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Research Article

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Survey of Different Segmentation Method for Low Quality Fingerprint Image

Anjani Pandey[1] , Gayatri Singh

*Corresponding author:

Anjani Pandey

[1]Dept of Computer Engineering V.I.T.S, Satna (M.P)
[2]Dept of CSE (Software System) V.I.T.S, Satna (M.P)

Abstract

In Computer Vision, Segmentation Refers to the Process of Portioning a Image into Multiple Segments (Sets of Pixels).The goal of Segmentation is to Simplify and change the Representation of an Image into Something that is More Meaningful and Easier to Analyze. Fingerprint Segmentation is an Important Pre-Processing step in Automatic Fingerprint Identification System. The task of a fingerprint Segmentation Algorithm is to Decide Which Part of the Image belongs to the fore-ground, Originating from the Contact of a fingertip With the Sensor, and Which Part to the Background , Which is the Noisy area at the border of the Image.

We Study Different Algorithm for the Segmentation of fingerprints is Presented and SVM (support vector machine) Classifier for fingerprint Image Classification. Segmentation and Classification are the Important Concepts of Digital Image processing (DIP)

Keywords: Segmentation, Classification, DIP, Sensor, SVM.

Introduction

In an increasingly digitized world the reliable personal authentication has become an important human computer interface activity. National security, e-commerce and access to computer networks are now very common where establishing a person's identity has become vital. Existing security measures rely on knowledge-based approaches like passwords or token-based approaches such as swipe cards and passports to control access to physical and virtual spaces, but there methods are not very secure. Tokens such as badges and access cards may be duplicated or stolen. Passwords and personal identification number (PIN) numbers may be stolen electronically. Furthermore, they cannot differentiate between authorized user and a person having access to the tokens or knowledge. Biometrics such as fingerprint, face and voice print offers means of reliable personal authentication that can address these problems and is gaining citizen and government acceptance.

Fingerprint

Fingerprint is fully created at about seven months of fetes development and it is unique and unchangeable during individual's cuts or injuries. Fingerprint consists of a sequence of ridges and valleys on the surface of the finger. In image point of view, ridges are actually the dark part in the image except the presence of different kind of noise, whereas valleys are the bright part. Frequently, ridges and valleys go in parallel but sometimes they bifurcate or terminate. Bifurcation is present when the ridge suddenly split into two ridges and termination exists when t fact, bifurcation and termination represent some of important minutiae points.

Different segmentation techniques of fingerprint image

New Modified Gradient Based Technique

The objective of Fingerprint segmentation is to extract the region of Interest(ROI) which contains the Desired fingerprint Impression. Present a Modified Gradient Based Method to Extract ROI. The distinct feature of these technique is that it gives high Accurate Segmentation percentage for fingerprint Image Even in case of low quality fingerprint Images.

Mean And Variance Based Method

Mean and Variance based method can Significantly Reduce the number of basic image entities. And due to the good discontinuity preserving filtering characteristic, the salient features of the overall image are retained [1].

Steps for mean and variance based method [1] are summarized as follows

1.Divide the input image I (I,j) into non-overlapping blocks with size wxw.

2. Compute the mean value M(I) for each block using equation 1.

$$M(I) = \frac{1}{W^2} \sum_{i=w/2}^{w/2} \sum_{j=w/2}^{w/2} I(i,j) \qquad (1)$$

3.use the mean value computed in step 2 to compute the standard deviation value std(I) from equation 2.

$$Std(I)= \frac{1}{W^2} \sum_{i=w/2}^{w/2} \sum_{j=-w/2}^{w/2} (I(I,j)—M(I))^2 \quad (2)$$

4.Select Empirically a Threshold Value Working on Different Images. If the (1) is Greater than Threshold Value, the Block is Consider as foreground otherwise it Belongs to Background.

Direction Based Methods

This Method is Mainly Based on the Coherence of Direction. A fingerprint Consists of Parallel line Structures the Coherence will be Considerable higher in the foreground Than in the Background[4]

The Steps for Direction Based Method [4][5] are Summarized as Follows;

1. Dived the Input image I(i,j) into Non- Overlapping Blocks With Size wxw.

2.Use 3x3 Sobel Vertical and Horizontal Marks Defined in Equalization 3 and 4 Respectively to Compute the Gradient dx (I,j) and dy(I,j) And at Each Pixel(I,j) which is the Center of the Block.

$$\text{Sobel Vertical} = \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 1 \\ -1 & 0 & 1 \end{pmatrix} \quad (3)$$

$$\text{Sobel Horizontal} = \begin{pmatrix} -1 & -2 & 1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix} \quad (4)$$

3. Estimate the local Orientation using equation 5,6 and 7 [6]

$$V_x(i,j) = \sum_{U=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} (dx(u,v))(dy(u,v)) \quad (5)$$

$$V_y(i,j) = \sum_{U=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} dx^2(u,v) - dy^2(u,v) \quad (6)$$

$$V_z(i,j) = \sum_{U=i-w/2}^{i+w/2} \sum_{v=j-w/2}^{j+w/2} (dx(u,v) + dy(u,v))^2 \quad (7)$$

4. Calculate Background Certainly and Orientation field using equation 8.

$$coh = \sqrt{\frac{Vx^2(I,j) + Vy^2(I,j))}{w^2 * V_z}} \quad (8)$$

5. select empirically a threshold value working on different images. If the coherence is greater than threshold value, the block is considered as foreground otherwise it belongs to background.

