Signature Verification System

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Abstract— **Personal identity verification is of great importance in today's world, with one's personal security being of utmost importance. A signature, being a very unique biometric, has been in use for quite some time for the purpose of personal identity verification. Signature verification is the process used to recognize an individual's handwritten signature, primarily for reasons of security. In this project, the dynamic nature of signatures is observed to prevent tampering. Map the x and y coordinates of the signature and use the features extracted from it to verify the signature MATLAB (Matrix Laboratory) has been used to undertake this project.**

Keywords—signature mapping, personal identification & authentication, biometric analysis, MATLAB

I. INTRODUCTION

Personal identification is the process of associating a specific individual with an identity. Identification can be in the form of verification (also known as authentication), which involves authenticating a claimed identity, or recognition (also known as identification), which involves determining the identity of a given person from the database of peoples known to the system.

Two traditional techniques widely used for automatic personal identification are knowledge-based and token-based approaches.

A. Token-Based

Token-based methods use something a person must use for personal identification, such as a passport, driver's license, ID card, credit card, or keys..

B. Knowledge-Based

Knowledge-based methods use something a person knows for personal authentication, such as a password or personal identification number (PIN).It is, however, possible for these authentication methods to be compromised as the person may lose the material or the information required to authenticate themselves.

Biometrics has come up as an alternative to these physical objects of authentication. Various kinds of biometrics are used nowadays and authentication methods based on recognition of iris, finger print and face are not uncommon. One such biometric that is widely used nowadays is the signature. Signature verification is one of the oldest means of identity validation and has been accepted widely, while other methods have been associated with criminal investigation. A reliable signature verification technique can thus be applied in a variety of fields. Handwritten signatures are already accepted as a biometric and they continue to play an important role in many domains.

Traditional bank checks, bank letters of credit, credit cards and various legal documents are an integral part of the modern economy. They are one of the primary ways individuals and organizations transfer money and pay bills. Even today all these transactions, especially financial, require our signatures to be authenticated.

II. METHODOLOGY

For the project, a 4-step methodology has been proposed. The 4 steps of the methodology are mentioned below:

A. Data Acquisition

Data acquisition is the process of collecting and gathering data from various sources. In the case of signature database, data acquisition involves collecting and capturing signature samples from individuals for use in creating a database of signatures. The first step in data acquisition of signature database is to identify the purpose of the database. The purpose may be to create a database for use in forensic investigations, for use in financial transactions or for any other purpose. This project's main use of the database is for academic purposes. The signatures can be collected in a variety of ways, including physical collection, digital collection, or a combination of both.

Physical collection involves obtaining a hard copy of the signature on paper or other material, while digital collection involves capturing an electronic version of the signature using a device such as a simple mobile scanner. Physical collection involves obtaining a signature from an individual on paper. This can be done using a variety of methods, including having the individual sign a document. The quality of the signature can be affected by factors such as the type of pen used, the quality of the paper, and the lighting conditions during the signature process. Digital collection involves capturing an electronic version of the signature using a device such as a signature pad or scanner. The quality of the signature can be affected by factors such as the resolution of the device and the software used to capture the signature. After collecting the signatures, the data needs to be stored and managed properly. In conclusion, data acquisition of signature database involves collecting and capturing signature samples from individuals for use in creating a database of signatures. In the project, a combination of physical and digital data collection has been implemented. The signatures of 50+ classmates were taken on unruled pieces of paper, and each person was asked to make 2 copies of their own signatures, one to be used as a reference and one for making the comparison. Then, these signatures were scanned using a high-quality camera, so as to store them on a digital database.

B. Pre-processing

Pre-processing of signature database using Matlab involves a series of steps to prepare the signature data for further analysis or processing. The steps involved in pre-processing of signature database using Matlab are:

- Image acquisition: The first step was to acquire the signature images, and this was done using a high-quality camera. The scanned signature images were stored in a folder as the database.
- Image enhancement: The next step was to enhance the quality of the signature images. This was done by adjusting the brightness and contrast, removing noise and other distortions, and smoothing the image to remove any irregularities. Matlab provides a range of functions and tools for image enhancement.
- Image segmentation: Image segmentation involves separating the signature from the background. Matlab provides various thresholding functions and tools for image segmentation, which were implemented.
- Data splitting: Data splitting involves dividing the pre-processed data into training and testing datasets, which were then used for further analysis and processing.

C. Feature Extraction

Feature extraction involves extracting important features from the signature image, such as the shape, size, and texture of the signature. Matlab provides a range of feature extraction techniques:

- Feature normalization: Feature normalization involves scaling the extracted features to a common range to eliminate the effects of differences in the feature values.
- Feature selection: Feature selection involves selecting the most important features from the extracted features.

D. Verification

- Signature template matching: The extracted and selected features of the signature image were compared with the signature template created during enrollment. A match score was generated using a distance metric, namely the SSIM value (structural similarity index value).
- Verification decision: The match score was compared with a predefined threshold. If the match score was greater than the threshold, the signature was verified, and if it was less than the threshold, the signature was said to be a possible forgery.

