

Preface

In our daily life, we use certain characteristics of people such as facial features, voice, gait, etc., to recognize people who are familiar to us. Automatic identification of the people by the use of their physiological (such as face, fingerprint, iris, hand geometry, etc.) and/or behavioral (such as voice, signature, gait, etc.) characteristics is called biometrics. As biometric characteristics are distinctive, cannot be forgotten or lost, and the person to be authenticated needs to be physically present at the point of access, biometric-based identification systems are gaining popularity and deployed in many important applications. In biometric identification systems, the identity corresponding to a query image is determined by sequentially matching it against all enrolled images in the database. Typically this approach works well for small databases. However, in real-life scenarios, size of biometric databases are usually high (e.g., Unique Identification Authority of India) and this sequential search makes the identification process extremely slow and computationally expensive. Efficient indexing techniques are required that enable searches over large databases in real time without compromising accuracy. Three different indexing techniques are designed, developed, tested, and described in this book.

The fundamentals of biometric recognition, importance of indexing techniques in large-scale biometric systems and their challenges, current developments and benchmarking are discussed in Chap. 1. An efficient triangulation based indexing technique for minutiae based biometrics especially for fingerprints is described in Chap. 2. This technique use an efficient representation named extended Delaunay triangulation for the fingerprints to make the system robust against distortions. Further, the extended triangulation is classified based on the type of minutiae at the vertices of each triangle. Such classification provides better partitioning of the database, leading to a significant decrease in the number of potential matches during identification. Chapter 3 discusses an indexing technique using match scores. For each image in the database, its match scores (i.e., index code) against a set of pre-selected sample images are calculated. Then a new storage mechanism is designed for the biometric databases. Like traditional database records, the biometric images are arranged in sorted order based on their scores. A set of images which are very similar to query are retrieved during identification using a voting

scheme. This results in a rapid search that takes constant time, i.e., independent of the database sizes.

A novel clustering based indexing technique using decision-level fusion is described in Chap. 4. An adaptive clustering algorithm is used that computes set of clusters in the database where each cluster is represented with an image called a ‘leader’. The set of leaders is used to compute the index code. During identification, a list of similar candidates is retrieved from the clusters as well as index table. This approach retrieves multiple evidences for identification with minimal resources. Conclusions and future scope of this work are discussed in Chap. 5. This book explores new and efficient storing structures for the biometric databases. The designed indexing approaches identify a query in less time with high level of confidence. Further, the proposed storage mechanisms prove to be effective for fast and accurate retrieval. It is suggested that future work can be done in the following areas:

- All of the existing indexing approaches are experimented over the databases which are relatively small because of the unavailability of the large biometric databases for the researchers. Hence, creating and experimenting with these techniques on such large databases may be a challenging problem.
- Securing the biometric data from theft is also another important research topic in the area of biometrics due to the limited availability of the biometric traits. Further, computing the cancelable index codes for biometric identification is also a challenging problem.

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for Large-Scale Systems

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