Abstract

Biometric identification is an automatic pattern recognition system that facilitates the use of physiological or behavioural characteristics of an individual for authentication. In general, biometric systems rely on unique characteristics of human such as iris, fingerprint, voice, face, etc. for authentication. However, the existing authentication systems suffer from enrolment problems due to non-universal biometric traits, susceptibility to biometric spoofing, or insufficient accuracy caused by noisy data, etc. Besides, one of the major limitation of the existing biometric systems is to handle query matching for large databases which often causes inefficient data retrieval.

To mitigate the above-mentioned problems, it is advocated for efficient data indexing mechanism assisting in fast data accessing operations. In this regard, a plethora of algorithms based on Geometric hashing, k-d tree, k-means clustering, etc. have been proposed in the literature, which index the records in an alphabetical or numeric order. Although, these traditional algorithms can be used with multi-dimensional data, yet, they fail with non-correlated multidimensional biometric data. Further, biometric data are characterized with a variety of features, thus, it is important to identify unique identifiers which are more resilient to distortion and provide better accuracy even with the presence of noise.

In this thesis, mechanisms for indexing biometric traits have been proposed. The process began with the consideration of unimodal biometric features, namely fingerprint and iris. Next, a multimodal indexing approach has been proposed by taking into consideration both the fingerprint and iris biometric traits. Several challenges posed by the biometric traits have also been resolved for the purpose of indexing. For instance, the fingerprint features are prone to distortion due to scaling and rotation effects. A 4-dimensional feature vector has been proposed which is tolerant to the effect of scaling and rotation.

To fulfill the aim of an efficient multidimensional fingerprint indexing, a space partitioning approach based on Locality sensitive hashing has been proposed. Such an approach helps an easy and fast accessibility of query data with a low penetration rate. Further, iris, considered as one of the most robust biometric trait, suffers due to usage of low quality equipment. Thus, before extraction of features, it is necessary that quality of captured iris images is evaluated. This step helps in better understanding of the quality of the extracted features and also helps in establishing the required search threshold for query retrieval.

For identification, dependency on a single modality can prove to be cumbersome; since, in many cases there remains a possibility of fingerprint abrasion or unsteady iris scanned images. Thus, there arises a necessity of multimodal biometric systems which can resolve the identification issues. In this thesis, a multimodal indexing approach has been proposed by combining the fingerprint and iris modalities. The proposed indexing mechanism can accommodate both the high and low dimensional data values. Further, the proposed mechanism is independent of data dimension.

Keywords: Pattern recognition, Image processing, Biometric data indexing, Fingerprint indexing, Iris indexing, Image quality analysis, Multimodal biometric