J Real-Time Image Proc (2013) 8:341–349
DOI 10.1007/s11554-011-0220-y

SPECIAL ISSUE

Parallel geometric hashing for robust iris indexing

Anukul Chandra Panda · Hunny Mehrotra · Banshidhar Majhi

Received: 31 December 2010 / Accepted: 11 August 2011 / Published online: 11 September 2011
© Springer-Verlag 2011

Abstract In this paper an effort has been made to improve the time complexity of existing geometric hashing based indexing approach for iris biometrics [1]. In the conventional approach, the annular iris image is used for the extraction of keypoints using Scale Invariant Feature Transform [2]. Further, geometric hashing [3] is used to index the database using extracted keypoints. The existing approach performs with an accuracy of 98.5% with improvement in time. However, to further improve time complexity, existing geometric hashing approach is made parallel during indexing as well as retrieval phase. In the proposed approach, the extracted keypoints are mapped to the processors of the hypercube through shared global memory. The geometric invariants are obtained for each basis pair allotted to individual processors in parallel. During indexing phase, these invariants are stored in the hash table. For iris retrieval, the invariants are obtained and the corresponding entries in the hash table receive a vote. The time complexity of the proposed approach is $O(Mn^2)$ for M iris images each having n keypoints, in comparison to existing approach with time complexity of $O(Mn^3)$. This marks the suitability of proposed approach for real-time applications.

Keywords Geometric hashing · SIFT · Indexing · SIMD · Hypercube

A. C. Panda (✉) · H. Mehrotra · B. Majhi
Department of Computer Science and Engineering,
National Institute of Technology Rourkela, Rourkela, India
e-mail: pandaa@nitrkl.ac.in

H. Mehrotra
e-mail: hunny@nitrkl.ac.in

B. Majhi
e-mail: bmajhi@nitrkl.ac.in

1 Introduction

Automatic identification of an individual is an area of keen interest among the researchers. Among several existing biometric traits, iris performs with enhanced accuracy and reduced time [4]. It is a protected internal organ whose random texture is stable throughout the lifetime of an individual. Visually recognizing an individual reliably through iris has become an intriguing approach when an image is captured at a very short distance. A generic iris biometric system extracts features from the input image and performs identification by comparing the probe template with all templates stored in the database. The number of false acceptances grows significantly due to the increase in the size of the database. Further, the time required to find the identity of an individual is directly proportional to the size of the database [5]. Thus, there is stringent requirement to minimize the time required to claim identification.

There already exist few indexing schemes to partition the biometric database. Indexing hand geometry database using pyramid technique has been proposed in [5]. The authors have claimed to prune the database to 8.86% of original size with 0% false rejection rate. In [6], an efficient indexing scheme for binary feature template using B+ tree has been proposed. In [7], the authors have proposed the modified B+ tree for biometric database indexing. The higher dimensional feature vector is projected to lower dimensional feature. The reduced dimensional feature vector is used to index the database by forming B+ tree. Further, an efficient indexing technique that can be used in an identification system with large multimodal biometric database has been proposed in [8]. This technique is based on kd-tree with feature level fusion which uses the multi-dimensional feature vector. In [9], two different approaches of iris indexing have been analyzed. First one uses the iris