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Signature Segmentation using Morphological Watershed Algorithm and Feature Extraction using Wavelet Transform

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***Abstract*—Signature verification is a one of its kind methods to identify the person which is used worldwide. Signature recognition is most popular to overcome the image forgery. The recognition of human signature is an important concern for the development of the interface between human beings and computers. Signature segmentation using a morphological watershed algorithm with wavelet transformation based feature extraction is presented. The preprocessing techniques such as normalization, binarization, and slant correction are applied to the signature data. The preprocessed image is further segmented by using a morphological watershed algorithm. The segmented image is feature select by Daubechies'5/3 integer wavelet transform to decrease training complexity. The signature data set is created by collecting signature from various persons. The proposed method is tested on the dataset created..**

***Keywords*—Biometrics, Signature Recognition, Segmentation, Feature Extraction.**

I. INTRODUCTION

Signature recognition is one of the most widely used biometrics for authentication in bank transactions, passports, etc. Biometrics can be divided into two broad categories behavioral and physiological. Signatures are frequently used in behavioral biometrics for personal recognition and authentication. A handwritten signature is frequently used as a means of transmission in day to day life like, in a formal agreements, financial systems, government use, marketing documents or paintings, etc. The main challenge observed in a signature recognizing the individual's signature are not consistent, change may appear due to signing situation, pen width, weight, stress, mood, time etc. [1] . Depending on the data acquisition method it can be classified in two different ways, offline and online signature verification. Here, offline signature verification has been used.

The paper is organized as follows. In Section II describes the preprocessing step which is necessary to improve the quality of the image and remove any noise.In Section III, segmentation process is proposed. The next step in the proposed work feature extraction is presented in Section IV.

II. PROPOSED METHOD

Signature dataset is created by collecting signature from various persons. In that collected signature the preprocessing methods such as slant correction, binarization and normalization have been done to remove the noise in the input image. In the next stage, segmentation process has been done by means of a morphological watershed algorithm.Finally, a feature extraction has been done using wavelet transform of the segmented image.

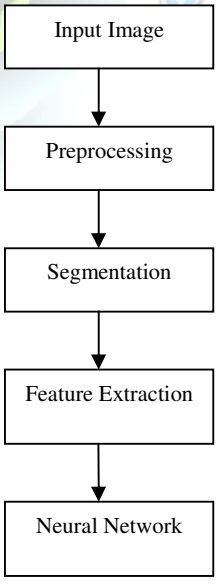

Fig.1 Block diagram for Signature Recognition

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A. Image Acquisition

In this phase handwritten signature of various persons has been collected. The scanner scans hand written Signature and converts it to a digital image. The acquired signature is stored in a database for pre-processing.

B. Pre Processing

The main objective of preprocessing is to obtain a transformed image with enhanced quality. It improves quality of the image and makes it suitable for feature extraction. In proposed work Conversion of RGB to Gray Scale Image, Cropping, Noise Removal, and slant correction has been done are shown below.

1) *Conversion of RGB to Gray Scale Image :*

Scanned images are stored in the database as a color image and should be converted into a grayscale image.

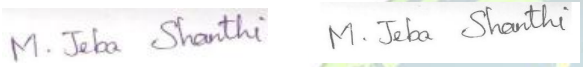

Fig. 2 Conversion of RGB to Gray Scale Image

2) *Cropping:*

Cropping process is removing unnecessary white background from the image. It reduces the size of signatures. The resulting signature only includes the main framework of the signature.

Fig. 3 Original image and Cropped Image

3) *Noise removal :*

Noise removal is needed to reduce the pixels that are not part of the signature, but contained in the image [3]. In Scanned signature, some unwanted pixels come with the scanned image that is not a part of the signature. So this rejected part must be separate before feature extraction. So in order to remove such unwanted data from our image, we use several filters to remove such noise .Here the Gaussian filter is used to remove impulse noise.

