On-Line Signature Verification

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ABSTRACT

In this paper, we are going to propose a new technique for On-Line signature based on global n local features. In general, shape of an on-line signature is used as a single discriminating feature. Sometimes shape of signature is used alone for verification purposes and sometimes it is used in combination with some other dynamic features such as velocity, pressure and entropy. In proposed system shape of signature is examined using Edge-Detection Algorithm (EDA), pressure points are calculated using Pressure Points Allocation using Clustering (PPAC). So the overall process can be thought as the process is signature examination based on shape and pressure points in combination with entropy and velocity and it performs verification on each partition separately. Finally, the signature is classified as genuine or a forgery.

Keywords: On-Line Signature, Edge-Detection Algorithm (EDA), pressure points, Pressure Points Allocation using Clustering (PPAC).

1   Introduction

In On-Line signature verification application, the signatures are processed to extract features like static and dynamic those are used for verification. There are two stages called verification and enrolment. Two types of features are used to validating a signature. They are static and dynamic features. Those features are extracted from signatures that are recorded as an image are called as Static features and features that are acquired in real time are called as dynamic features. Function based and parameter based features are the types of features. Function based feature examples include velocity, position, and pressure. Use of parameter based features are more efficient.

2   System Design

Online signature verification system examines shape of signature using (EDA) Edge Detection Algorithm along with (PPAP) pressure points using Pressure Point allocation using pixels in combination with entropy and velocity features.

System Architecture:

This system has four phases as follows:

1.   Distance Matching (Morphology)
2.   Velocity calculation
3.   Entropy matching
4.   Calculation of pressure points
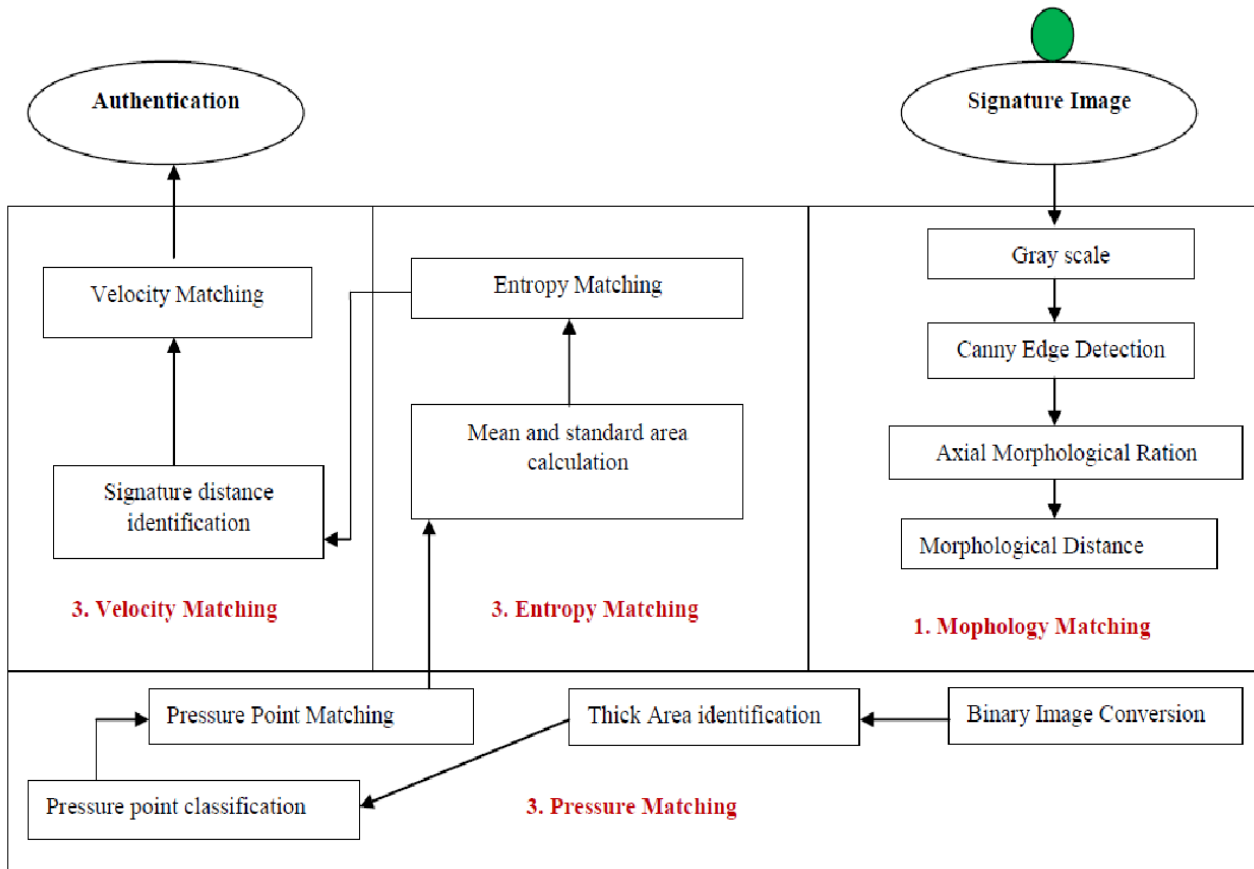
3   Methodology

