

Review on Core Point Detection Techniques in Fingerprint

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ABSTRACT

Biometrics is a robust approach for identification or verification of person as it identifies person based on physical or behavioral characteristics. Among all characteristics fingerprint is the most popular and widely used biometric modality for identification or verification of person. Performance of the fingerprint verification or identification system is based on accurate core point detection technique. Till date many techniques are proposed to detect core point in fingerprint images but performance of these techniques is highly depends on type, quality of input fingerprint image so core point detection in fingerprint is still an open problem for research community. This paper deals with review of different techniques which are proposed for detection of core point in fingerprint image.

General Terms

Image Processing, Pattern recognition

Keywords

Biometrics, fingerprint and core point.

1. INTRODUCTION

An automatic personal identification or verification is becoming very important for the function of our electronically interconnected information society [1]. Number of systems requires checking a person's identity before allowing that person to access these resources. Now a day's biometric system is becoming a very strong approach for person identification or verification [2]. Unlike traditional authentication systems which are based on "something that you have" e.g. key or "something that you know" e.g. Personal Identification Number [PIN], biometrics relies on "something that you are". For identification or verification biometric system uses physiological characteristics such as fingerprint, face, palm print, iris etc. or behavioral characteristics such as voice, writing style, and gait and so on. Among these various modalities fingerprint is the most popular and widely used modality for authentication. Fingerprints are the result of unique ridge and valley structure formed by skin over the fingers [3]. Every person has unique structure of these ridges and valleys like left loop, right loop, arch, tented arch, whorl and double loop [4]. Success rate of the fingerprint verification or identification is based on accurate core point detection technique. In biometrics core point is simply center part of fingerprint image. A core is defined as a point in the orientation field where the orientation in a small local neighborhood around the point presents semi-circular tendency, it is one of the singularities of the fingerprint [5]. Fig 1 shows core point and delta point in fingerprint image.

Till date number of core point detection methods have been proposed. A common method used for core point detection is Poincare Index [PI] method but for noisy images performance

of the PI degrades.

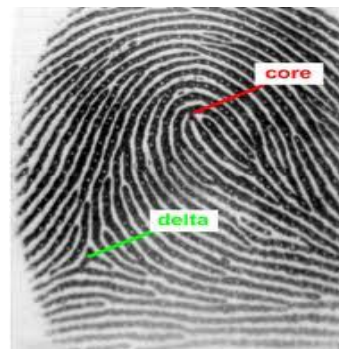


Fig 1: Core point and Delta Point in fingerprint image

Another commonly used method used for core point detection is sign-map based method which is based on Multi Resolution Analysis [MRA], this method can detect the core point even for low quality images but it requires lot of preprocessing so ultimately results into more time complexity.

2. RELATED WORK

In this section some core point detection techniques are reviewed with summary of- algorithm used for core point detection, database used for experiment and their percentage result. In September 2012, Suwarna et al. have proposed method for core point detection in fingerprint which is based on Least Mean Square algorithm [5]. Segmentation and normalization has been carried out in order to preprocess fingerprint image. For segmentation author has used Mean and Variance method then segmented image is normalized. Then orientation field estimation is calculated with the help of Second Derivative of Gaussian filter [SDG]. By extracting best region of interest and orientation field core points are detected accurately. Author has used 'DB1_A' dataset of FVC-2004 for experiment. Database contains total 800 images, out of that 600 images are taken for experiment. Author has categorized these images as good, bad quality images. For good quality images out of 100 images 98 images showed correct core point. In March 2008, Young-Chul Song et al. have proposed a novel method for core point detection using orientation and edge maps, where a color loop-up table is defined and used to obtain the orientation map. The edge map is obtained from the orientation map. From edge map an upper part maximum edge region is detected as the edge region having maximum area in the edge map. At the last, the core point is detected by searching a point placed in the lowest part of the upper-part maximum edge region [6]. Experiment was carried out on FVC2004 'DB2_A' and 'DB3_A' dataset, which both contains 800 fingerprint images.