In linear Hybrid Classifier for fingerprint Segmentation Method

A Hybrid algorithm based on linear classifiers for the segmentation of fingerprints is presented. The propose algorithm uses a Block-wise classifier to separate foreground and background blocks in the main and employ a pixel wise classifier to deal with pixels accurately. In order to evaluate the performance of the new methods based on other classifiers.

A captured fingerprint image usually consists of two components, which one is called the foreground and the background [2] .the foreground is the component that originated from the contact of a fingertip with the sensor. the noisy area at the borders of the image is called the background[3]

Block-wise segmentation

Block-wise segmentation includes foreground and background blocks to reduce computational consumption in subsequent procedure and avoid introducing false segmentation within small region. The fingerprint image portioned into blocks of 16*16 pixels. Two features block mean information and block variance information, are used in block-wise segmentation. For most fingerprint sensors, the ridge-valley structures can be approximated by black and white lines, while the background, where the finger does not touch the sensor is rather white. This means that the mean gray value in the foreground is in general lower, that is, darker gray, than it is in the background.

$$Mean(m,n)= \frac{1}{16\,16} \sum_{i=0}^{15} \sum_{j=0}^{15} I(i+16m,j+16n)$$

In general, the variance of the ridge-valley structures in the foreground is higher than the variance of the noise in the background. The block variance for each block is given by:

$$Variance\ (m,n)= \frac{1}{16\,16} \sum_{i=0}^{15} \sum_{j=0}^{15} \{I(i+16m,j+16n) - mean(m,n)\}^2$$

Each of blocks is assigned into three sets, foreground, background and pending blocks set, respectively. Using class w_1 for the foreground block, class w_0 for the background block, class w_2 for the pending block, and w for the assigned class, the following decision function is applied;

ω_0 mean(m, n)< T_1 , variance(m, n)<T_2

ω= ω1 mean(m, n)>T_3, variance(m, n)>T_4

ω_2 otherwise Where T1,T2,T3 and T4 are threshold values.

Pixel-wise segmentation

Pixel-wise segmentation identifies and removes non-ridge pixels from the pending blocks. In this procedure, Coherence, Mean, and variance and selected as the pixel features. The coherence gives a measure how well the gradients are pointing in the same direction . In a window W around a pixel, the coherence is defined as

$$Coh = \frac{|\sum_w (G_{s,x}, G_{s,y})|}{\sum_w |(G_{s,x}, G_{s,y})|} = \sqrt{\frac{(G_{xx}-G_{yy})^2+4G^2_{xy}}{G_{xx}+G_{yy}}}$$

Where $(G_{s,x}, G_{s,y})$ is the squared gradient,

$G_{xx} = \sum_W G^2_x$, $G_{yy} = \sum_w G^2_y$, $G_{xy} = \sum_w G_x G_y$

And (G_X, G_Y) is the local gradient.

The average gray value measures how gray the pixel is. Using I as the intensity of the image, the local mean for each pixel is given by;

$$Mean = \sum_W I$$

The variance measures the gray variance around the local area. The variance is for each pixel is given by;

$$Var = \sum_W (1-Mean)^2$$

The Coherence, Mean and variance feature values are normalized in the [0, 1] range. The proposed pixel-wise segmentation is based on [8]. The algorithm presented in [8] uses a linear classifier which is called label box to enhance the performance of fingerprint image segmentation. The classifier uses three pixel features, being the coherence, the mean and the variance. The parameter modal is established using sample space at first. Then the type(background and foreground) of each pixel is pending blocks is decided by the parameters model and features.

Low Quality Fingerprint Images

This is a new algorithm to segment fingerprint Images [9]. These algorithm uses four features the global mean, the local mean, variance and coherence of the image to achieve the fingerprint segmentation. Based on these features a rule features a rule based system is built to segment the Image.

The proposed algorithm is implemented in three stages; pre – processing, segmentation and post processing. Gaussian filter and histogram equalization are applied in the pre-processing stage. Segmentation is applied using the local features. Finally, fill the gaps algorithm and a modified version of threshold in the post-processing stage. Segmentation stage.

