An Efficient Signature Verification Method Based On An Interval Symbolic Representation And A Fuzzy Similarity Measure

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Abstract *In this paper an efficient off-line signature verification method based on an interval symbolic representation and a fuzzy similarity measure is proposed. In the feature extraction step, a set of Local Binary Pattern (LBP) based features is computed from both the signature image and its under-sampled bitmap. Interval-valued symbolic data is then created for each feature in every signature class. As a result, a signature model composed of a set of interval values (corresponding to the number of features) is obtained for each individual's handwritten signature class. A novel fuzzy similarity measure is further proposed to compute the similarity between a test sample signature and the corresponding interval-valued symbolic model for the verification of the test sample. To evaluate the proposed verification approach, a benchmark offline English signature dataset (GPDS-300) and a large dataset (BHSig260) composed of Bangla and Hindi off-line signatures were used. A comparison of our results with some recent signature verification methods available in the literature was provided in terms of average error rate and we noted that the proposed method always outperforms when the number of training samples is eight or more. We are using fuzzy logic to provide some set of instruction and that FIS(Fuzzy Inference System) is used as verification of sign with trained signs.A fuzzy control system is a control system based on fuzzy logic—a mathematical system that analyzes analog input values in terms of logical variables that take on continuous values between 0 and 1, in contrast to classical or digital logic, which operates on discrete values of either 1 or 0.*

Index Terms— Off-line signature verification; Interval-valued symbolic representation; Fuzzy similarity measure; Texture feature extraction.

1. INTRODUCTION

BIOMETRICS is defined as an automated use of physiological or behavioural characteristics of an individual for identification/authentication purposes. Many different biometric identification systems have been proposed as a means of determining or verifying personal identity using different behavioural characteristics. Signatures, as one of the behavioural human characteristics, are extensively used as a proof of identity for legal purposes on many documents such as bank cheques, credit cards, and wills in our daily lives. Considering the large number of signatures handled daily through visual inspection by authorized persons, construction of an efficient automatic system to handle such a huge volume of signatures has many potential benefits for signature authentication to reduce fraud and other crime. A quick look at the literature of signature identification/ verification indicates that handwritten signature identification / verification systems are well established.

Signature authentication

Signature authentication machine is implemented to provide a simple, safe, fast biometric behavioral security system. By using some equations from co-ordinate geometry makes this method faster than other methods. The color matching technique makes it more secure. The Interface of this application is very simple which makes it user friendly and easy. The implemented system has the following limitations:

1. Our system only able to identify the static changes in a signature, it cannot identify any dynamic changes in a signature.

2. This signature authentication system works offline. No online device is connected with this system. And the methods of signature authentication tested only offline.

Signature verification system

Most of the offline signature verification system consists of four stages these are image acquisition, pre processing, feature extraction and Enrolment and verification. The overview of the system is depicted in the Fig.

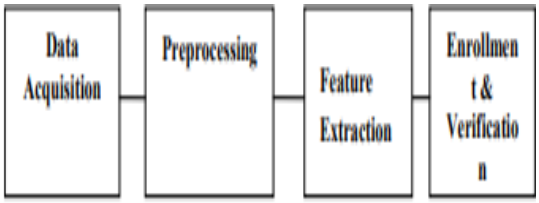


Fig. 1. Overview of Signature verification System.

2. LITERATURE REVIEW

SigWiComp2015, have defined three tasks for off-line and on-line signature verification and provided signature data (both on- and off-line) in multiple languages (Italian ,Bengali, and German). Furthermore, for evaluation, we rein-forced our paradigm based on likelihood computations via the Cllrandb Cminllr values which are forensically substantial.

Diday (1987). In statistics, usually data are formatted as single values. However, sometimes the data are represented by lists, intervals, histograms or even distributions. To deal with these kinds of data, the concept of symbolic data. Among symbolic data, interval-valued data are the most commonly seen in application. Recently, different approaches have been introduced to analyze interval-valued data, including linear regression, principal component analysis and clustering, etc. This research focuses on interval-valued data regression analyses.

