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THEME

Automated Fingerprint Matching Algorithm using Representative Ridge Points

Mr. MANSOURI Kamel	University of M'sila	Head
Mr.BELHADJ Foudil	University of M'sila	Supervisor
Mr. K.Jaber	University of M'sila	Examiner

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General Introduction

Biometric recognition refers to the use of distinctive physiological and behavioral characteristics (e.g., fingerprints, face, hang geometry, iris, gait, and signature), called biometric identifiers or simply biometrics, for automatically recognizing a person. Questions such as "Is this person authorized to enter the facility?", "Is this individual entitled to access the privileged information?", and "Did this person previously apply for a job?" are routinely asked in a variety of organizations in both public and private sectors. Because biometric identifiers cannot be easily misplaced, forged, or shared, they are considered more reliable for person recognition than traditional token- (e.g., keys) or knowledge- (e.g., password) based methods.

Biometric recognition can provide better security, higher efficiency, and increased user convenience. It is for these reasons that biometric systems are being either increasingly deployed or evaluated in a large number of government (e.g., welfare disbursement, national ID card, issuing of driver's license) and civilian (e.g., computer network logon, automatic teller machine, cellular phone, Web access, smartcard) applications.A number of biometric technologies have been developed and several of them are being used in a variety of applications. Among these, fingerprints, face, iris, speech, and hand geometry are the ones that are most commonly used. Each biometric has its strengths and weak -weaknesses and the choice of a particular biometric typically depends on the requirements of an application. Various biometric identifiers can also be compared on the following factors; universality, distinctiveness, permanence, collectability, performance, acceptability and circumvention. Because of the well-known distinctiveness (individuality) and persistence properties of fingerprints over time, fingerprints are the most widely used biometric characteristics. In fact, fingerprints and biometrics are often considered synonyms! Fingerprints have been routinely used in the forensics community for over one hundred years and automatic fingerprint identification systems were first installed almost fifty years back. Fingerprint recognition is a complex pattern recognition problem; designing algorithms capable of extracting salient features and matching them in a robust way is quite hard, especially in poor quality fingerprint images. There is a popular misconception that automatic fingerprint recognition is a fully solved problem since it was one of the first applications of machine pattern recognition almost fifty years ago. On the contrary, fingerprint recognition is still a challenging and important pattern recognition problem .This project reflects the progress made in automatic techniques for fingerprint recognition over the past four decades.

Algorithms for fingerprint matching are used in human identification systems with applications in biometrics and forensics. The structures most widely used by fingerprint matching algorithms are minutiae– which are representations of ridge bifurcations and ridge endings. Minutiae-based algorithms with varying accuracy and efficiency are described in the literature on automatic fingerprint identification systems (AFIS).

While some minutiae matchers are highly accurate in full fingerprint matching, their error rates dramatically increase with decreasing number of minutiae.

The use of ridge similarity for fingerprint alignment has been previously described. While it leads to efficiency it is also vulnerable to non-linear deformation. When the threshold for ridge similarity is loosened to tolerate non-linear deformation, alignment errors will simultaneously increase. Even if the original scheme is improved by considering multiple ridge pairs for alignment, it is still worse than some matchers that use only minutiae. In some minutiae matchers with high accuracy, local similarity models cover small regions. However, entire ridges cover relatively larger regions. Similarity defined on a larger region is apparently more sensitive to non-linear deformation which prevents the ridge similarity model from better performance.

An effective algorithm for using ridges, based on utilizing representative ridge points (RRPs), is the focus of our project. A consideration was that an RRP have the same representation as minutiae so that existing minutiae matchers could be utilized with simple modifications.

The rest of this project is organized as follows:

The first chapter is dedicated to the presentation of biometrics. , And we will explain the architecture of a system of verification and biometric identification and biometric techniques.

The second chapter is dedicated to the fingerprint modality; we will explain the architecture of a verification system and fingerprint identification, and characteristics of the fingerprint and the steps for extracting characteristics.