Feature for fingerprint segmentation

Fingerprint features must reflect both the gray level of fingerprint and the direction of ridge lines . however the complicated construction of fingerprint pattern and the Imbalance in the contrast, require local feature Instead of the global features for gray-level based methods while coherence is the feature for direction based method . the combination for these features in one algorithm show efficiently the distribution of the pixels for ridges and valleys in the image. coherence feature indicates the strength of the local window gradients centered on the processed point along the same dominate orientation.

local mean, local variance and local coherence [7] are calculated as following

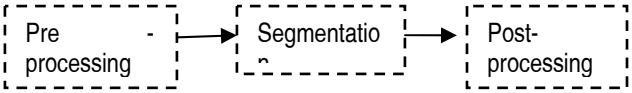
$$mean = \frac{1}{w^2} \sum_w I \quad , Variance = \frac{1}{w^2} \sum_w (I-mean)^2$$

where I is Intensity and w is the window size Centered on the processed pixels.

$$coh = \sqrt{(g_{xx}-g_{yy})^2+4(gxy)^2 / (g_{xx}+g_{yy})}$$

$$g_{xx} = \sum_w Gx^2 \, , \, g_{yy} = \sum_w Gy^2 \, , g_{xy} = \sum_w Gx\, Gy$$

where Gx and Gy are corresponding horizontal and vertical gradient components which are given by sobel operators.



Pre-Processing

fingerprint image with low contrast, false traces ridges or noisy complex background cannot be segmented correctly. therefore it is required to enhance the image. Gaussian filter used in this method and histogram equalization. Gaussian filter used to smooth the image and hence background areas. this step together with split and merge technique , with is applied in the next stage, will collect pixels with similar gray levels into big areas. histogram equalization is invoked in this stage too. when the global mean of the image under consideration is higher than a certain threshold, which mean a bright Image , histogram equalization is used to enhance the image by reduce the brightness of the image.

Segmentation

In this stage , Split and merge technique is applied to collect similar background areas after the smoothing process. in order to separate the foreground from the background, the image is divided into a number of non-overlapping sub –images of size 10X10 pixels and the local mean, local variance and local coherence are computed for each sub-image. the global mean together with the three a fore mentioned parameters are used to build a rule based

system to segment the foreground and background of the image under
consideration. the result of this rule based system is to decide whether a certain block is a foreground or a background.

Post Processing

the segmentation fingerprint image may contain isolated background blocks which are surrounded by foreground blocks. obviously these background blocks are foreground in the original image . a simple post processing technique is proposed to eliminate the presence of these isolated blocks.

Support Vector Machine (SVM)

The key idea of SVM is generalization: A classifier need not only to work well on the training samples, but also to work equally well on previously unseen samples. Although this is realized long before the appearance of SVM, it is SVM that gives this idea a good implementation. A linear SVM is a separation hyper plane with its separation margin maximized and the number of mis-classified samples minimized. The margin is defined as the distance between the hyper plane and the samples of the two classes that are closest to the hyper plane (among those being correctly classified). By minimizing the number of training errors, SVM seeks good performance on the training data; by maximizing the margin, the generalization ability for future data is optimized.we are using the new technique for Fingerprint Image Classification is Support Vector Machine fingerprint classification is Important for different practical applications. an accurate and consistent classification can greatly reduce fingerprint matching time for large database.

References

[1]. Maltoni D, Maio D, Jain A, and Prabhakar S. Hand Book of fingerprint recognition, springer ,newyork,2003.

[2]. Bazen AM, and Gerez SH. "segmentation of fingerprint images", proc-pro RISC 2000, 12th Annual workshop on circuits , systems and signal processing ,Nov 2001.

[3]. Chen XJ, Tian J, Cheng JG, and Yang X. "segmentation of fingerprint"

[4]. Bazan AM, and Gerez SH. "Directional Fields Computation for Fingerprint Based on the Principal Component Analysis of local Gradient" proRISC 2000 Workshop on Circuits, Systems and Signals Processing ,Veldhoven,the Netherlands,Nov.2000.

[5]. Lim and Jac S. "Two Dimensional Signal and Image Processing ", Englewood Cliffs, NJ, Prentice Hall, PP.469-476,1990.

[6]. Dario Maio and Davide Maltion , "Direct Gray-Scale Minutiae Detection in Fingerprints" ,IEEE Trans An Pattern Analysis and Machine Intelligence , Vol.19,PP.27-40,Jan.1997.

[7]. Helfroush M, and Mohammad M. pour, "Fingerprint Segmentation," Presented at 3rd International Conference " on Information and Communication Technologies: From Theory to application, Damascus, Syria. 2008.

[8]. Ren CX, Yin YL, and Ma J. " Fingerprint image segmentation based on linear classifier", fifth international Symposnum on Multispectral Image Processing and Pattern Recognition (MIPPR 2007),Proceedings of the International Sociaty For Optical engineering (SPIE),Vol. 6790, PP.67905J, wwhan china, Nov. 15-17, 2007.

[9]. Hasan Fleyeh, Diala Jomaa, Mark Dougherty"Segmentation of Low Quality Fingerprint Images" IEEE member Computer Science Department, Dalarna University, Borlänge – Sweden-2009.