

A Novel Approach for Offline Signature Verification based on Texture and Gabor Wavelet Features

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Abstract: The main point is the Fingerprint Recognition is widely used for the individual verification that gives stress to the signature verification system. We used local binary patterns with the Scale invariant Feature Transform and G-SURF to match the scanned signature to the inked signature. The unwanted features are removed and the signature are matched and verified. I categorize and give an account of the various type of techniques that have been proposed for signature verification.

Keywords: Biometric, Fingerprint Recognition, SIFT, G-SURF, LBP

1. Introduction

1.1 Biometric

Biometrics is the estimation and factual examination of individuals' physical and behavioral qualities. The innovation is for the most part utilized for distinguishing proof and get to control, or for recognizing people that are under observation. The fundamental reason of biometric verification is that everybody is one of a kind and an individual can be recognized by his or her inherent physical.

There are two main types of biometric identifiers:

- 1) **Physiological characteristics:** The shape or composition of the body.
- 2) **Behavioral characteristics:** The behavior of a person.

The main types of biometric verification:

- 1) **Eyes - Iris Recognition-** It's the latest technique in which the features of iris in the eye can be used to found identity of individual.
- 2) **Face Recognition-** In this we examine of facial feature for the verification of a people. Eigen faces or local feature analyses are used by most.
- 3) **Fingerprint Recognition-** Edges and valleys found at first glance tips of a human finger to recognize a person is utilized.
- 4) **Gait Recognition** – The use of an individual's walking style or gait to determine identity.
- 5) **Signature Recognition-** The validation of a person by the examiner handwriting style, mostly the signature.

1.2 Signature Recognition

Today most important method in the world for security is signature verification. This is very popular method. More advantage of the use of signature recognition as an authentication approach is that most of the modern moveable computer and individual digital assistants use handwritten inputs.

There is very little signature recognition solution which can provide sufficiently high recognition rates at a reasonable level of efficiency. Signature recognition becomes very vastly growing method for security purpose. We have two sorts of advanced transcribed handwritten signature authentication, Static and Dynamic.

- Static method is a visual examination between one scanned signature and another signature. Advanced algorithm is utilized by two examined signature utilize.
- Dynamic is mostly known for function information is caught alongside with the X,Y,T and P co-ordinates of the sign. We can used this information for a court of law utilizing advanced scientific examination apparatuses.

The Signature verification works as the scanned signature are matched to that of the inked signature from the database kept in which different types of techniques are used for the matching. The unwanted features from the image are removed and the main part is thus considered for the matching and then it's is verified with given signatures. Following diagram shows us the working of the signature verification.

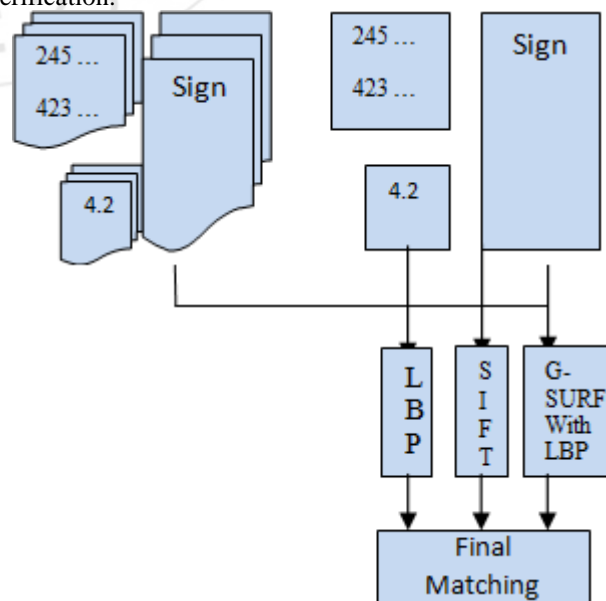


Figure 1.1: Signature Verification System

2. Approaches Used

Local Binary Pattern (LBP):