According to author, 95% accuracy is achieved for DB2 database while 97.5 % for DB3 database. In April 2011, Navrit Kaur Johal and Amit Kamra have proposed a new

method for core point detection especially for low quality images [7]. After preprocessing like segmentation, normalization, orientation field estimation author has detected core point based on slope value of block ranging from 0 to $\pi/2$. Experiment has been carried out on 180 images; author has not mentioned percentage accuracy. In 2008, M. Usman Akram et al. have presented a novel method for core point detection in fingerprint using improved segmentation and orientation [8]. First of all preprocessing with modified gradient based segmentation, normalization has been carried out. Then smoothed orientation field estimation is calculated and core point is detected. Experiment has been carried out on FVC 2004 database and according to author 91.56 % accuracy is achieved. According to author this optimal core point detection method has high accuracy also less computational time compare to Poincare index and Detection of curvature method.

In 2013, G. A. Bhagat et al. proposed a new fast and accurate technique for core point detection. Author has proposed mask set that locate core point from ridge orientation map. A mask set arranged in square shape is presented. Orientation map of image is calculated and then mask set scans smoothed segmented orientation map. Finally core point is detected at the end of discontinuous line appearing in the orientation map [9]. FVC 2002 DB1 and DB2, FVC 2004 DB1 databases are used for experiment. Author has achieved accuracy of 96.66%, 91.06% and 87.5 % respectively for three databases. In 2007, Atipat Julasayvake et al. have proposed hybrid approach i.e. combination of Direction of Curvature [DC] and Geometry of region [GR] technique for core point detection [10].

Table 1. Summary of core point detection techniques

Author	Method	Database	Success rate	Execution time
H B Kekre et al. (2010)	coherence of gray scale gradient, Poincare index, angular coherence and orientation field mask	FS 88 database	98 %	16 ms
Suwarna et al. (2012)	Least Mean Square algorithm	FVC 2004 DB1	98%(good quality images) 85%(bad quality images)	not specified
Young-Chul Song et al. (2008)	orientation and edge maps	FVC 2004 DB2_A FVC 2004 DB3_A	95% 97.5%	not specified
Thien Hoang Van et al. (2009)	convex orientation consistency	FVC 2004 DB2	96.9%	not specified
G A Bhagat et al. (2013)	Mask set with core point at the end of discontinuous line of orientation map	FVC 2002 DB1 FVC 2002 DB2 FVC 2004 DB1	96.66% 91.06% 87.5%	33.9ms 43.8ms 8.1 ms
Atipat Julasayvake (2007) et al.	Hybrid approach- Dc and GR technique	FVC 2002 DB2	93%	12 ms
Usman Akram et al. (2008)	Extraction of best ROI and fine orientation field	FVC 2004	91.56%	10.8 ms

FVC 2002 DB2 database was used for experiment and result showed 93% accuracy with 12ms processing time. In 2010, H B Kekre et al. proposed method to detect core point in fingerprint, this method is based on multiple features extracted from fingerprint which includes coherence of gray scale gradient, poicare index, angular coherence and orientation field mask [11]. For experiment author has collected images with FS88 Scanner. Experimental analysis showed the accuracy of 98% while execution time is 16 ms. In 2009, Thien Hoang Van et al. have proposed a novel method for detection of core point. This method is based on computation of the convex orientation consistency [12]. Experimental results showed 96.9% of accuracy. Experiment was conducted on FVC 2004 DB2 dataset. Table 1 summarizes the different methods which have been reviewed with database used for experimentation, success rate and execution time required.

3. CONCLUSION

Detection of core point in fingerprint image is very crucial task. In order to achieve more identification or verification rate, accurate detection of core point plays very important role. Till date many techniques have been proposed for core point detection but performance, success rate highly depends on types of input images used, quality of images, so core point detection in fingerprint images is still an open problem for research community.

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