Handwritten Signatures using ANN

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Steps to perform handwritten signature verification using neural networks

1. Retrieval of signature images from a database
2. Pre-processing the signatures
   1. Converting signatures into binary
      1. A gray scale signature image is converted into binary to make feature extraction simpler
   2. Image resizing
      1. Standardize the size of the signature into 256 X 256
   3. Thinning
      1. Thinning makes the extracted features invariant to image characteristics like quality of pen and paper. Thinning means reducing binary objects or shapes to strokes that are single pixel wide
   4. Finding bounding box of the signature
      1. Construct a rectangle encompassing the signature. This reduces the area of the signature to be used for further processing and saves time
3. Feature Extraction ( Total of 24 features)
   1. Maximum horizontal and vertical histogram (2 features)

Horizontal histogram is calculated by going through each row of the signature image and counting the number of black pixels. A row with maximum number of black pixels is recorded as maximum histogram

A vertical histogram is calculated by going through each column of the signature image and counting the number of black pixels. A column with maximum number of black pixels is recorded as max histogram

1. Centre of Mass (1 feature)

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

1. Normalized area of signature ( 1 feature)

It is the ratio of area of signature image to the area of signature closed in a bounding box. Area of signature is number of pixels comprising it

1. Aspect Ratio (1 feature)

It is the ratio of width of signature image to the height of the image. This is done because width and height of a person's signature may vary but the ratio remains approximately equal

1. The tri surface feature (3 features)

Two different features may have the same area so to increase the accuracy of the features, the signature is divided into 3 equal parts and area for each part is calculated. The signature area is then normalized for each part and the area is calculated

1. The six fold surface feature (6 features)

Divide the signature into 3 equal parts and find a bounding box for each part. Then calculate the center of mass for each part and calculate the area of signature above & below the center of mass within the bounding box. This provides six features.

1. The transition feature ( 10 features)

Traverse a signature image in left to right direction and each time there is a transition from 0 to 1 and 1 to 0. Calculate a ratio between the position of transition and the width of the image traversed and record it a feature. Repeat the same process in right to left, top to bottom and bottom to top. Also calculate the total number of 0 to 1 and 1 to 0 transitions. This provides 10 features

1. Creature of feature vectors by combining the extracted features

A feature size of 24 vectors are formed using the feature extraction step

1. Normalizing the feature vector

Extracted 24 features are normalized to bring them in the range of 0 to 1. These normalized vectors are applied as inputs to neural network

1. Training a neural network with normalized feature vector
2. Test the model using steps 1 to 5
3. Applying normalized feature vector of test signature to trained neural network
4. Using a result generated by the output neuron of the neural network declaring signature as a genuine or forged

Various Methods to solve the handwritten signature verification problem

1. Hidden Markov Models (HMM)
2. Neural Networks
3. Template Matching
4. Statistical
5. Support Vector Machines