3. SIGNATURE VERIFICATION METHOD

In addition to the limitations mentioned in Table 1, some general challenges [24] in the area of off-line signature verification that still attract many researchers for further investigation in this field are indicated as follows

i. High intra-class variability in handwritten signatures of every individual compared to the physiological biometrics, such as fingerprints or iris of the individual,
ii. Low inter-class variability between genuine signatures and skilled forgeries of every individual,
iii. The existence of only genuine signatures as partial knowledge for training off-line signature verification systems,
iv. limitations in the amount of signature data available for training off-line signature verification systems in real scenarios, as during the enrolment process users often provide only a few samples of their signatures, and v)
v. The presence of signatures written in different scripts.

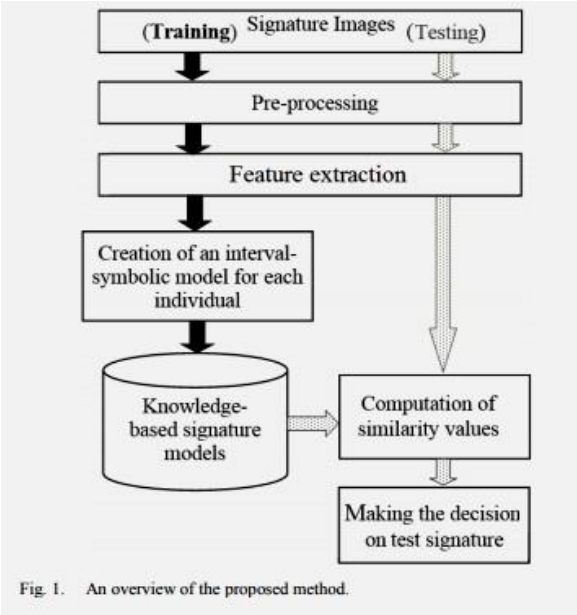
TABLE I
OVERVIEW OF DIFFERENT SIGNATURE VERIFICATION METHODS.

Type / approach	Methods	Limitations
HMM-based	30, 34, 36, 38, 41	Poor performance when few signature samples are available for training, needs reconstruction whenever a new writer is added to the system.
NN-based	4, 7, 19, 42	Needs enough data for training and convergence, needs to retrain the neural networks in the case of changing the number of signature classes.
SVM-based	5, 10-14, 27-28, 31, 37, 38, 40-42	Needs to find an appropriate kernel and then tuning its parameters, has high algorithmic complexity and extensive memory requirements in large-scale tasks.
GMM-based	6	Needs to estimate an appropriate number for the Gaussian components, lacks the generalisation ability to make accurate predictions for new data.
Bayesian-based	3	There is no precise way to obtain prior knowledge, posterior distributions are heavily influenced by the prior knowledge.
Similarity-based	3, 8, 12, 29, 32, 33, 35, 36	Needs to choose an appropriate distance, it is very sensitive to irrelevant features as all features contribute to the similarity and thus to the classification

Furthermore, with particular reference to fuzzy-based signature verification methods, we noted that only a few related papers have been reported in the literature despite the progress achieved in the signature verification field. Moreover, the membership functions and also the fuzzification processes used for signature verification are mostly based on the exponential and Gaussian membership functions, which provide a probability very close to zero for a sample that deviates much from the mean in the Gaussian as well as in the log-space models. This would mean a very large negative number is added to the accumulation probability result. That is a big penalty for the cases where handwritten genuine signatures are roughly written by genuine authors. In the present research work, we mainly focus on the problem of inter-/intra-class variability of handwritten signatures.

4. PROPOSED METHOD

The proposed method includes four main steps: a) preprocessing, b) feature extraction, c) creation of an interval valued symbolic model for each individual, and d) computation of similarity values and the final decision. An overview of our proposed signature verification method is shown in Fig.



