Offline Signature Identification Using Adaptive Window Position Technique

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Abstract*: Offline handwritten signature identification is the technique which is used to identification of the behavioural characteristics which is part of biometric characteristic of the each person. But this type of signature identification is subjected to the mal practices, so to prevent this the offline handwritten signature identification using adaptive window position technique, this technique uses the windows for segmentation of the signature image, the windows are of size n*n, the windows are placed on the signature image, after acquiring the position on signature image the window will fragment the images then generates the small sub images, before going to feature extraction phase pattern adjustment technique will applied, this leads to the simple and accurate calculations of the features, there are 10* 50 = 150 signature images are present in the dataset, which are signed by the 10 different persons, each person have signed his signature 15 times, 10 * 10 = 100 signature images are kept in training data set and 10 * 5= 50 signature images are kept in the testing dataset, the comparison between the two sub images takes place based on their similarity properties using an similarity correlation equation, using the adaptive window position technique we can easily find the signature of the genuine user. The accuracy of the proposed method is 94% .*

Keywords: Scanned Images of signatures, Adaptive Windowing Segmentation, Feature Extraction, Code Book.

Introduction

Handwritten signature is very unique to the individual person, signatures are used to the find the validations of the person, offline signatures are those signatures which are signed on the paper then it will be scanned into computer. Now days everything has gone machinery handwritten signatures play vital role, signatures are takes place on the cheques, bank services, even they intransitive on the documents which are very important in government services, there may be copy of signature of one person by the other person takes place, by doing this activity a person may get authority to do important works behalf of the genuine user. This is the reason a fake person get the estimable property of other person. To reduce this process signature identification is very important.

Shanker and Rajagopalan [1], proposed the method for trained set signature images using elastic matching, DTW algorithm is used. in this technique the one-dimensional characteristics propelling from vertical section after getting the characteristics from the trained and tested images. Then it will find the signatures between the different persons. using the dynamic time warping, in this technique the modified version of the DTW algorithm captures the contents of the signature image which are in the stable. Larkins and Mayo [2], proposed method for Adaptive Feature Thresholding for off-line signature verification, in this technique the extracted characteristics from the test images are converted into binary feature vectors, then it will compare between the binary features of the testing and training dataset then it will find the signatures between different persons, in this technique the CEDAR and GPDS dataset are used. Adaptive feature is very complex and difficult to get accurate results and an reliable and efficient results. Ramachandra A C et al. [3], proposed the method for Signature Verification using Graph Matching and cross validation, in this technique the desirable thresholding value is to be taken to comparing the characteristics between the signature images. In this technique the similar measure

between the signature used to refer the selected signatures. Kekre et al. [4], proposed the method for Gabor filter based feature vector for dynamic signature recognition this works on signature can be carried out by using either signature identification or signature verification. Gabor filter is linear filter which is mainly used for the detection of the edge. the Gabor filters are works particular in the representation of the texture and discrimination. Qiao et al. [5], proposed the method for Off-line signature verification using Online Handwritten Registration, in this technique the signature images are registered through online. But its not makes use of signature images are registered through offline the identification of signature is done by the comparing the features of the test signature with the signatures which are registered through online. but the limitation is this process is very expensive. but the limitation of this technique its not suitable for skilled forgery. Shirdhonkar and Kokare [6], proposed the method for technique is based on the rotated complex wavelet filters, in this technique two-dimensional signature images are used. It will extracted the features from the images in 12 directions. then it will find signature between different person, in this technique the features are extracted by using the rotated complex wavelet filters (RCWF) and dual tree complex wavelet transform (DTCWT) together. At last final results of this technique will compared with the Discrete Wavelet transform(DWT), after comparison of the results it has proved that this technique is efficient than the DWT. Khuwaja and Laghari [7], proposed the method for off-line handwritten signature recognition in which handwritten signature, it is defined as the first and last name written in your own handwriting. In this technique the biometric technique is defined as the depends upon the his or her behavioral characteristics identification of the person takes place, this technique is very helpful in differ the authorized person from other persons. In this technique neural networks for recognition of the signatures, the signature images that are scanned by the computer are having the low resolution. Meenu Bhatia [8], proposed the method for Off-line Hand Written Signature

