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Dynamic Signature Recognition and Verification Using Pixel Based Approach

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Abstract—In the modern world of technology, Digital signature processing is most popular in the field of image forgery. We are using online signature recognition and verification technique of image forgery detection in which the signature is acquired from Digital signature pad or similar devices, and the image is compared to the signature which is already saved in the database, using various techniques. Signatures are of two types: Online and Offline. Now a day online signature is most frequently used technique in any era of signature recognition and verification, where image forgery is reduced and chances of malfunctions are less. We are pre-processing the signatures so it becomes easy to verify signature accurately at the end, in the same process it does the feature extraction by which signature is extracted in such a way that input signature will be in the easier form to be recognize. This paper verifies signature using pixel based approach in which the stored image and entered image are matched and if the matching factor is high enough or nearer to threshold value then the signature is accepted otherwise rejected.

Keywords— Digital Signature, Pixel Based method for verification, Image forgery, Gray Scale, Edge Detection, Thinning

I. INTRODUCTION

Authentication is the primitive thing when it comes to any confidential data; authentication and confidentiality always work hand in hand. Think about the scenario when one need to sign particular document which are confidential and it should be done without any forgery, then one phenomenon comes in spotlight, that is "*Digital signature recognition and verification*". The process of capturing human signature can be done by electronic signature pad or similar devices and it is recognize as well as verified by our proposed algorithm. Process of recognition and verification contain several steps such as: Data acquisition, pre-processing, feature extraction and verification. The first step is to acquire signature from particular user, means user have to sign his/her signature on signature pad or similar devices. In the step of pre processing signature, signatures are pre processed which contains several processes like: gray scale the image, thinning, and cropping [2]. Gray scaling is nothing but a process of converting
RGB image into gray scale image in which various shades of gray are appeared and signature is converted into gray scale.[7]
Another step is image thinning in which the overlapped points are removed so signature cursivity is reduced and it becomes much easier to recognize the signature. In the process of cropping, boundary is fixed around the signature, so extra space is automatically reduced to get the accurate signature area. In the step of feature extraction various factors of signature like pen tip pressure, velocity, speed factor etc. are measured. Here we have done our implementation using MATLAB R2008a. MATLAB® is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java®. MATLAB can be use for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. [3]

II. RELATED WORK

Kritika Raghuwanshi, Niketa Dubey, Riju Nema and Rishabh Sharma[2] They suggested the method for offline signature verification rests on the hypothesis that each user has similarity among signature example. In this paper, author use VPP or HPP method for signature verification. Main aim of this paper is reduction of forgery in business transaction and minimizes the fraud in image forgery.
Priyank Jain and Jayesh Gangrade[3] in this work they have proposed an online signature verification. They used pre-processing steps and also measured angle, energy and chain code for verification. They have used Dynamic time warping algorithm for signature verification.

P.N .Ganorkar and Kalyani Pendke[5] They proposed a system which represent relative slope method for signature verification. They have taken a signature from pen tablet or digital sign pad. Using this technique accuracy of signature is increase up to 80%.

Anu Rathi, Divya Rathi and Parmanand[7] In this work they have proposed method for signature verification using pixel based approach. They measured the False Rejection Rate of signature and verified it using pixel based approach.

III. ALGORITHM

3.1 Architecture Design

Functional Architecture design of signature algorithm is shown in Fig.1.

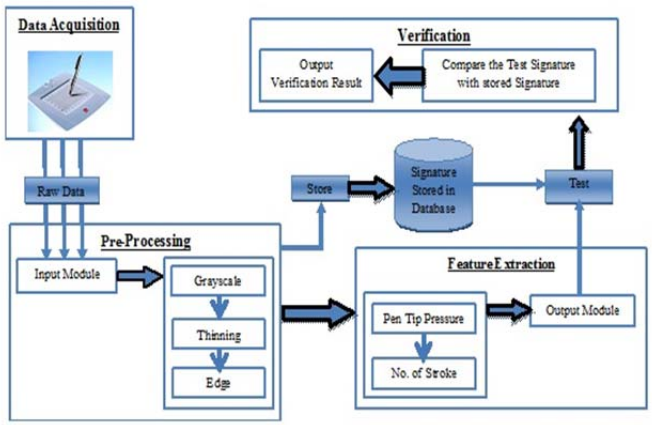

Fig.1 Architecture of signature verification process

3.2 Model Description

As shown in the design, signature is acquired through signature pad in this scenario in which user simply do the signature. Pre-processing[5] is done on the acquired signature and it has several steps like gray scale, thinning and rotation. Signature is converted from RGB to grey scale image. Thinning is the process where overlapping pixels are removed, so it will become quite effective to process the signature. In the step of rotation, signature is rotated from any point to its arbitary point. Edge detection is the step where boundary line is fixed for particular signature. There is also the phase called Feature extraction[11] where pen tip pressure, number of stroke are measured, so signature can be verified more accurately. Finally the processed signature is stored in the database. Now in the verification[7,13] phase if stored signature and test signatures are matched and the matching value is greater than or equals to threshold value then signature is matched otherwise it will be an invalid signature. It is noted that pixel based approach is used for verification in this algorithm.

Algorithm for signature verification:-

Input: - Image of Signature

Output:-Conformation from system whether signature is genuine or counterfeit.

Step 1:-Acquire signature from the signature pad.

Step 2:-Enhanced the inputted signature image by pre-processing.

Step 3:- The image is extracted to measure pen tip pressure and velocity.

Step 4:- signature is verified using pixel based approach.

A) Pre-processing

Pre-processing is the step where signature is processed such a way that it will become efficient in the recognition. It is done in three steps. First one is gray scale where image is converted in black and white form. Second step is thinning[15], where overlapping pixels are removed and pixel mapping is also done.

