

Review and Proposed Methodology for a Lecture Attendance System using Neural Network

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Abstract— The place of verification and identification is increasingly important in this century even as technology all-over the world is tending towards E-Systems. These systems include e-voting, e-commerce, e-banking among many others. To avoid impersonation, high security integrity can be achieved via verification and/or identification in the above highlighted e-services. In implementing the above stated verification and/or identification process, certain unique human features are needed that are accessible and cannot be forged easily. This results in obtaining biometric features for authentication purposes. The verification method could be either online, offline or a hybrid system (combination of the two methods). This paper presents a review of online signature verification methods using image processing. These were effectively analyzed with relevant methodology proposed and conclusions drawn for a university lecture attendance system.

Index Terms— Biometrics authentication, Verification, Identification, Online Signature, Neural Network.

I. INTRODUCTION

BIOMETRICS authentication is an “automatic identification or identity verification of an individual based on physiological and behavioral characteristics”[1]. Verification in this context means comparing the captured physiological or behavioral characteristics with previously enrolled physiological or behavioral characteristics reference template stored in the system. This is simply a one-to-one comparison. On the other hand, Identification recognizes an individual by searching the entire enrolment template database for a match. This simply means one-to-many matching. These two phenomena are illustrated in Fig. 1.

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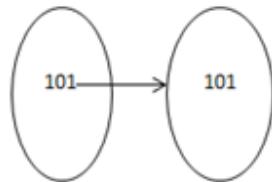
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A few researches have been done in the aspect of online signature verification system in relative to offline verification

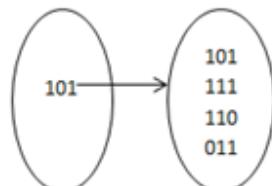
methods. This makes online verification one of the major subjects of discussion especially in this decade.

II. BIOMETRIC VERIFICATION

There are different methods of carrying out biometric verification/identification using physiological/behavioral features of an individual. These include signature recognition, facial recognition, fingerprint recognition, voice recognition and iris recognition.



(a)Verification: One to one matching



(b)Identification: One to many matching

Figure 1: Illustration of identification and verification

Among the above highlighted methods, signature recognition is the most widely used verification/identification method. [2]. Signature recognition plays a vital role in commercial, legal and financial transactions. Signature serves as a seal in showing the authenticity of a document. This is also used in digital procurement systems used in multinational organizations.

III. ONLINE AND OFFLINE VERIFICATION TECHNIQUES

There are two distinct techniques of signature verification/identification in image processing. These include:

- a. Offline or Static Signature Verification/Identification Technique
- b. Online or Dynamic Signature Verification/Identification Technique

A. Offline or Static Signature Verification Technique

In Offline signatures verification method, Scanner or camera is used to capture signatures signed in the conventional way (signing on paper). Signature images generated through this means contains noises that needed to be removed to get high quality images. And also they need to pass through thresholding and morphological operations before robust features can be extracted from them. There are many feature extraction techniques that can be used to get invariant robust features from signature image for accurate verification purpose [1]. Typical pattern classifiers that are widely used for offline signature verification include Euclidean distance, Support Vector Machine (SVM) and Artificial Neural Network (ANN) [2]-[5].

B. Online or Dynamic Signature Verification Technique

This is based on dynamic or varying characteristics of the process of signing on electronic devices. The dynamic features include: number of strokes, overall speed of signing, pen pressure at each point and spatial information (x- axis versus time plot, y-axis verses time plot and pressure versus time plot). All these features logically make forgery more difficult [6][7]. An applicable signature pad product for this purpose is Wacom STU-Series [6][8].

In [9], comparative study on the consistency of twenty two (22) commonly used features in online signature verification was made. This paper shows that speed (distance variation with time), coordinate sequence (X, Y, [X,Y]) and the angle α ($\cos(\alpha)$, $\sin(\alpha)$) have high consistency and are therefore reliable.

A survey was carried out on the offline and online signature verification system in [10] which identified eleven (11) different approaches for verification processes. Each approach was highlighted with their corresponding False Rejection Rate (FRR) and False Acceptance Rate (FAR) percentage calculated.

