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The Application of Hough Transform-Based Fingerprint Alignment on Match-on-Card

Cynthia S. Mlambo[1][2], Fulufhelo V. Nelwamondo[1][2], Mmamolatelo E. Mathekga[2]

[1]Department of Electrical and Electronic Engineering Science,
University of Johannesburg, Johannesburg, South Africa
[2]Council for Scientific and Industrial Research, Pretoria, South Africa
Email: smlambo,fnelwamondo,dmathekga@csir.co.za

Abstract

Smart cards are one of the most commonly used technologies that are integrated with fingerprints to develop higher security. One of the important uses of smart cards is the development of authentication systems for an individual. The demand of these cards, has led to the need for further improvements on smart cards combined with fingerprint biometrics. Due to the insufficient memory space and few instruction sets in Java smart cards, developers and programmers are faced with implementing efficient applications with limited memory space. This paper presents the application of an improved Hough Transform-based fingerprint alignment on a Java match on card. Experiments conducted determine the performance of Hough Transform based fingerprint alignment algorithm on Java smart card in terms of accuracy of alignment, memory usage and computing time. The algorithm was tested **on** a public database FVC2004 DB4 because this database contains rotated and translated images that will show results of alignment from the algorithm. Minutiae points were extracted from mentioned databases and used to compute alignment between two fingerprint images of the same finger that are captured at different instances. In addition, the experiments were conducted on two types of smart cards, Java Card Platform for Government ID, contact (ISO/IEC 7816) and contactless (ISO/IEC 14443). The performance measures considered in this research are memory usage and computing time since smart cards have limited resources which affect the performance of its applications. The results show that if the memory required in the alignment process is reduced, the whole matching process will also be reduced. The required memory for the entire process of alignment varies with the number of minutiae points that need to be aligned. As a result, if few minutiae points i.e. less than 20 are used, the accuracy of alignment decreases. Conversely when the number minutiae points have increased, alignment results becomes more accurate but requires more memory for processing. The average computing time that were taken to compute alignment parameters from two sets of minutiae points were depended on the number of minutiae points and the implementation of instruction sets. With sufficient amount of minutiae points the accuracy becomes more correct, however it requires more time to compute alignment parameters and process all minutiae points.