This approach is used in face recognition. This approach is used to divide face image into grid of small or non overlapping regions. One drawback of the previous method is that a given image region corresponds to the same part of the face in all the faces in the dataset. It happened only in the case of face images are fully frontal, scaled, and aligned properly. When LBP are invariant against monotonic grayscale transformation they are still affected by illumination changes that induce non monotonic gray-scale changes such as self shadowing.

$$LBP(X_C, Y_C) = \sum_{p=0}^{P-1} 2^p S(I_p - I_C)$$

SURF: "Off-Line Signature Verification using G-SURF" is proposed that is discovering as well as unrivaled descriptor purposes of energy for a photo where the photo is changed into headings, using a framework called multi-determination. This methodology assures that the reaction of leisure activity are scale invariant. Surf is an number neighborhood emphasizes identifier used as a piece of PC idea errands like article affirmation or 3D proliferation. The variation of Surf is a couple time speedier than SIFT and ensured by its makers to be more intense beside particular picture changes than SIFT.

G-SURF: The family of G-SURF descriptor is totally based on original SURF descriptor. We replace second-order gauge derivatives L_{ww} and L_{vv} . With these two first order derivatives L_x and L_y . We compute the derivative first in Cartesian coordinate frame (x, y) , and then fix the gradient direction (L_x, L_y) for every pixel. We obtained invariant gauge derivative up to any order and scale. We can apply our descriptive formulation to any scale feature detection method. From the definition of gauge coordinates in Equation 1, it can be observed that these coordinates are not defined at pixel locations where $\sqrt{L_x^2 + L_y^2} = 0$, i.e. at saddle points and extreme of the image. In practice this is not a problem as term Haar Romeny states in since we have a small number of such points, and according to Morse theory we can get rid of such singularities by infinitesimally small local changes in the intensity landscape. What we do in practice is to not sum the contributions of these points into the final descriptor vector.

3. Related Work

Jani, R. et al [1] "A Proposed Framework for Enhancing Security in Fingerprint and Finger-Vein Multimodal Biometric Recognition" The physical attributes of a human is the way of expedient and scrutinizing in biometric. In this paper we investigate the score level of fusion with characteristics extraction. The fusion of various techniques includes processing modality successfully until an adequate match is got.

Moganeshwaran, R. et al [2] "Fingerprint-finger vein multimodal biometric authentication system in field programmable gate array" In this paper author discuss the system on clip field programmable Gate Array, which is based on the implementation of multimodal biometric

authentication. Multimodal Biometric can solve many problems related to uni-modal biometric authentication. First step is Fingerprint and Finger vein are used like biometric trait and the whole procedure is implemented in SOC FPGA. The accuracy of the system is promising with an Error Equal Rate (EER) of 0.33%.

Deore, M.R. Et al [3] "A survey on offline signature recognition and verification schemes" Signature have various biometric screen. Today the identification of person is signature. Everyone has different signature has its own physiology or behavioral characteristics. Human signature is used as an identification of person in various works like bank checks etc. The signature identification can be offline or online. Offline Image processing technique for signature identification has no dynamic feature is available in offline identification. A brief survey on various off-line signature recognition & verification schemes is represented this paper.

Jayasekara, B. et al [4] "An Evolving Signature Recognition System" This paper is used to represent the signature recognition method which is based upon fuzzy logic and genetic algorithm. This consist of two phases the fuzzy interface system using GA & Signature Recognition. The feature extraction process is followed by selection preprocessing. The projection profile geometric centre, actual dimensions, signature area, local features, and the baseline shift are supposed as the feature set in the study. Those results are combined using a second stage fuzzy system.

Suruliandi, A. et al [5] "Local binary pattern and its derivatives for face recognition" For face recognition the Local Binary pattern texture method is used mostly. Experiments conducted for Japanese female facial expression, YALE and FRGC version2 databases. The results show that LDP and LTP perform much better than the other LBP-based models.

