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Offline Signature Verification Using Image-Processing Techniques

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Abstract— Signature is one of the important method of individual authentication and identification. Signatures. A variety of techniques have been proposed for signature identification in the past. Handwritten signatures are one of the most and effective method of authenticating an individual's identity. Lot of research is going on for signature recognition. In this paper we have used image processing techniques for signature recognition.

Keywords— Biometric, Signature matchine, segmentation, image analysis, and retrieval.

I. INTRODUCTION

The problem of an individual verification and identification is the fast growing area of research. There are various methods and are based on different personal characteristics; voice, lip movement, hand geometry, face, odor, gait, iris, retina and fingerprint are the most commonly used authentication methods. All these psychological and behavioral characteristics are called biometrics. The driving force of the progress in this field is above all, the growing role of the internet and electronic transfers in modern society. Therefore considerable number of applications is concentrated in the area of electronic commerce and electronic banking systems.

The signature of a person is an important biometric attribute of a human being and is used for authorization purpose. Various approaches are possible for signature recognition with a lot of scope of research. Here, we deal with an off-line signature recognition technique. Signatures are composed of special characters and flourishes and therefore most of the time they can be unreadable. Also intrapersonal variations and interpersonal differences make it necessary to analyze them as complete images and not as letters and words put together [1].

A problem of personal verification and identification is an actively growing area of research. The methods are numerous and are based on different personal characteristics; voice, lip movement, hand geometry, face, odor, gait, iris, retina and fingerprint are the most commonly used authentication methods. All these psychological and behavioral characteristics are called biometrics. The driving force of the progress in this field is above all, the growing role of the internet and electronic transfers in modern society. Therefore considerable number of applications is concentrated in the area of electronic commerce and electronic banking systems [2].

The method of signature verification reviewed in this paper benefits the advantage of being highly accepted by potential customers. The use of the signature has a long history which goes back to the appearance of writing itself [9]. Utilization of the signature as an authentication method has already become a tradition in the western civilization and is respected among the others. The signature is an accepted proof of identity of the person in a transaction taken on his or her behalf. Thus the users are more likely to approve this kind of computerized authentication method [3].

Signature verification systems differ in both their feature selection and their decision methodologies. More than 40 different feature types have been used for signature verification[4]. Features can be classified into two major types: local and global [5]. Global features are features related to the signature as a whole, for instance the average signing speed, the signature bounding box and Fourier descriptors of the signatures trajectory. Local features correspond to a specific sample point along the trajectory of the signature. Examples of local features include distance and curvature change between successive points on the signature trajectory [5]. Most commonly used online signatures acquisition devices are pressure sensitive tablets capable of measuring forces exerted at the pen-tip, in addition to the coordinate of the pen. The pressure information at each point along the signature trajectory is another example of commonly used local feature Some of these features are compared in order to find the more robust ones for signature verification purposes. Other systems have used genetic algorithms to find the most useful features. Due to the high sampling rate of the tablet, some consecutive sample points may mark the same trajectory point especially when the pen movement is slow. Most verification systems resample the input so as to obtain a trajectory consisting of equidistant points. This is often done in order to remove redundant points to speed up the comparisons and to obtain a shape-based representation, removing the time dependencies, separately keep track of the local velocity values and use them in aligning two signatures.

II. PREPROCESSING

A. *Binarization*

All gray scale images are binarized with the help of modified Niblack algorithm [6]. The Niblack algorithm works very well for most of the handwritten text images with complex backgrounds.

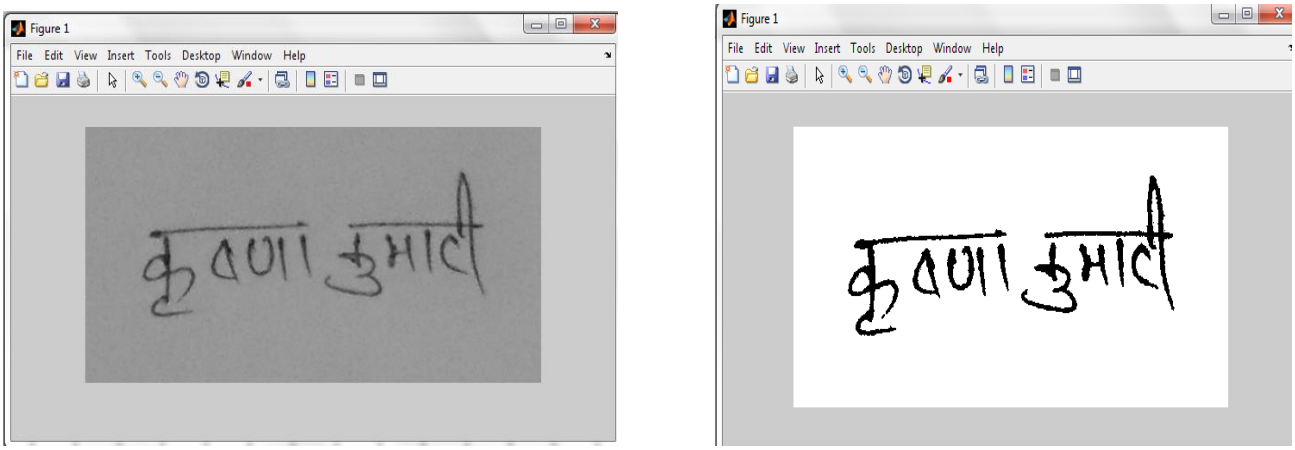


Fig. 1 shows the original image (Left) and its binarized image (right)

B. *Noise Removal*

Once the original image is binarized, the next step is to remove the noise from the binarized image.

