Abstract

Automatic face recognition (AFR) has been extensively studied over the past three decades in various domains resulting in a dramatic improvement especially in the last ten years. However, face recognition performance severely degrades under pose, lighting and expression variations, occlusion, and aging. Limited availability of training images, large size of image feature set leading to higher storage requirement & slower processing, are other issues which are of concern in AFR systems and tend to the degradation of face recognition performance.

In this work some of the above mentioned key issues are studied aiming at robust AFR systems. Some of the latest methods used widely for pattern detection and recognition have been studied and novel face recognition algorithms have been proposed based on those methods. The main contribution of the dissertation includes:

1. Providing an extensive survey of the history of AFR and the state of the art.
2. Various methods used for illumination invariance of the facial image features have been investigated and a method based on the concept of shape from shading has been proposed to get rid of the illumination variation problem. 3-dimensional depth images of the corresponding 2-dimensional gray level face images have been used since the depth features are expected to be independent of illumination variations.
3. Various transform based feature extraction methods used for face recognition have been investigated and three simple but effective algorithms have been proposed using Coiflet Packet, Radon Transform and Fourier Mellin Transform to recognize human faces from
some databases of still gray level images, under the environment of illumination and pose variations.

4. Classification plays an important role in face recognition algorithms. Hence an extensive study of various methods used for classification of face images have been carried out and a performance comparison of neural network based classifiers which are popularly used for face recognition has been done.

5. Another novel face recognition algorithm based on orientation histogram of Hough Transform Peaks has also been proposed. This is a modular local feature based algorithm and has been formulated mainly to improve the face recognition performance for lesser number of training images compared to the transform based approaches.

6. Scale Invariant Feature Transform (SIFT) and several variants of the same have gained a lot of popularity in recent years in the field of pattern recognition. Two algorithms based on SIFT for robust face recognition where only a single training image is available have been proposed. The algorithms take care of illumination variations as well as severe expression variations in the face images.

7. Local Binary Patterns (LBP) is yet another method that has been widely used in object detection & recognition problems. LBP & its variants have been studied in details and the LBP-DWT method has been proposed for face recognition using a single training image. This algorithm is robust against pose variations as well as expression & illumination variations and partial occlusion.