Distance Matching

This first phase of our system which consist of following steps: Take input signature (image) & convert it into gray scale image (grayscale). In this step the original image is converted into grayscale image. System applies on an original image characterized by shadow region. In this algorithm, first calculate (l) length and (w) width of image. Consider integer format at position of image (x, y) , where x is the distance from the origin in the horizontal axis, y is the distance from the origin in the vertical axis. Convert this integer value into hexadecimal value. With this, we get Blue (B), Green (G) and Red (R of that pixel. Then calculate GRAY value for each pixel by using eq (1). Apply this calculated GRAY value to each Green (G), Blue (B) and Red(R), value of that pixel i.e. , G=GRAY, B=GRAY, R=GRAY. we get grayscale image. $GRAY = (R + G + B)/3$

Figure3.1: Gray Scale Image

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

GAUSSIAN BLUR EQUATION

Apply Canny Edge-Detection algorithm(edgeimage). Algorithm for (GB)Guassian Blur using in Canny Edge(CE) :

Step 0: Start

Step 1: Get Image path

Step 2: Get (L*W) Length and width of the Image

Step 3: FOR each pixels from 0 to width

Step 5: Get a Pixel at (x, y)

Step 6: Get the (SD) Standard Deviation of the pixel

Step 7: Calculate(1/(2 * pi *SD*SD))

Step 8: Calculate (x*x +y*y)/ (2*SD*SD)

Step 9: Calculate G as Product of step7 and Step 8

Step 10: Apply G to Pixel

Step 11: Stop4.

Double thresholding Edge pixels (EP): Potential edges are determined by thresholding.

- Edge pixels (EP) stronger than the high threshold are marked as most valid.
- Edge pixels (EP) weaker than the low threshold are average.
- Edge pixels (EP) between the two thresholds are marked as most invalid.

Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (most valid) edge.

- Most valid edges are interpreted as certain edges, and can immediately be included in the final edge image.
- Weak edges are included if and only if they are close to strong edges.

Figure 3.2: Edge Image

Signature Morphology and morphological distance

The morphology of the any signature yields structure of the signature and the shape which helps to recognise the right signature. Upper x axis of the signature is considered as the stagnant axis which records the ratios.

Algorithm for Signature morphology identification

Step 0: Start

Step 1: Get Image path.

Step 2: Get (L*W)Height and width of the Image.

Step 3: FOR x=0 to width.

Step 4: FOR y=0 to Height.

Step 5: Get each Pixel at (x, y) as signed integer.

Step 6: Convert pixel integer value to Hexadecimal to get R, G, and B. S

Step 7: if (R!=255 and G!=255 and B!=255) (checking for signature pixel)

Step 8: Get the value Y for the pixel

Step 9: Then ratio Rt= Y/Height

Step 10: Add value Rt in an array RA

Step11: End of inner for

Step 12: End of outer for

Step 13 : Stop

Algorithm for morphological distance matching (MDM) Input Rd and Ri as every dataset signature and two distance arrays of input signature.

Step 0 : Start

Step 1: Initialize sum S=0

Step 1: for i=0 to length of Ri and Rd

Step 2: get x and y as elements of Ri and Rd respectively

Step 3: d=x-y

Step 5: S=S+d

Step 6: End of for

Step 7: distance=S/ length of Ri

Step 8: Stop

Pressure Matching

Binary Image conversion: Online signature image is converted into black and white component of the image pixels called binary image. We can get the complete image with two colored pixels as black and white. Online signature system efficiently removes colored pixels which are a barrier to identify the pressure points in given image. Below algorithm shows

Figure 4-5: Binary Image

Thick Area identification

Online Signature system perform thick area detection using clustering based clusters that identifies thick area if signature.

Figure 4-3: Area Segmented Image

Pressure point classification:

In algo detected thick area is considered as pressure points and we are applying clustering using nearest four pixel as one pressure point.

Figure 4-6: Pressure Points

Entropy matching

After validation of pressure calculation phase we are considering entropy of image based RGB factors.