C. *Rotation of Signatures*

The results are dependent on the rotation algorithm.

Algorithm:

```
function[ ] = Rotation(input_image)
A[x,y]=co-ordinates of the lowermost pixels.
[p]=polyfit(A(x,y),1); p is the equation of the
best fit line
final_image=cp2transform(input_image,'project
ive',slope(p))
end
```

Projective transformation is being used for the rotation purpose.

The algorithm worked fine on rotation angles -30-30 degrees.

D. *Thinning of Signatures*

The signatures are thinned to reduce down the computation of the graph matching algorithm. We work on thinned images. Thinning algorithm [8] (Thinning by preserving LOCAL coupling Points) is being used for the purpose. The algorithm worked fine on the signature images preserving intricate details and other geometrical properties of images.

E. *Bounding box of the signature:*

In the signature image, construct a rectangle encompassing the signature. This reduces the area of the signature to be used for further processing and saves time.

F. *Feature Extraction [7].*

The choice of a powerful set of features is crucial in signature verification systems. The features that are extracted in this phase are used to create a feature vector. A feature vector of dimension 24 has been used to uniquely characterize a candidate signature. These features are extracted as follows:

a. Maximum horizontal and vertical histogram

Horizontal histogram is calculated by going through each row of the signature image and counting number of black pixels. A row with maximum number of black pixels is recorded as maximum horizontal histogram. Similarly, a vertical histogram is calculated by going through each column of the signature image and finding a column with maximum number of black pixels.

b. Centre of mass

Split the signature image in two equal parts and find centre of mass for individual parts.

c. Normalized area of signature

It is the ratio of area of signature image to the area of signature enclosed in a bounding box. Area of a signature is the number of pixels comprising it. $Normalized\ area = Signature\ Area\ Area\ enclosed\ in\ a\ bounding\ box.$

d. Aspect Ratio

It is the ratio of width of signature image to the height of the image. This is done because width or height of person's signature may vary but its ratio remains approximately equal. $Aspect\ Ratio = width\ of\ signature\ in\ a\ bounding\ box\ Height\ of\ signature\ in\ a\ bounding\ box.$

e. Tri surface feature

Two different signatures may have same area .so; to increase the accuracy of the features three surface feature has been used. In this, a signature is divided into three equal parts and area for each part is calculated.

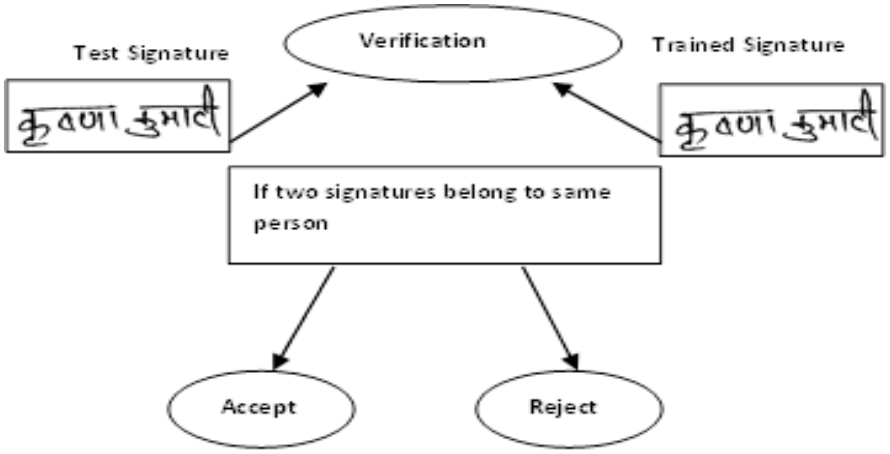
f. The six fold surface feature

Divide a signature in three equal parts and find bounding box for each part. Then calculate centre of mass for each part. Draw a horizontal line passing through centre of mass of each part and calculate area of signature above and below centre of mass within a bounding box. This provides six features.

g. Transition feature

Traverse a signature image in left to right direction and each time there is a transition from 1 to 0 or 0 to 1, calculate a ratio between the position of transition and the width of image traversed and record it as a feature. Repeat a same process in right to left, top to bottom and bottom to top direction. Also calculate total number of 0 to 1 and 1 to 0 transitions. This provides ten features. 2.3 Creation of feature vector A feature vector of size 24 is formed by combining all the extracted features and then Verification. In the verification stage, a signature to be tested is pre-processed and feature extraction is performed on pre-processed test signature image to obtain feature vector. After normalizing a feature vector it is matched with the test signature the final result classify a signature as a genuine or forged.

III. RESULTS



30 users were randomly selected with eight signatures of each individual. It was found that 27 users' signatures out of the given 30 users were acceptable for using the feature. This was done by passing 4 randomly selected originals through the trained model (checking for the intrapersonal variations). The accepted 27 users were verified against 240 separate signatures. The results achieved are as follows: FAR in case of Random Forgery was found to be 0.9%. FRR was 0.1%.

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