Dissertation Proposal

Department of Computer Science and Engineering,
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A Framework for Efficient Fingerprint Identification using a Minutiae Tree

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Abstract

Automated Fingerprint Identification Systems (AFIS) match a query fingerprint image with potentially large number of enrolled templates. Techniques such as pyramid indexing have been used to improve search efficiency by pruning templates using a varying range of feature values at each level. Other indexing methods preorder the templates based on similarities in local regions. For example, a recently described method using correspondences of feature triplets and geometric constraints shows that substantially reducing the search space improves the speed of matching and retrieval at the expense of accuracy. The challenge in practical AFIS operating on large datasets is to keep error rates low, while providing a match in real-time.

We propose to develop an efficient indexing and matching methodology for AFIS using a novel tree-based algorithm. Fingerprint templates of the enrolled users will be registered in a tree structure using minutiae features (contour ridge singularities) extracted from different local regions of a fingerprint image. We will develop the notion of minutiae bins, so that minutiae with similar properties can be stored at the same node of the tree. During traversal, branch selection will be made using the properties of the minutiae (e.g. distances to neighboring minutiae) corresponding to the current node of the tree. Variations in the minutiae extracted at different instances or due to distortions and noise can lead to binning errors. We propose to overcome this problem by placing the same template in multiple bins and at multiple locations in the tree thus reducing the effect of missing and spurious minutiae. In this approach the depth of the tree depends on the number of minutiae features, therefore the search time during identification and retrieval remains constant. We will extend this method to a full range of commonly used fingerprint features such as relative minutiae positions, orientations and ridge counts, and investigate methods to optimize the number of bins needed at each tree node.

We will validate our proposed methods on standard, publicly available live-scan and ink-based datasets and compare performance with other recent prominent approaches.