Verification using Neural Network, in this technique the trained images are present in the neural network. Verification of the signature is done by the comparing features of trained images which are present in the neural network with tested images. feed forward back propogation algorithm is used. they have developed fast and simple algorithms for the handwritten signature recognition. Aarti chugh et al. [9] proposed method for Learning Approach for Offline Signature Verification Using Vector Quantization Technique in this the behavioral characteristic of the person is done by using the identification of signature. Through offline or online we can verify the signature of each person. In this technique the verification of the signature is done by using the technique of quantization of vectors. Zahoor Jan et al. [10], proposed method for an Automated System for Offline Signature Verification and Identification Using Delaunay Triangulation in this technique explained about the signature identification is necessary because the authentication of the signature is also subjected to malpractices. The signature images collected by different persons then they will scanned by the computer. In this technique the functions of the signature system based on the Delaunay triangulation of a input signature image. The False Acceptance rate(FAR) and False Rejection Rate (FRR) are highly decreased. The acceptance of the signature of the person who are having the authenticity, and rejection of the signature of the fake person will takes place. Tara and Sanjay [11], proposed the method for Review On: Enhanced Offline Signature Recognition Using Surf and Bayesian Approach, the signature of the each person is unique, but the imitation of the signature of the one person may lead to the other person may get his valuable assets so this leads to an un desirable consequence, so to avoid this the signature identification is necessary is necessary, signature identification is the technique of finding the authenticity of the person. Signatures are used via financial transactions, bank cheques, and other documents which have the greater importance. In this technique the SURF and Bayesian based recognition of offline signatures system is the signature images which are scanned and skilled with the low resolution. By using the SURF techniques and Bayesian technique and the computer vision the human signatures are manage image. By using the SURF and Bayesian techniques there is capturing of the signatures takes place and after capturing it will presented to the user in image format. Using the various image processing techniques the parameters will be extracted from the signature image for the verification of the signature

2. Methodology

The below block diagram represents the steps that are used in the implementation of the identification of offline signature methodology.
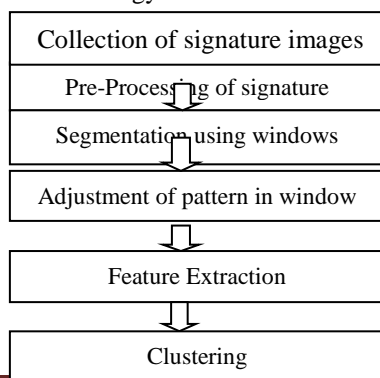
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┌─────────────────────────────────────┐
│   Collection of signature images     │
├─────────────────────────────────────┤
│     Pre-Processing of signature      │
├─────────────────────────────────────┤
│     Segmentation using windows       │
├─────────────────────────────────────┤
│   Adjustment of pattern in window    │
├─────────────────────────────────────┤
│         Feature Extraction           │
├─────────────────────────────────────┤
│             Clustering               │
└─────────────────────────────────────┘
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Figure 1: Block diagram of proposed work

The technique is start with the collection of data images, the input images are collected from the dataset, the data set is created by the collecting the signatures from the many persons, each individual person signed his signature 15 times, the totally 10 persons are signed their signatures then the total images are equal to 15*10=150 images. Now the dataset consisting of 150 signature images, in this technique there are 2 data sets are present, training dataset and testing dataset, the training dataset consists of 10 signatures of the individual person total 10 persons are there so this dataset consists of 10 * 10 = 100 signature images and testing images consisting of 5 signatures from the each person totally 10 * 5 = 50 signature images are present in testing dataset. Signature images are collected by person on the paper then that paper will be scanned by the computer as shown in figure 2 (a). After collection of the dataset, the input signature images which are scanned by the computer are pre-processed by the suitable technique. pre-processing is the process which is used to remove the unwanted data like noisy data, noisy data will make effect on the results, if unwanted data present in the input signature image we will not get accurate results, so there very essential to make pre processing of the signature images. In this technique the global threshold otsu algorithm is used for converting the grey scale level image into binary images. The main objective involves in this step is enhancement of the input signature image, feature extraction phase is become very simpler by pre-processing technique, by using this technique we will get the more accurate, reliable and efficient results as shown in the figure 2 (b). As shown in the figure 2 (c) The division process is applied on the signature images, this process the signature image is fragmented by placing the windows on the Pre-processed signature images by using adaptive window position algorithm, The windows are placed in such way that they should captures the redundancy that are present in the pre-processed signature image and this step will produces the small fragments of the signature images, so that provide the fragments which are having correct and accurate comparison. The windows that are applied to the division of the signature images are in the square shape, the size of the window should be a*a, we can choose any size but should give the efficient result. Adaptive window position method is based on the technique that ink trace which is having the aim to provide the efficient position of window which is depends on the handwritten signature image skeleton analysis how the person will draw his signature. The window process is divide the every component from the vertical and horizontal directions of the image. After the segmentation phase pattern adjustment will be applied to the signature image, when the components are produced in the window position technique, each window will produce the patterns, the patterns inside each window in random manner, due to this randomness the unwanted data like noise and distortion will be produce during the similarity comparison in the next step this will gives the inaccurate and inefficient results, so to prevent this pattern adjustment technique will applied to the each window component. Pattern adjustment is the technique in which the image will be place with respect to window by moving the image component to the upper-left corner of the window, by pattern adjustment phase the features are calculated which are present in the corner of the window, instead of taking the features of the whole size of the window, which

