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Offline Signature verification and recognition using ART 1

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Abstract:

The main objective of this project is signature verification in cheque using ART 1 Classification theory. A valid digital signature gives a recipient reason to believe that the message was created by a known sender, such that the sender cannot deny having sent the message and that the message was not altered in transit. After image acquisition apply the pre-processing. In pre-processing convert the image into graycolor and reduce noise. Then crop and binarize the cheque image. Finally image thinning is applied for the pre-process. The features are extracts after pre-processing. This project extracts the global features. Finally verify the signature using the ART 1 classification theory.

1. Introduction:

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. The applications of image processing is classification, feature extraction, pattern recognition and etc. A digital signature is a mathematical scheme for demonstrating the authenticity of a digital message or document. A valid digital signature gives a recipient reason to believe that the message was created by a known sender, such that the sender cannot deny having sent the message (authentication and non-repudiation) and that the message was not altered in transit (integrity). Digital signatures are commonly used for software distribution, financial transactions, and in other cases where it is important to detect forgery or tampering.

Online Signature Verification system finds its application in digital transactions and authentication system. However a wider use of signature verification system is found in offline signature verification system. Such systems are used in almost everywhere, in every document for attestation of the user. Features extraction plays an important role in a signature verification system, and the features extracted can be categorized as global or local features. Global features treat patterns as a whole whilst local features are extracted from a portion or a limited area of the pattern. Global features tend to be less sensitive to variation or noise whilst local features provide more detailed information.

2. Related Work:

PiotrPorwik [1].The paper presents a new signature similarity measure and proposes a new efficient method of recognizing handwritten signatures. The proposed approach consists in dividing signature into windows and calculating similarity values between individual windows. The influence of the size of windows and their location in a signature has been analysed.The proposed method consists of a few stages, where rotation of signature, normalization its features, and similarity determination between signatures are carried out. Anjali.R [2] This paper presents the offline signature verification using SVM and neural network. The aim of this paper is to measure gray level features of an image when it is distorted by a complex background and train by using neural network classifier and SVM. There are two stages i) Training Stage ii) Testing

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Stage. The training stage consists of three major steps 1) Retrieval of a signature image from a database 2) Image pre-processing 3) Neural network training using back propagation feed forward algorithm and SVM. A Testing stage consists of four major steps 1) Retrieval of a signature to be tested from a database 2) Image pre-processing 3) Application of extracted features to a trained neural network 4) checking output generated from a neural network using back propagation feed forward algorithm and SVM. BENCE KOVARI [3].This paper presents the signature verification using the feature matching. In this paper there are 2 stages training and testing field. First step is the acquisition step which converts a number of paper sheets to a set of digital images. In second step preprocessing which is a sequence of image transformations creating the best possible input for the feature extraction algorithms. In matching is defined between the features of the different images, then a distance (or similarity) measure is calculated based on the corresponding features and finally this measure is normalized to make it a suitable input for a classifier. E. N. Zois [4] This paper presents the off line verification using the two step transitional features. This paper used the subset of the curvature feature. Each signature pixel inside the segmented and partitioned sub-images statistics are calculated for 15 curvature and line paths inside a confined chessboard distance of two. In the stage of classification SVM is used. SVM classifier has been employed for the first stage of the verification stage. K.Harika [5] This paper presents the signature verification based on robust tool. The signature databases such as GPDS and MCYT are used for processing signatures. The technique uses histograms of various patterns such as local derivative, local directional and local binary. Different classifiers were built to evaluate those parameters. The classifiers used include SVM, NN. The aim of the technique is to verify offline hand written signatures.

3. Methodology:

3.1 System Architecture:

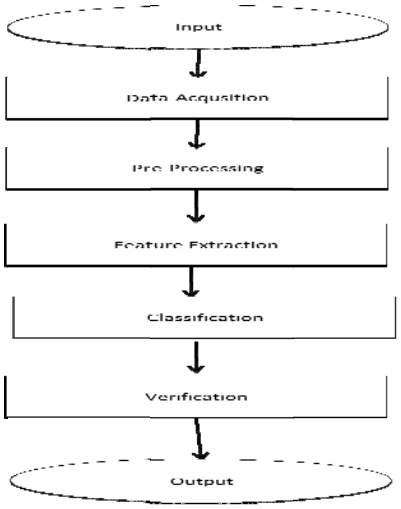

Fig: 1 overall Architecture

3.2 Modules:

3.2.1. Data Acquisition:

In data acquisition, handwritten signatures are collected from different individuals and some unique features are extracted from them to create a knowledge base for each individual. This project collects the genuine and forged signature. The samples are collected from 25 users and stored in the database.