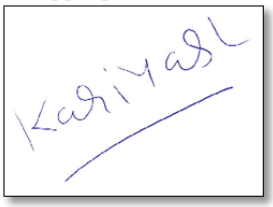

Fig.2 Original Image

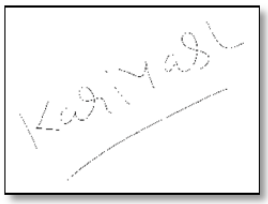

Fig.3 After Thinning Operation

After the thinning operation, rotation is performed and signature is rotated to its arbitrary position considering its X and Y coordinates[16].

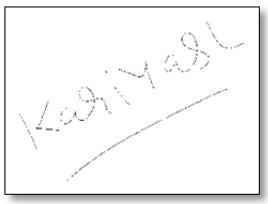

Fig.4 Before rotation

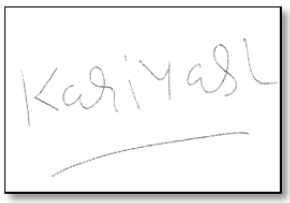

Fig.5 After rotate at zero degree

Algorithm for Rotating image at arbitrary point :-

Input:- Take the image

Output:- Image at the origin point

Step-1:- Acquire signature from the signature pad

Step-2:- Set the value of theta

Step-3:- Apply rotation about an arbitrary point Set value of x axis and y axis

Step-4:- Set the value of corner points

Step-5:- Transform the image

Step-6:- End

Now last step of pre-processing is edge detection[1]. In it, find out the signature from page and the crop the page as per signature area.

B) Feature Extraction

Feature extraction is the functionality which verifies style of user signature like how many times pen is taken up and down?, how much pressure is there while doing signature, Number of strokes and so on. In the field of signature recognition, there are huge chances of image forgery-i.e. some people may copy someone's signature and may use it anywhere, but by using feature extraction this issue may be resolved. Let take an example to understand the above statement-While doing one signature someone takes three times pen-tip ups and another one may take two times pen ups, image forgery is easily detected by this step of feature extraction.

No. of stroke

A signature can be considered as a sequence of strokes. This motivated development of a stroke-based algorithm by[11]. The first step is to detect the stroke boundaries. In dynamic signature verification, stroke is defined as collection of points where there is a 1) decrease in pen tip pressure, 2) decrease in pen velocity, and 3) rapid change in pen angle.

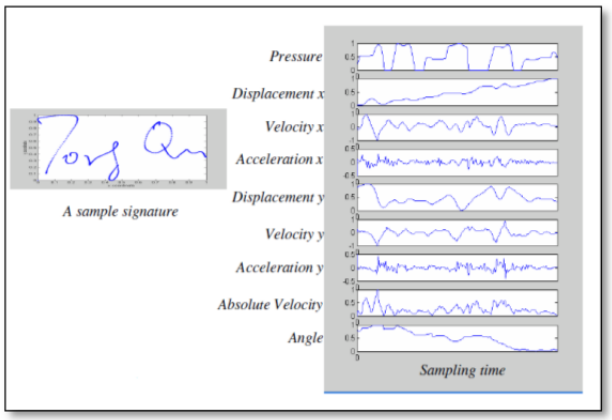

Fig 6. Number of strokes

C) Verification

Signature verification can be done by using various techniques like pixel based, histogram, region matching, graph matching and similar. In this proposed approach, pixel based verification technique is used for verification of signature. In pixel based approach, signature is segmented into small pixels and each of the pixel lies in the signature is important[7]. Both the saved and test image are matched pixel by pixel; it is not possible to have exact signature every time so we have some threshold value which will show the target of matching factor of these two signatures. If threshold is high enough that means signature matched, but if signature is not matched up to threshold value, then counterfeit is increased i.e. user can have two or more chances to enter the signature and same process of verification is repeated[11]. If signature does not match in any attempt, user will be automatically blocked.

IV. Result Analysis And Conclusion

The proposed system gives the 80% success rate by recognizing the all signature pattern correctly for all that signature which is used in training. Generally the failure to recognize/verify a signature was due to poor image quality and high similarity between 2 signatures. Main disadvantage of this system is, the non-repetitive personality of variation of the signatures, because of age, sickness, geographic location and some extent the emotional state of the person, accentuates the problem. So, signature may vary but to resolve this problem threshold value is set and so, signature threshold below threshold will be simply not accepted**.** If the signature is matched then, 0 value will be return else it will return 1.

Finally we concluded that signature verification is done in three stages – Signature acquisition, pre-processing and verification. These are the main steps to recognize and verify any signature online; one can further go into extraction phase to detect image forgery, which will provide security from signature tempering.

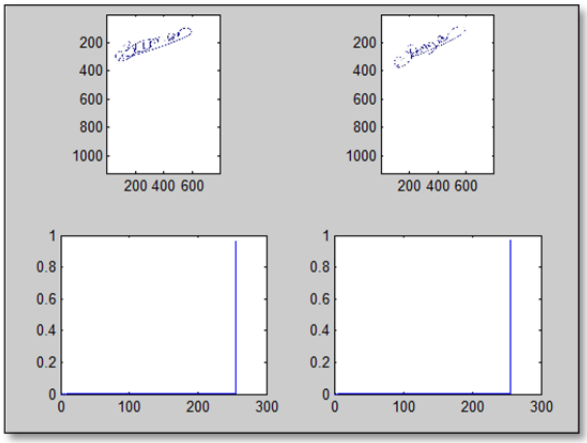

Fig 7. Histogram comparison

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