leads to the production of unwanted noisy data, in this technique same scale of the handwritten signature is used because each person having the unique scale, this phase will applied to before proceeding to the feature extraction phase as shown in the figure. 2 (d) the
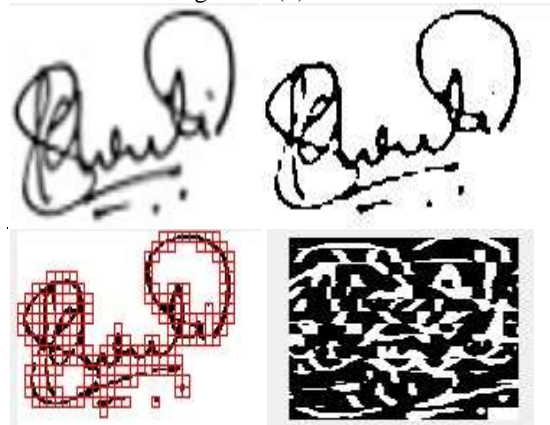

Figure 2: (a) Original image (b) Pre-processed image (c) After using adaptive window position segmented image (d) Pattern adjustment of the image

In an offline signature For the success of a signature verification system the identification technique the extraction of features will be very difficult because variability of the handwritten signature and the handwriting signature process having the less number of the dynamic features which are not enough for verification of the signature process. In this technique the minimum extraction of features which will gives the interpersonal distance maximum between the signatures signed by the various persons, but the interpersonal distance will be minimum for the signatures which are signed by the same person. In offline signature verification system there are mainly two types of the features will be extracted, The shape of the handwritten signature which is in the static form, and the pseudo dynamic features of the writing. If the signature image is in the segmented form than these features are extracted in locally, the features will extracted globally if the whole signature image present in the entire image form. In pattern or window adjustment phase the patterns are position with respect to the window, then that images are input to the feature extraction phase, the features are extracted from the adjusted patterns that are present in each window. The calculations of the features will gives accurate results, the features may include the size, shape, colour. But in the adaptive window position technique the features like shapes are Length and window size are used. Feature extraction step is more important because it will cause the more effectiveness on the identification process. The extracted features form the more categorized codebooks which are more related to each other, to doing this we can achieve good identification process. In the feature extraction step the data is represented in a sensible way which are analysed by the person or machine. After the feature extraction phase the similarity measurement process will be done, in feature extraction phase the features are extracted from the patterns(sub images) which are adjusted in the pattern adjustment phase. The extracted features are calculated based upon their similarity measurements using a some equations, the sub images are represented by the set of features. In the similarity measurement step the comparison between the sub images are done by the correlation similarity measurement equation using the equation (1).

$$S(X,Y) = \frac{n_{11}n_{00} - n_{10}n_{01}}{\sqrt{[(n_{11}+n_{10})(n_{01}+n_{00})(n_{11}+n_{01})(n_{10}+n_{00})]}} \quad (1)$$

After sub images are represented by the set of features there is among all windows the similar measure will be done which leads to the comparison between the two sub images. Take the sub images X and Y the number of the pixels that are present in the two sub images is represented by ' N_{ij}' at the corresponding positions of the pixels they are having the values 'i' and 'j' respectively. After the similar measurement between the two sub images calculated if it is close to 1 then the compared sub images are having exactly similar shape. The similar measurement between the sub images is done in the similar measurement step the comparison between the two sub images will be calculated, the value will be calculated if the value equal to 1 then the sub images are having the exactly same. The sub images that are having the patterns which are adjusted in the pattern adjustment step will form the clusters. The set of features will form the clusters based upon the similarity function and the clusters are used to classify the set of features. Depends upon the differences in the signatures and style of writing the signatures the variation of the length and number of classes takes place. The text amount that is present in the each sample depends upon this, the elements that present in each class will be find.