3.2.2. Pre-processing:

The main goal of the pre-processing to enhance the visual appearance of images and improve the manipulation of datasets. Pre-processing of image are those

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operations that are normally required prior to the main data analysis and extraction of information. Image pre-processing, also called image restoration, involves the correction of distortion, degradation, and noise introduced during the imaging process.

In this project the pre-processing used to convert the color signature to gray scale and binarized image. RGB to grayscale image conversion where all the scanned images are converted to grayscale images, noise removal for removing spurious pixels that can be attached to the image during scanning time, image cropping is used to remove unwanted region using the Region of Interest (ROI), grayscale image to binary image and thinning for reducing a connected region in the image to a smaller size and minimum cross-sectional width character.

3.2.3. Feature Extraction:

In this project extracted the global features. Global features treat patterns as a whole whilst local features are extracted from a portion or a limited area of the pattern. Global features tend to be less sensitive to variation or noise whilst local features provide more detailed information.

1.Area (A): Signature area is the number of pixels which belong to the signature. This feature provides information about the signature density. Calculate the total number of the black pixels (0) in black and white image.

2. Width (W):It is defined as the distance between two points from either ends in the horizontal projection which contain more than one pixels of the binary image.

3. Height (H): It is defined as the distance between two points from either ends in the vertical projection which contain more than one pixels of the binary image.

4. Height/Width Ratio: Signature height-to-width ratio is obtained by dividing signature height to signature width.

5. Centroid: In is means that calculating the centre of the signature.

6. Four Area: The last feature that we implemented in our project is that dividing the image in four equal parts. Identifying them as a1, a2,a3 and a4. After that we only calculate its black pixel (0) area in the each part of image which we divided equally.

3.2.4. Classification:

In this project using the ART1 for classification. The algorithm is given below.

Step-1: Collecting hand written signatures
Step-2: Extracting the features of all the signatures by to get all the gray-scale values
Step-3: development of ART-1 with(i) serial and (ii) parallel processing
Step-3 and 4: Development of ART-1 algorithm and its training:
Step-0: Initialize the parameters and Initialize the weights:
Step-1: Perform Steps 2-13 when stopping condition is false.
Step-2: Perform Steps 3-12 for each training input.
Step-3: Set activation of all F2 units to zero. Set the activation of F1(a) units to input vectors.
Step-4: Calculate the norm of s:

$$\|s\| = \sum_i s_i$$

Step-5: Send input signal form F1 (a) layer to F1 (b) layer:

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$$x_i = s_i$$

Step-6: For each F node that is not inhibited, the following rule should hold:

$$\text{If } y_j \neq -1, \text{ then } y_j = \sum_i b_{ij} x_i$$

Step-7: Perform Steps 8-11 when reset is true.

Step-8: Find J for all nodes j.

Step-9: Recalculate activation of X of F1 (b):
Step-10: Calculate the norm of vector x:
Step-11: Test for the reset condition.
If ||x||/||s|| < ρ, then inhibit node J, y J = -1. Go back to
Step 7 again
Else if ||x||/||s|| ≥ ρ, then proceed to the next step (Step 12).
Step-12: Perform weight updation for node J (fast learning):
Step-13: Test for the stopping condition. The stopping conditions may be:
a. No change in weights.
b. No reset of units.
c. Maximum number of epoch reached.