IV. LITERATURE REVIEW OF ONLINE SIGNATURE VERIFICATION

A. Handwritten Signature Recognition and Verification using Neural Network by Pradeep Kumar et al, 2013.

This paper focuses on the image processing, geometric feature extraction, neural network training with extracted features and verification. The work further introduces the neural network method of signature verification which is further divided into two stages namely: training stage and testing stage. The training stage was further divided into four which are: retrieval of signature image from the database, pre-processing the image, extraction of the needed features of the signature and neural network training. Also, the testing stage

consists of five sub stages which are: retrieval of signature from database, image pre-processing, feature extraction, applying the features extracted to a trained neural network and finally checking the output generated from a neural network [2].

In continuation, back propagation artificial neural network is proposed because of its ease of implementation. The method consists of three layers namely; the input layer, the hidden layer and the output layer.

For the training process, a total of 2000 signature samples of 50 different individuals were used and sourced from the GPDS database i.e., “*Grupo de Procesado Digital de Senales*”. For each individual, a total of 24 samples of genuine signatures and 24 samples of forged signatures were used. 24 neurons respectively were used in the input layer and hidden layer and 100% success was recorded in verifying signatures the system was initially trained for. The major challenge in the proposed neural network method is its inability to give a more accurate result in verifying signatures that it was not initially trained for and signatures that are very similar. It is important to note that this method was applied for the offline signature verification method but its applicability can be seen in online signature verification method if a real-time image of the signature is captured using a digital tablet [2].

B. Online Handwritten Signature Recognition by Length Normalization using Up-Sampling and Down-Sampling, Fahad Layth Malallah et al, 2015

The x(t) horizontal, y(t) vertical and p(t) pressure coordinates of the captured signature from the digital tablet are pre-processed hereby normalizing them. Thereafter, the important features are extracted which are later stored in the database for identification purpose. This process defines the enrolment process.

On the other hand, the authentication process involves classifying the extracted features of the online signature using Artificial Neural Network and the identification process is done compare the classified features at hand to those in the database. If the comparison is true (it meets a particular threshold value) the signature is accepted if it goes otherwise, the signature will be rejected.

The Normalization Stage

This is performed on signatures with respect to time (t) so as to give all signatures a specific fixed length for uniformity purpose most especially in a situation where the classifier and feature extraction algorithm are tailored towards receiving fixed length signatures. This could either be a down-sampling or up-sampling.

Down-sampling is done in a situation where the length of the signature is more than a fixed time (t) length N' that is acceptable by the system in question while up-sampling is done to increase the length of the signature in order to matchup with the fixed time (t) length N'[11].

The Verification Method

The verification method proposed by Fahad Layth Malallah et al, 2015 is achieved by extracting features from input signatures using Principal Component Analysis (PCA) before

applying Artificial Neural Network (ANN) as classifier. The purpose of the PCA is to increase the rate at which the signature is to be recognized. This is done by increasing the variance and decreasing the correlation between genuine and forged signatures used. This is done by changing the earlier normalized values of $x(t)$, $y(t)$ and $p(t)$ to uncorrelated domain [11].

The ANN topology used was carefully selected after an empirical experiment using MATLAB. The result shows average error rate accuracy without validation to be 3.4%. This result is due to the reason that validation procedures tries to generalize the training data in ANN which resulted in a more competitive rate of verification [11].

V. PROPOSED METHODOLOGY FOR A LECTURE ATTENDANCE SYSTEM

In the context of a university setting, signature plays a vital role in capturing students' lecture attendance. Also, signature serves as a seal in showing the authenticity of a document such, signing of various internal memos, signing of student complaint forms among many others.

Some Basic Identified Challenges and Bottleneck in Manual Lecture Attendance System

Manual mode of signature attendance leads to extra effort from academic staff in the following:

- Sorting;
- attendance percentage calculation;
- setting attendance limit of 75% (This value could lower or higher based on university examination eligibility policy);
- analyzing;
- Uploading and filing of lecture attendance reports.

Also, according to Al Singh, 2010, the level of human efficiency reduces with increase in work load which leads to error of omission or commission. The above statement finds it place in a situation where a lecturer will have to supervise, analyze and calculated attendance percentages for one hundred students compared to working with twenty students [12].

The proposed method in this section further finds it place in proffering a solution to above identified challenges hereby increasing the speed and integrity of attendance taking, analysis, report and filing.