In conclusion, the signature verification system involved authenticating the identity of an individual by comparing their signature image with a previously stored signature template. The process involved acquiring the signature image, pre-processing the image, extracting and selecting important features, normalizing the features, matching the signature template using a distance metric, and verifying the signature image using a predefined threshold.
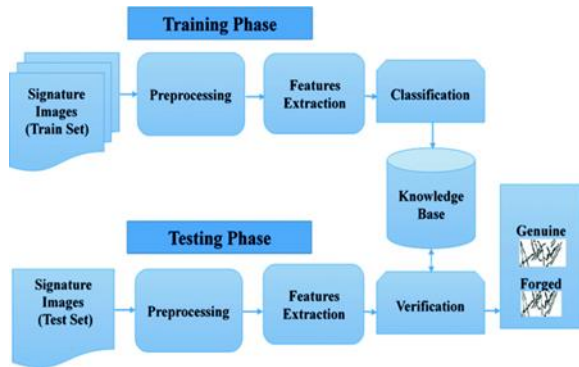
Fig. 1. Flowchart on signature verification process flow
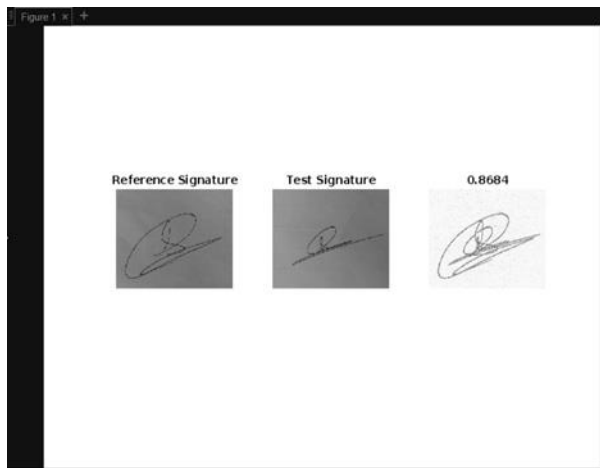
III. RESULTS

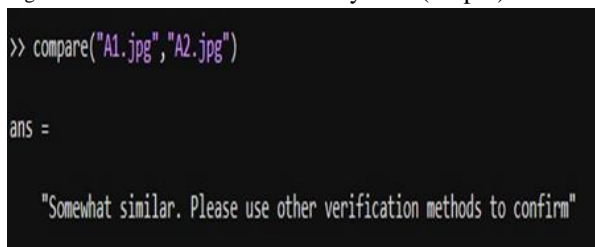Fig. 2. Frontend of verification system (output)

Fig. 3. Input prompt with associated text output

Fig. 4. Signature database

IV.ADVANTAGES OF SIGNATURE VERIFICATION SYSTEM

There are several advantages of the signature verification system, including:

1) *Enhanced security: Signature verification can provide an additional layer of security to prevent unauthorized access to sensitive information or transactions.*

2) *Convenient and user-friendly: Signature verification is a convenient and user-friendly biometric method that is easy for users to perform, particularly in comparison to other biometric methods such as fingerprint or iris recognition.*

3) *Cost-effective: Signature verification can be a cost-effective solution for implementing biometric authentication, particularly when compared to other biometric methods that require specialized hardware or equipment.*

4) *Versatile: Signature verification can be used in a wide range of applications, from financial transactions and legal documents, to access control and ID verification.*

5) *Reliable: Signature verification can be a reliable biometric method when implemented properly and validated against a robust dataset.*

There are several advantages of using Matlab for signature verification, including:

1) *Wide range of image processing and feature extraction tools: Matlab provides a wide range of image processing and feature extraction tools that can be used for signature verification, including noise reduction, segmentation, feature selection, normalization, and classification.*

2) *Robust statistical analysis: Matlab provides robust statistical analysis tools that can be used to analyse the extracted features and improve the accuracy of the signature verification system.*

3) *User-friendly interface: Matlab has a user-friendly interface that allows for easy visualization of the signature verification results and tuning of the system parameters.*

V.CONCLUSION

In conclusion, our signature verification project using Matlab can provide an effective and convenient solution for biometric authentication. By leveraging

advanced image processing techniques and machine learning algorithms, signature verification can provide enhanced security for sensitive transactions and documents while maintaining user-friendliness and convenience.

The success of a signature verification project depends upon the quality and diversity of the dataset, the accuracy of feature extraction techniques, the robustness of the normalization methods, and the suitability of the distance metrics used. By optimizing these parameters and fine-tuning the system threshold, the signature verification project can achieve high accuracy and low error rates.

Overall, the system can provide a reliable, versatile, and cost-effective biometric solution for a wide range of applications, from financial transactions and legal documents to access control and ID verification.

ACKNOWLEDGEMENT

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