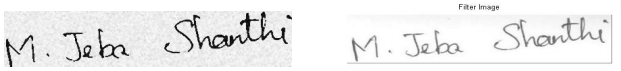

Fig. 4. Before Filtering image and After Filtered Image

4) *Slant Correction:*

In, removing slant in a signature will reduce variation within classes and easier to recognize. [4] In slant removal 2D spatial transform is used to change the x data and y data of the read image which automatically shifts the source of our output image to make as much of the reconstruct image visible as possible..

It will also make segmentation easier, since Signature that are straight up have more distinct space between them than signature that are at a slant.

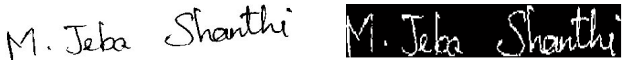

Fig. 5. BeforeSlant Correction and After Slant Correction

III. SEGMENTATION

Segmentation is essentially present to extract the specified or required region from an image. In Signature several segmentation processes have been used such as morphological opening and closing.

In our analysis, we use morphological watershed transform to the segment. It is a more stable segmentation process and it involves in continuous segmentation boundaries

Fig. 6. Original Image and Edge detection, image using gradient magnitude

The Segmentation process involves the boundary detection, pixel varies very rapidly along the boundaries between two regions which were usually analyzed using the gradient magnitude method for boundary detection. [5, 6, 8] In our method of segmentation, background and foreground morphological study before applying it into the watershed transform for segmentation is exposed in the Fig.6.

This morphological process involves two important processes, "opening-by-reconstruction" and "closing-by - reconstruction" for cleaning up the image to avoid over-segmentation and under-segmentation when applying it into the watershed transform.

A. Morphological Opening

In Morphological opening is simple erosion followed by dilation, which is used to remove the unwanted structures in an image.

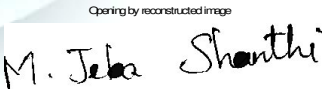

Fig. 7. Opening by reconstructed image

B. Morphological Closing

Morphological closing is a dilation followed by erosion, which is used to merge or fill structures in an image. Closing-by reconstruction involves dilation followed by morphological reconstruction, which helps in removing the unwanted components in our background.

C. Erosion

Erosion is usually employed here to reduce objects into an image.

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Fig. 8. Opening or Erosion of the image

D. Dilation

Dilation is employed here to increase the object into an image.

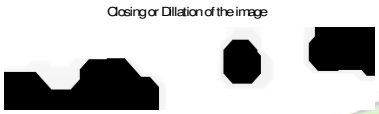

Fig. 9. Closing or Dilation of the image

Further apply the watershed transform to segment the handwritten image into letter and words based on watershed lines obtained from the above process are shown in fig.10.

Fig. 10. Watershed Transform

IV. Feature Extraction

Feature extraction is the process of transforming input data into a set of feature. Feature extraction which helps in reducing the training complexity of neural networks and for reducing computation time before training process. [7]

In our analysis we use daubechies'5/3 integer to integer wavelet transform for feature extraction. Feature extraction is to get more relevant information from the original data and represent that information in low density regions. After the handwritten signature image is transformed by the integer to integer wavelet. Daubechies'5/3 integer to integer wavelet transform is that, it is easily reversible and lossless.

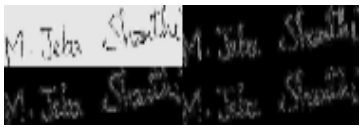

Fig.11. Daubechies'5/3 integer to integer wavelet transform

V. Conclusion

In this paper, an overview of the recent works done on signature verification. In preprocessing various methods has been done, which helps in segmentation and feature extraction. In segmentation uses the simplest and efficient watershed transform to segment handwritten signature, which makes this system for a lossless feature extraction process. This proposed work provides a platform for the development signature recognition using "opening-by-reconstruction" and "closing-by-reconstruction" various methods. In further, a neural network is used to recognize the signature.

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