The third chapter is dedicated for describing the relationship between available number of minutiae in the input fingerprint, the number of matching and identification accuracy. Alignment based on ridge similarity is described together with its drawbacks; next we introduce RRP and how to utilize RRP on existing minutiae matchers. And we explain the algorithm that we used for the improved phase matching with RRP.

The fifth chapter is used to express the model used for the design and implementation of our system and the various stages of design.

We finally conclude this project with a general conclusion.

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SUMMARY AND CONCLUSIONS

In our project, we have seen the emergence of biometric recognition methods, a biometric access control system for restricted areas based on individual finger print and Gabor filter for enhancement process is presented in the first part. For fingerprint enhancement, this unique property contributes significantly to improve the image quality. For efficiently we discuss image enhancement techniques based Gabor filter. A computer program is coded in C# to implement algorithms for enhancement, minutiae extraction and matching processing. The resulting minutiae information was used as a method for identifying matching fingerprints.

In the second part we have been demonstrated that ridge information can be utilized to reduce error rates in matching. Representative ridge points are proposed as an effective way to utilize ridge features. And we present a novel biometric approach to match fingerprints that run in linear time. We match the minutiae in the fingerprint by constructing a Nearest Neighbor Vector (NNV) considering its 2-nearest neighbors. The consolidation of these matched minutiae points is done by RRPs and by incorporating them in binary tree that propagates simultaneously in both fingerprints.

Abstract:

Automatic fingerprint identification systems utilize algorithms which matches only extracted minutiae from the input fingerprint– which are ridge endings and ridge bifurcations with minutiae in known fingerprints. Verification error rates of such algorithms occurs especially if the number of available minutiae are few which are not enough to give a reliable matching. Existing algorithms use local ridge similarity only for fingerprint alignment which are sensitive to non-linear deformation (since ridges cover relatively larger regions). An algorithm is proposed to utilize ridge information that performs more effectively by choosing representative points along the ridges. The chosen ridge points are used, together with minutiae, in existing minutiae matching algorithms. Since the addition of ridge points increases computation time significantly, a ridge point selection scheme is proposed, through which only one representative ridge point (RRP) is selected per ridge. The approach has two merits: significant performance improvement for fingerprints and usability with conventional matchers.

Keywords: fingerprint verification, biometrics, fingerprint matching, ridge points

ملخـــــص:

الانظمة الاوتوماتيكية للتعرف على البصمة تستخدم الخوارزميات التي تطابق التفاصيل المستخرجة من بصمة الاصبع المدخلة التي هي النهايات والتشعبات، مع تفاصيل بصمات الاصابع المعروفة. نسبة خطأ التحقق لمثل هذه الخوارزميات تحدث خصوصاً اذا كان عدد التفاصيل المتاحة قليلة بحيث انها لا تعطي تطابقا موثوقا بما فيه الكفاية. الخوارزميات الحالية تستخدم التشابه المحلي للحافات من اجل تخطيط البصمة فقط والتي هي حساسة للتشوه الغير خطي (حيث الحافات تغطي اكثر مساحة في البصمة). خوارزمية مقترحة لاستخدام معلومات الحافة التي تعمل بفعالية اكثر باختيار نقاط تمثيلية على طول الحافات. نقاط الحافات المختارة مع التفاصيل مُستخدمة معاً في خوارزميات تطابق التفاصيل. لان إضافة النقاط التمثيلية تزيد من وقت الحساب بشكل ملحوظ, لذلك تم اقتراح مخطط اختيار نقطة الحافة التي من خلالها تم اختيار نقطة تمثيلية وحيدة لكل حافة (RRP). المنهجية لها ميزتين: تحسين الأداء للبصمة و سهولة الاستخدام مع خوارزميات المطابقة التقليدية.

الكلمات المفتاحية: التحقق من البصمة, القياس البيولوجي، تطابق البصمة، نقاط الحافات.