4. Methodology

Signature verification/matching are a process for authentication of a user on the basis of offline signature using feature extraction approach. Key point based feature extraction approaches have been used for extraction of features from signature images. Best approaches for key point based features encoding are SIFT and Surf features. But these approaches do not consider local shape description of the images so that makes it less effective for signature verification. Effectiveness of above defined approaches get decreases due to fact that key point descriptor does not acquire global shape of signature and does not consider locations of key point descriptors available in the character image.

In this paper an approach has been described that computes local descriptive features of the signature image and compute global shape value with key point descriptor. In the purposed approach local binary pattern has been embedded with G-SURF approach for computation of key point described, global and local texture features for signature verification.

In the purposed work SURF algorithm has been used for computation key point descriptors available on the signature image. To achieve this integral image has been loaded to the system by using box filtering and laplacian transformation key points have been discovered on a single image.

4.1 SURF feature Extraction

- In the process of feature extraction using SURF approaches integral image has been computed on the basis of different preprocessing steps that are thinning, binarization of the image. After preprocessing of image integral image has been computed from the image that has been used for key point's detection.
- After integral image computation key point detection approach has been implemented for detection of key points on the image.
- After this process box filters have been applied to the image so that fast discrete hessian operators can be computed at different scale levels. After this local maximum and interpolation of the different scale space has been computed on the basis of different transformation. Local maxima provide information about key points detected in the system and interpolation used to refine corresponding key point locations.
- Finally all the key points dominant and orientation neighborhood has been used for feature description. On the basis of orientation scale factor. Haar wavelet has been implemented on the squared are for computation of different features. These feature are done as final descriptive features.

In this purposed work Gabor features have been embedded to SURF features so that easy global image description features can be embedded to the image.

4.2 Gabor Feature

Gabor filter has been implemented to the signature image to compute global information about the signature space in the image. In this approach two dimensional Gabor filter has been implemented by using these formulas. The Gabor filter is implemented on a square image that computes global description about different key point orientation computed by using SURF.

$$G(x, y, \lambda, \theta, \psi, \sigma, \gamma) = \exp\left\{\frac{x'^2 + \gamma^2 y'^2}{2\sigma^2}\right\} \cos\left(\frac{2\pi x'}{\lambda} + \psi\right) \quad (1)$$

Where $x' = x \cos \theta + y \sin \theta$

$$y' = -x \sin \theta + y \cos \theta$$

In the first equation λ indicate the wavelength of cosine factor, θ indicates orientation of the normal to the parallel strip of Gabor function. Ψ is use to represent the phase offset considered for feature computation, σ is use to indicate sigma of Gaussian envelope, γ is use to represent spatial aspect ratio and ellipticity of the Gabor function.

After implementation of Gabor function to the 50*50 normalized signature image that computes 2500 different global description about the signature has been embedded with SURF key point descriptors. SURF computes 128 key descriptive features and that are embedded with 2500 descriptive global features that compute a feature vector of

2628 values. These signature features does not contains information about local texture panel available in the signature image that has been used by computing local binary pattern technique to add up texture features of the signature image.

4.3 Local Binary Pattern

In this processing signature image has been under goes the processing of local descriptive features available in the image. To implement this signature image has been undergoes the process of LBP approach that moves a mask of 3 *3 to the image and compute the center pixel value and on the basis of center pixel value the Local binary code has been generated. These codes have been embedded by using different histogram contamination and full image feature descriptors have been developed that has been added to G-SURF feature vector so that signature matching can be achieved higher accuracy.

134	56	200
45	90	189
34	56	109

This table represents the pixel values available in the signature image that contain signature part. The variation in the pixels occurs due to non-overlapping of the information available in the image. Center value 90 is selected as the center pixel value that has been denoted by I_c and other are neighborhood values.

$$X = I_c - I_{ij} \begin{cases} \text{if } x > 0 \text{ then } I = 1 \\ \text{else } I = 0 \end{cases}$$

By using this formula LBP code has been generated that has been represented below.

1	0	1
0		1
0	0	1

LBP code= 10111000

These codes have been computed for whole image and concatenate to form a feature vector based on LBP. This feature vector is embedded with G-SURF feature vector for matching purpose.

