense the signatures which are in the form of analog signals. These signals are converted into a digital signal by using analog to digital converter. After processing, Microcontroller unit will stored the data in the memory & the corresponding message, i.e. "signature registered" will be displayed on the LCD display. Digital forms of signatures are stored in the form of an array. When same signature comes on the touch screen, the same process will be repeated. Microcontroller unit will verify the signature with the database signatures & if the signature matches with the corresponding signature of the database, the message "signature correct" will be displayed on the display. If the signature does not match

with the database, then message “signature incorrect” will be displayed on the display

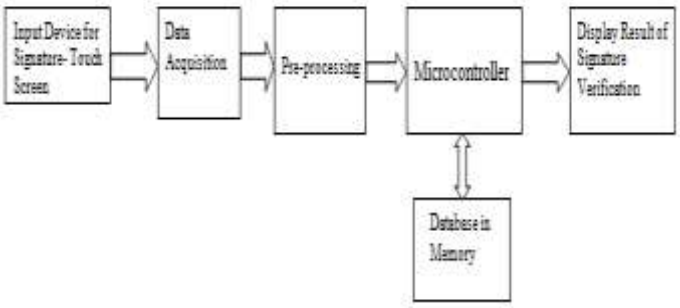

Figure1: Block diagram of Embedded System for Biometric Online Signature Verification

V. CONCLUSION

This review article gives the detailed overview of dynamic signature verification. Many researchers worked on online signature verification. It is biometric technique for person identification. It is used in banking for document verification. The main weakness of the signature verification is that signature varies with mood, illness and age. Also signature acquiring device is the major thing in signature verification system.

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