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基于微特征的指纹识别算法研究

Research of Fingerprint Recognition Algorithms

Based on Minutia

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## 摘要

指纹具有唯一性、可靠性和稳定性的特征，在身份鉴别认证领域得到了广泛的应用，其商业应用也越来越成熟。从指纹图像中提取高质量的指纹模板，并且实现高识别率和鲁棒性的基于微特征的指纹匹配算法，是实现基于指纹的生物特征的挑战/应答认证的前提。同时，为了实现基于生物特征的挑战/应答认证，需要摆脱目前商品化的指纹认证系统，这些系统多数包含了厂家拥有知识产权的特殊技术。因此，基于微特征的自动指纹识别技术依然是一个具有重要研究意义的课题。

在对国内外公开的指纹识别算法研究的基础上，本文重点研究了如何提取有效的指纹模板和基于微特征的指纹匹配算法。本文的特色主要包括以下两个方面：

1、提取有效的指纹模板。首先，为消除指纹图像中噪音的影响，利用预处理技术进行指纹的图像增强，包括实验研究规格化、分割、方向场估计、频率场估计、滤波增强、二值化等算法，并且提出基于 Harris 角点的分割算法的一种改进形式，该算法不仅能够有效消除指纹背景区域带来的伪特征点，也可减少指纹图像预处理的计算量。其次，通过对增强后的指纹图像进行细化，提取指纹微特征，并且设计了基于微特征的脊线跟踪算法，能够消除因毛刺、桥、洞等伪特征结构产生的伪特征点，从而提高指纹模板的质量。

2、基于微特征的指纹匹配算法。本文提出一种改进的基于微特征的指纹匹配算法，该算法不依赖于指纹的中心点和脊线结构等全局特征，并且采用相似矢量三角形来解决点模式匹配算法中的关键问题：参考点定位。改进的基于微特征的指纹匹配算法，不仅使得指纹模板的空间大小满足基于生物特征的挑战/应答认证的要求，而且算法对指纹的平移、旋转和形变情况具有较高的识别率和鲁棒性。

本文在 PC 上使用 Microsoft Visual C++ 6.0 软件对所有算法进行了实验研究，编程实现了一个自动指纹识别系统的原型，统计结果表明，系统达到了预期的目的，满足课题研究的要求。

**关键词：**自动指纹识别系统；特征提取；点模式匹配

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## Abstract

With the characteristics of uniqueness, reliability and stability, fingerprint is widely used in identification and verification fields, and is becoming a more and more mature business technique nowadays. Extracting high quality fingerprint template and studying fingerprint matching algorithms based on minutia with high accuracy and robustness, are preconditions to implement Challenge/Response verification based on biometrics. Meanwhile, in order to implement Challenge/Response verification based on biometrics, we need to get rid of commercial fingerprint verification system with protected patents that belong to commercial companies. Therefore, fingerprint recognition is still a far reaching research field.

Based on mounts of studies on the fingerprint home and abroad, the paper does deeply researches on how to extract high quality fingerprint template and fingerprint matching algorithms based on minutia. The paper consists of several characteristics as follows:

1. High quality feature extraction. Firstly, the preprocessing technology is used for the fingerprint image enhancement, including normalization, segmentation, orientation field estimation, frequency estimation, filter enhancement based on Gabor, binarization algorithms and so on. Especially, the paper proposed an improved segmentation algorithm based on Harris corner, which not only effectively eliminates false minutiae from the fingerprint background region, but also reduces the calculation of fingerprint image pre-processing. Secondly, with thinning, feature extraction and reducing false minutiae from false features based on ridge tracking algorithm, high quality fingerprint template will be obtained.

2. Fingerprint matching algorithm based on minutia. Through lots of researches on fingerprint matching algorithms, this paper proposed an improved fingerprint matching algorithm based on similar vector triangle, which is independent of the global features of fingerprint, such as the core points and ridge structure. Furthermore, the algorithm is conducted to solve the key problem of fingerprint matching based on minutia: reference point orientation. And the improved fingerprint matching algorithm based on minutia, not

only makes the fingerprint template size meet the requirements of Challenge/Response Verification based on biometrics, but also obtains relatively high accuracy and robustness to the fingerprint translation, rotation and deformation.

In this paper, all algorithms are tested on the platform of Microsoft Visual C++ 6.0, with the production of an AFIS prototype. Finally statistic experimental results show that the AFIS prototype has achieved our predicted goals and meet the research's requirements.

**Key words:** AFIS; Feature Extraction; Fingerprint Matching Based on Minutia

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