5. Results and Discussions

In the purposed work offline signatures samples have been used from different users for signature verification process. These different samples available in the dataset have been used for training and testing purposes. In the purposed work different preprocessing steps have been implemented on the sample signature image for computation of different local and global key point descriptive features.



Figure 6.1: Sample signature image

This figure represents Sample signature image that has been used for signature verification process. This image has been undergoes different preprocessing steps for extraction of key point based features.



Figure 6.2: Gray scale image

Sample image has been converted into gray scale format so that extractions of features have been simple from a combination of all the features. Colors available cause problems of mismatching due to high saturation variations.

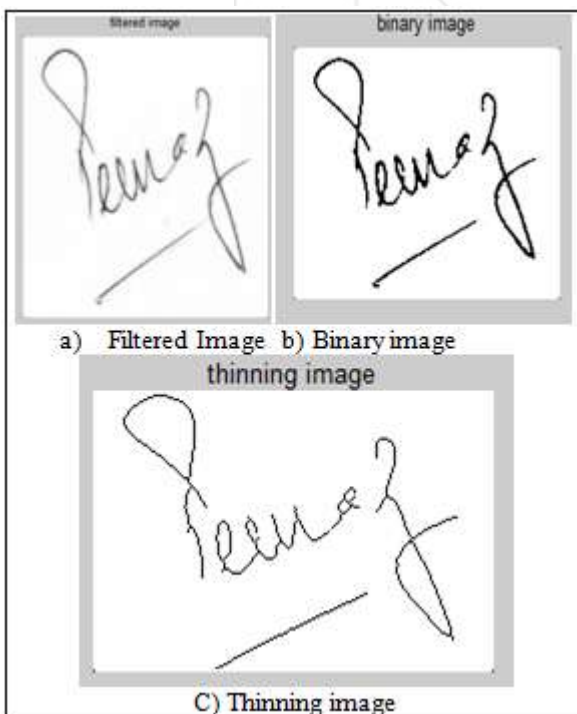


Figure 6.3: This figure represents different images for different features used for extraction of feature by using various preprocessing features

After preprocessing of the sample image different features have been computed for extraction of different global and local key point based features using purposed approach.

These features have been computed for training and testing dataset. These both features undergoes for matching purpose using SVM classifier that divides images into different classes. These classes are divided on the basis of matching feature. After this step a all the tested samples is matched manually with dataset matching features various performance evaluation parameters have been measured.

Parameters: FAR: It stands for false acceptance rate. This is the frequency that accepted the anon-authorized human being as authorized human being is considered as follow

$$FAR = \frac{N_{fs}}{N_f}$$

N_{fs} = The successfully attempted fraud against a person
 N_f = Total successfully fraud attempted against a person.

The false acceptance rate is use to measure that the biometric security system will incorrectly accept an access attempt by an unauthorized user. It provides half information to us.

FRR: It stands for False Rejection Rate. It is the frequency that a certified signature is discarded and is considered as follow.

$$FRR = \frac{N_{qr}}{N_{fq}}$$

N_{qr} = Number of rejected verification attempts for a qualified person
 N_{fq} = Total Number of verification attempts for a qualified person

Table 6.1: Comparative Results of purposed and previous approaches

Features	FAR	FRR
SURF	23.25	26.75
G-SURF+LBP	1.75	2.35

This table represents FRR and FRR that has been computed for different signature samples. On the basis of this parameter EER has been computed that is an Average error rate for the system that is 2.05 for purposed system.

6. Conclusion

This paper represents a NOBAL technique for computation of different local and global key descriptive features for computation of different features that achieve high accuracy. In this paper features have been extracted using LBP+G-SURF approach. This method can be used for signature image from which some part is missing that has been completed by using thinning and suphourification approach. In future reference approaches can be used for selection of best features from the image on the basis of different parameters. In future one can plan to utilize other Indian languages for extraction of features and matching.

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