Applicable signature pad products for this purpose are Wacom STU-Series Tablets [8]. For this purpose, Wacom STU-500 is proposed. It has the following features

- It has a high resolution, which makes image processing easier[8];
- Availability of spatial/dynamic signature properties [8];
- Ability to easily integrate it with signature applications in C++, .Net and Java. SDK/API are also available for developers [8].

The proposed system block diagram and hardware/software integration is shown in Fig. 2 and Fig. 3 respectively.

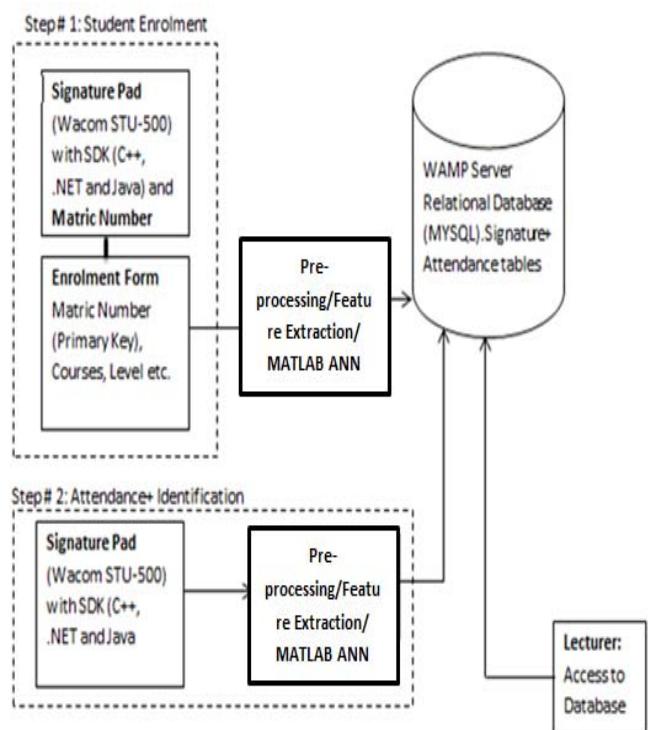


Fig. 2: The Proposed System Block Diagram

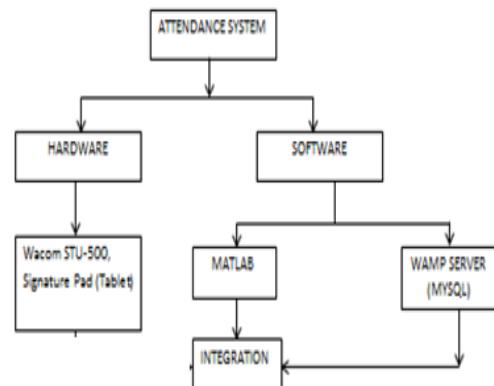


Fig. 3: Software and Hardware Integration in the Proposed System

A waterfall model standard software development life cycle is proposed for the software development of this system. As earlier stated, the signature pad proposed is Wacom STU-500 which has Software Development Key (SDK) for application developers. The Wacom STU-500 also has higher resolution relative to other Wacom STU lesser series. Microsoft Visual Studio (VB.NET) is proposed for creating the above stated application (the enrolment platform). MATLAB is proposed

be used for implementing the feature extraction and matching algorithms as introduced in [10].

Wamp Server (MYSQL) relational database is proposed to be used to create, manipulate and manage tables created for each course/subject taken by the students, enrolment details among many others that will be needed to achieve the aim of the work. This is also proposed to be used to present attendance report summary. It is important to note that the proposed primary key for the relational database is the student matriculation number.

VI. CONCLUSION

The foregoing presents a review of online signature attendance system and a proposed method of developing a signature attendance system using online verification technique. Online signature classification and verification method using Artificial Neural Networks was reviewed. Also, a signature enrolment platform to be interfaced with an electronic signature pad for enrolment and verification processes was discussed. In addition, a relational attendance database was proposed for collation, analysis, storing and reporting of collected lecture attendance details. Furthermore, a unit integration system was proposed which houses both the software and hardware components of the system in question. Lastly, a waterfall software development lifecycle model is proposed. The proposed system is capable of proffering solutions to the various identified lecture attendance issues.

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