A Review of Non-Minutiae Based Fingerprint Features

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ABSTRACT

This article presents a critical review of extensive research on automatic fingerprint matching over a decade. In particular, the focus is made on the non-minutiae-based features and machine-learning-based fingerprint matching approaches. This article highlights the problems pertaining to the minutiae-based features and presents a detailed review on the state-of-the-art of non-minutiae-based features. This article also presents an overview of the state-of-the-art fingerprint benchmark databases, along with the open problems and the future directions for the fingerprint matching.

KEYWORDS

Fingerprint Datasets, Fuzzy Features, Image-Based Matching, Matching Errors, Non-Minutiae Features

1. INTRODUCTION

From early 1960’s, automatic fingerprint identification tools have been used in the implementation of the law enforcement in civilian, forensics and security domain. This motivates the research organizations and academic institutions to carry out intense research on the design and development of an automated fingerprint matching system for the identification of an individual.

Fingerprint matching algorithm compares two given fingerprints and returns either a degree of similarity (score between 0 and 1) or a binary decision (match/non-match). Most of the algorithms require fingerprint pre-processing / enhancement before feature extraction and matching that are implemented directly on the gray scale fingerprint images. The fingerprint representation derived from the feature extraction as template (T) during the enrolment and representation of a fingerprint to be matched as the input (I). The fingerprint feature extraction and matching algorithms are usually quite similar for both fingerprint verification and identification problems. An automatic fingerprint identification system (AFIS) mainly consists of three important steps, viz., pre-processing, features (descriptors) extraction and similarity evaluation as shown in Figure 1. Extraction of reliable features is the most important step in the success of any AFIS. Pre-processing and similarity evaluation methods may vary with different types of features used.

The difficulties in fingerprint matching are mainly due to the large variability in different impressions of the same finger (i.e. large intra-class variations). The main factors responsible for intra-class variations are displacement, rotation, partial overlap, non-linear distortion, pressure, skin condition and noise and feature extraction errors. Figure 2 shows the large intra-class variation of two different impression of the same figure taken from FVC2002 DB1 (Maio et al., 2002a). The rotation may be inserted during image capturing, as finger may be placed on the sensor surface with different conditions and partial overlapping of fingers may also occur.
angle each time. The images are captured with arbitrary rotation between ±35 degrees (Maio et al., 2002). A large number of fingerprint matching algorithms have been proposed in the literature. Most of the algorithms perform well during matching on the good quality fingerprint images. However, matching the low-quality images and partial images still remains a challenging problem to date. It is evident from the study given by Maio et al. (2002) that 20% of false-rejection rate is 80% contributed by the poor-quality images.

Therefore, the development of a robust fingerprint matching system that is capable of processing and matching poor-quality images is still in a great demand. Following sections, presents a comprehensive review on the fingerprint matching techniques by classifying them into three major categories: Correlation-based matching, Minutiae-based matching, and Non-minutiae feature based matching.

The recent techniques of fingerprint matching and classification are based on machine learning. Some of the works in this category include: (Sjogard, 1992; Baldi & Chauvin, 1993; Quek et al., 2001; Coetzee and Botha, 1990; Melin et al., 2005; Ji et al., 2007; Kang and Zhang, 2009; Yang et al., 2005; Yang et al., 2006; Yang and Park, 2008a; Yang & Park, 2008b; Wilson et al., 1994; Hong...
An Empirical Study for Human Behavior Analysis
www.igi-global.com/chapter/an-empirical-study-for-human-behavior-analysis/197046?camid=4v1a

Facial Image Processing in Computer Vision
www.igi-global.com/chapter/facial-image-processing-computer-vision/77590?camid=4v1a