4. Results:

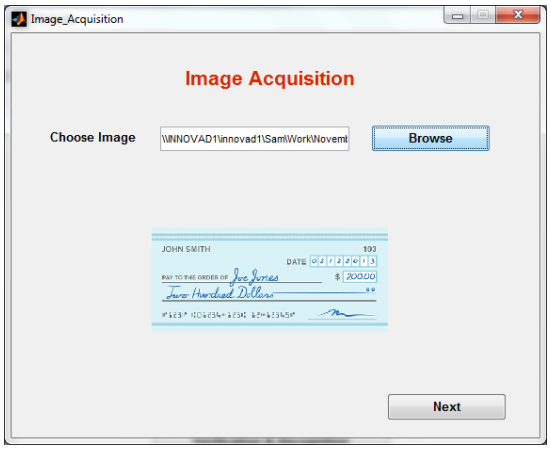

Fig: 4.1 Image Acquisition

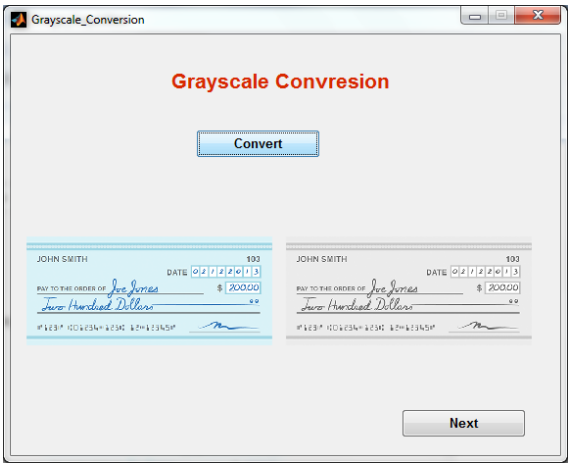

Fig: 4.2 Gray scale conversion

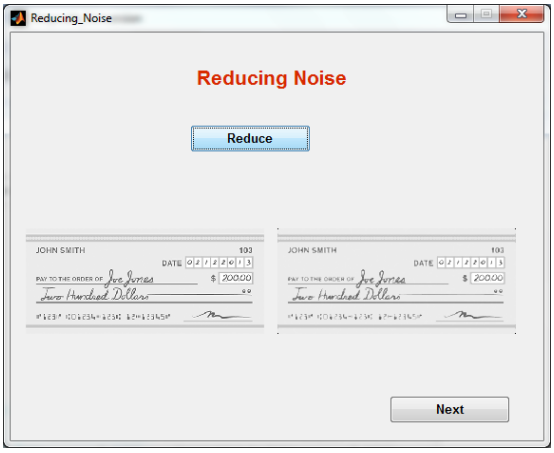

Fig: 4.3 Reduce Noise

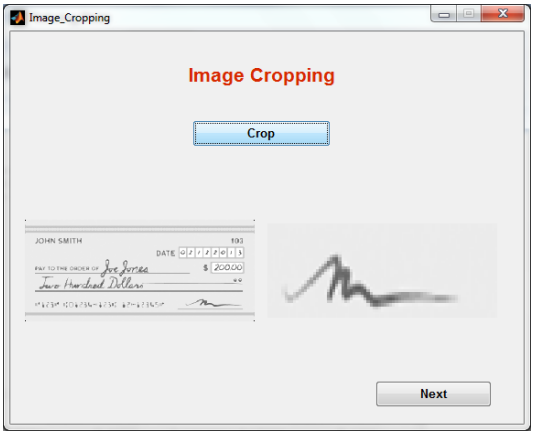

Fig: 4.4 Image Cropping

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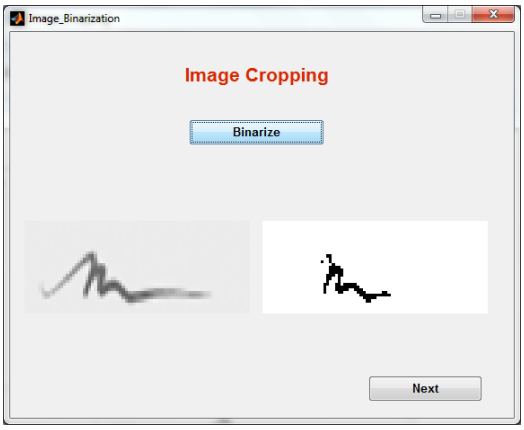