Velocity calculation

Velocity of image is calculated as:

Total length of signature (max X-min X)/ average time.

Velocity match (Input Image Velocity, Data Set Image Velocity)

4   Results and Discussion

To measure efficiency of system precision and recall are considered as the best measuring techniques. So precision can be defined as the ratio of the number of relevant signatures authenticated to the total number of irrelevant and relevant signatures are authenticated. It is usually expressed as a percentage. Whereas Recall is the ratios of the number of relevant signatures are authenticated to the total numbers of relevant signatures are not authenticated. It is usually expressed as a percentage. This gives the information about the absolute accuracy of the system.

For more clarity let we assign

- A = The number of signatures are authenticated,
- B = The number of signatures are not authenticated   • C = The number of irrelevant

signatures are authenticated. So,

$$Precision = (A/ (A+ C))*100$$
$$Recall = (A/ (A+ B))*100$$

To measure the performance of the model, system is set to authenticate signature images of 10 input images at each run. The performance is shown in the below figure.
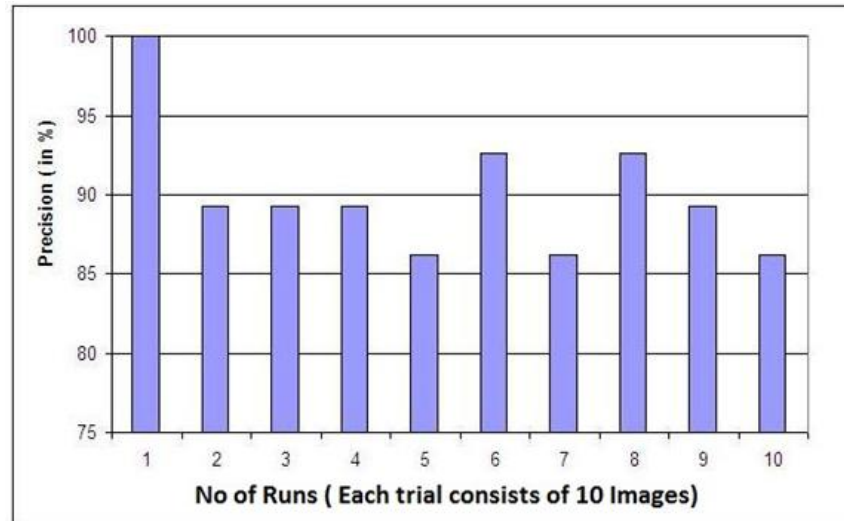

Figure 7: Average precision of the proposed approach

In above Figure 7, we observe that the tendency of average precision for the authenticating signature images are high compared to other systems.
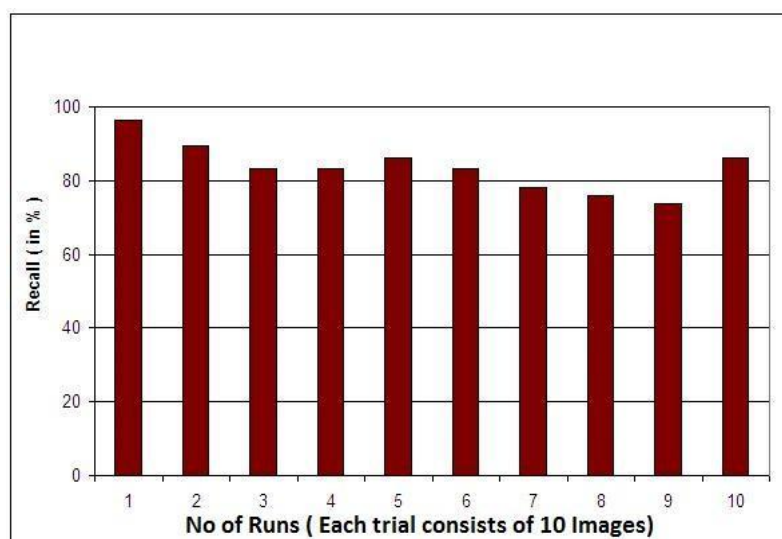
Figure 8: Average Recall of the proposed approach

In Figure 8, we observe that the tendency of average Recall for authenticating signature images are high compared to other system. So this shows that our proposed system is achieving high accuracy than any other method.

5   Conclusions

In this paper, we have discussed an offline signature verification technique using grid based feature. The signature image is first converted in to gray image then into binary, segmentation and then thinned. The pre-processed signature i.e., gray image, black and white, segmented, thinned and signature is divided into the grid of size m x n. and matrix is formed. Then CMS is calculated and if CMS is greater than or equal to 60 then RMS is calculated.

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