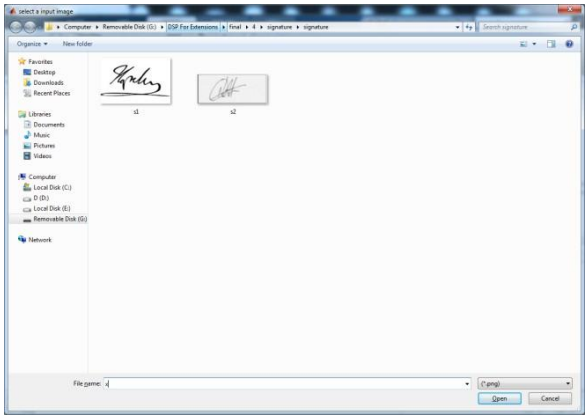
Proposed method

5. MATLAB SOFTWARE

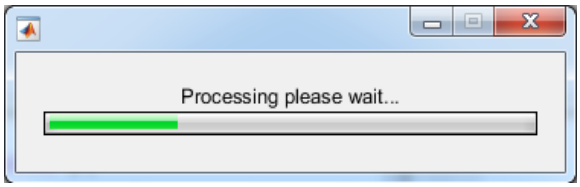
MATLAB is an immoderate-overall performance language for technical computing. It integrates computation, visualization, and programming in an clean-to-use surroundings wherein troubles and answers are expressed in acquainted mathematical notation. MATLAB stands for matrix laboratory, and become written first off to offer smooth get entry to to matrix software application advanced by using LINPACK (linear system bundle) and EISPACK (Eigen system package deal deal deal) responsibilities.

MATLAB is consequently constructed on a basis of sophisticated matrix software program application in which the important element is array that does not require pre dimensioning which to resolve many technical computing issues, especially people with matrix and vector formulations, in a fragment of time. MATLAB talents a own family of programs specific answers referred to as toolboxes. Very important to most customers of MATLAB, toolboxes permit analyzing and utilizing specialised era. These are complete collections of MATLAB features (M-documents) that growth the MATLAB environment to remedy unique commands of problems. Areas in which toolboxes are available embody sign processing, manipulate device, neural networks, fuzzy appropriate judgment, wavelets, simulation and plenty of others.

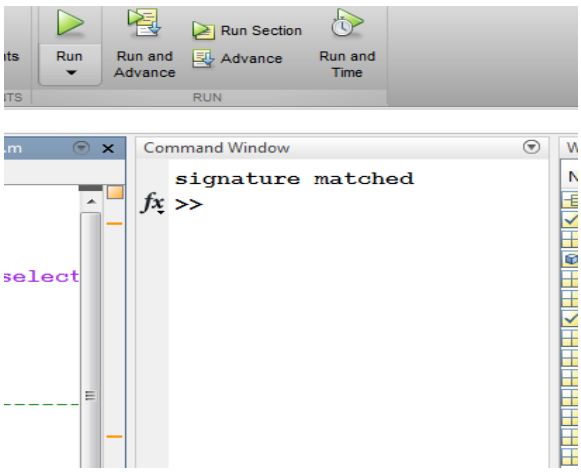
6. RESULTS ANALYSIS



Select an input image from available images



Processing wait bar for fuzyy inference system



Final Results of matched signature for given input

7. CONCLUSIONS

In this investigation, the performance of the proposed writer-dependent interval-based symbolic representation model for off-line signature verification is demonstrated, whereby a wide range of experiments was conducted on different datasets. A symbolic representation is used to model the feature vectors, constructing a set of interval values suitable for characterization of intra-class variability of features extracted from different signature samples of an individual. A fuzzy similarity measure applicable to an interval-value symbolic model is proposed to address the inter-class variability of features. A new texture feature based on a low-resolution image obtained employing the under sampling technique is further introduced. The proposed method provided significantly improved results compared to the state-of-the-art methods considering two different off-line signature datasets. The main advantage of the proposed model is that it allows the design and integration of a model for a new individual using only genuine signatures with the same parameters as before, without any need of re-tuning all the parameters. However, in the case of training with very few samples, the proposed method is not as efficient as when the training is performed with 6 or more signatures. In future, because of the difficulty of acquiring enough genuine samples, we plan to extend this research work by constructing a representative model, which is composed of different models for feature encoding, using only a very small number of genuine signature samples of each signer for training.

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