Fig: 4.5 Image Binarization

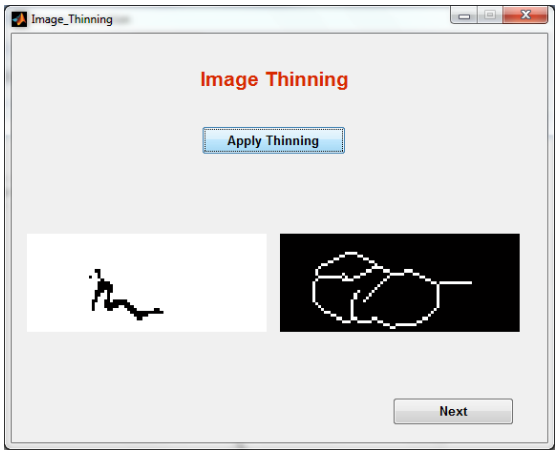

Fig: 4.6 Image Thining

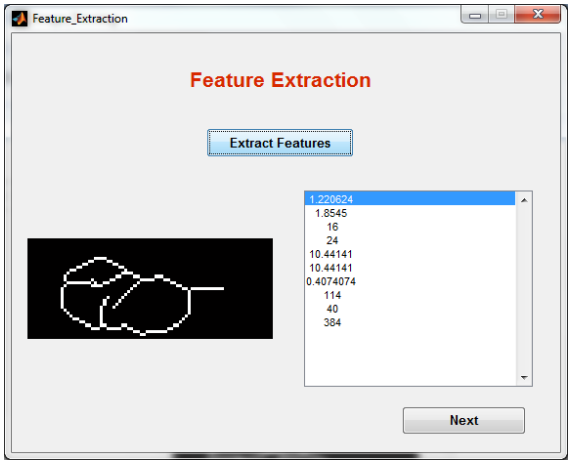

Fig: 4.7 Feature Extraction

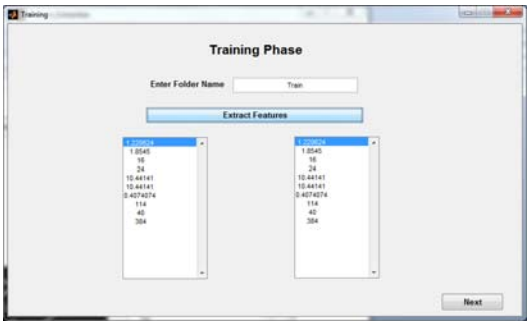

Fig: 4.8 Feature Extraction in training

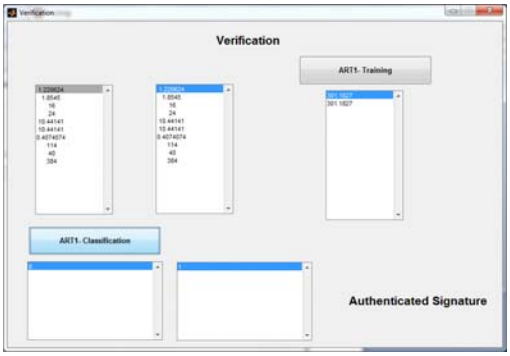

Fig: 4.9 Verification

Experimental Results:

Performance Metrics:

Accuracy:

Accuracy is the measurement system, which measure the degree of closeness of measurement between the original value and the extracted value.

$$Accuracy = \frac{TP + TN}{TP + FP + TN + FN}$$

Where, TP – True Positive (equivalent with hit)

FN – False Negative (equivalent with miss)

TN – True Negative (equivalent with correct rejection)

FP – False Positive (equivalent with false alarm)

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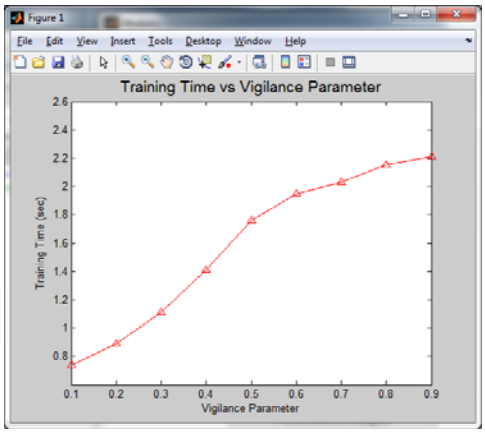
Detection Time

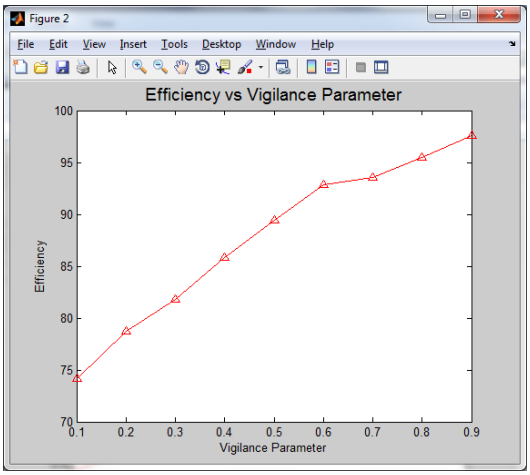
Detection Time is the time needed to calculate for detecting the nodes. It is the calculation of the starting time and the ending time. It is expressed as,

$$DetectionTime = EndingTime - StartingTime$$

Performance Evaluation:

Vigilance Parameter	Efficiency	Training Time
0.1	74	0.7
0.2	79	0.9
0.3	83	1.1
0.4	85	1.4
0.5	89	1.8
0.6	93	1.9
0.7	94	2.0
0.8	95	2.1
0.9	97	2.2





5. Conclusion:

This project proposed signature verification in cheque using ART 1 Classification theory. After image acquisition was apply the pre-processing. In pre-processing converted the image into graycolor and reduced noise. Then the image was cropped and binarized. Finally image thinning is applied for the pre-process. The features are extracted after pre-processing. This project extracted the global features. Finally verified the signature using the ART 1 classification theory.

Reference:

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