The Length and number of the classes are varied depends on the style of the handwritten of the person and the differences in signatures of the different persons.

3. Experimental results

In our proposed method we have taken 10 * 15 = 150 total signature images, we have created dataset which consisting of signature images, the signature images are collected by the 10 different persons ant that signature images are stored in the dataset. Each person have signed his signature 15 times so the total number of signature images are becomes 10 * 15= 150 signature images, where the total number of persons are 10 and the signature of the each person are 15 times. The signature dataset consisting of the 10 * 15 = 150 signature images, we have kept 10 signature images in the training dataset and 5 signature images in the testing dataset out of 15 signature images collected from the each person. The 10 signature out of 15 signature images collected from the each person we have kept in the training dataset so the total number of signature images that are present in the training dataset is 10 * 10 = 100 where the number of the persons 10 and the number of signature images from each person is also 10 then the total signature images 100. The 50 signature images collected from different persons we have kept in the testing dataset. The number of signature images 5 out of 15 signature images collected from the each person we have kept in the testing dataset so the total number of the signature images in the testing dataset become 10 * 5 = 50 where number of the persons 10 and number of the signature images 5.

3.1 False Acceptance Rate (FAR)

False Acceptance Rate is the one of the performance parameter which is the biometric security system's measurement that will accepts the signature which are signed by the other person who is not an genuine person

$$FAR = \frac{\text{The number of the false atteptance of the signatures}}{\text{Total number of identification attempts}} * 100$$

3.2 False Rejection Rate (FRR)

False Rejection Rate is the one of the performance parameter which is the biometric security system's measurement that will reject the signature which are signed

by the genuine person. The False Rejection Rate is calculated by using below equation. The below calculation gives the total FRR of the proposed method.

$$FRR = \frac{\text{The number of the rejections of genuine person}}{\text{Total number of identification attempts}} * 100$$

3.3 Accuracy
Accuracy is performance parameter which is defined as the how exactly the signature image is classified which include both positive values and negative values.

$$Accuracy = \frac{\text{The number of signature images are identifed}}{\text{The total number of the signature images}} * 100$$

Table 1. Experimental results

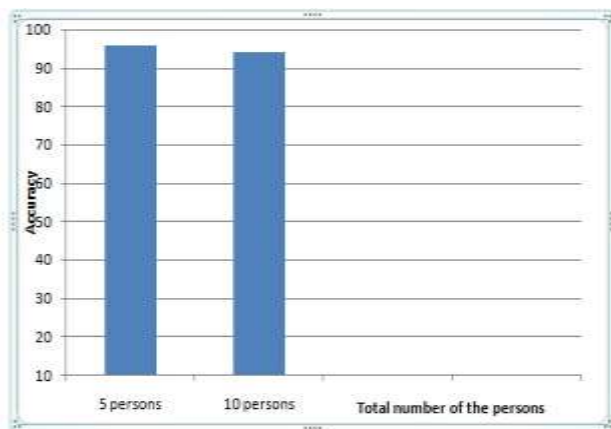| Parameters	Performance
False Acceptance Rate	0%
False Rejection Rate	6%
Accuracy	94%

Figure 2. Total accuracy of proposed work

Conclusion

The conclusion of our proposed method is present in this chapter, offline signature identification is done by using the adaptive window position technique, in our proposed method the data was collected from the 10 different persons then the total signature images are 10* 15 =150 signature images pre-processing technique will be apply to the collected signature images, which is the process in which the removal of the noisy data takes place. Binarization pre-processing technique which converts the grey level image into binary images After the pre-processing technique will be applied to the signature images after they are converted into binary images segmentation technique will be applied to the binary images. the proposed technique is using the adaptive window position technique for segmentation of the signature images. Using this technique the extraction of the features from the segmented signature image are reliable, the extracted features are The adjustment is done by moving the that fragment to upper left corner of the window, adjustment of the pattern that is presented in the each window step in this technique provides the easy and accurate calculations of the features of the signature image, after adjustment the features are extracted from the each window. the similarity comparison will be done in the codebook, this technique uses the codebook method which is having the shapes of the

handwritten signature and this is also creates the vectors of features of the manuscript. Clustering is the grouping of the objects or features which are having the similar properties, and classification is the categorization of the objects in which the recognition and differentiate of the objects. Finally the clusters are formed for each windows then there take group classifications based on the similar properties, the features which are similar properties will form the groups.

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