CHAPTER 7
SUMMARY AND FUTURE WORK

This chapter summarises the main results and contributions from the thesis and outlines directions for future work.

7.1 SUMMARY OF THE THESIS

In this thesis the problem of face recognition has been studied. Recognizing faces is quite a challenging task, since a face is a complex structure and we have to find the unique set of attributes to be able to determine whether a structure is a face of a particular person or not. The facial image features are subjected to variation due to illumination, size, orientation, expression, occlusion and presence of structural components. Furthermore, a computer has to deal explicitly with problems in the identification domain, that humans do not even realize that they are doing. Furthermore, humans use knowledge they have about the context of the image. A computer has to deal with every detail in the domain that humans take for granted.

The automatic face recognition system consists of three main stages. They are face localization, feature extraction and classification. For robust face recognition system, face localization and feature extraction are crucial. Classification helps to improve the overall performance of the system by employing the discriminatory features captured in the feature extraction stage.
In this thesis, a face localization procedure is developed to localize the face region. To normalize the effect of noise and illumination, wavelet-based illumination normalization technique is used to pre-process the image. The localization procedure employs edge information to detect the elliptical shape region to make it less sensitive to illumination compared to gray scale images. The localized face image is subjected to scale and angle normalization using geometric moments. The developed face localization is computationally efficient and not sensitive to size, illumination variation and facial expression, but it fails to localize the face if there is a large deviation in the angle of the image.

This thesis has proposed three different types of face representation technique and classification method for identification. Chapter 4 introduces the orthogonal polynomial transform-based approach followed by RBF as classifier. Moment function with orthogonal polynomial set as kernel additionally yields global characteristics of the image shape and provides a lot of information about different types of geometrical features of the image. These shape characteristics are used to construct feature vectors which are invariant to scale, rotation and translation. Generalized Pseudo-Zemike Moment and Tchebichef Moment are used in this work to extract the face features. The contribution of the RBF Network as a classifier is analyzed and also compared with conventional classifiers.

A hybrid feature extraction technique employing 2DPCA and Krawtchouk moment is proposed to overcome the problem of uneven illumination and facial expression. 2DPCA is used to extract the global features and Krawtchouk moment is utilized to extract the local features such as left face, right face, upper face and lower face. Ensemble of RBF NN is
used to classify the features, and fuzzy integral is used to fuse the output from the classifier. The performance of the soft fusion technique is found to be superior to the conventional weighted distance classifier. The proposed system performs well, even though the images are corrupted with noise. The time taken for recognition is high as compared to global methods.

In Chapter 7, a modular AANN-based model with WT for feature extraction is proposed to obtain robustness to face variation due to expression, noise and occlusion. Wavelet transform which is a spatial frequency analysis technique is good in capturing local variation in the image. The approximation of the WT coefficients is taken as the input features of the Autoassociative neural network. The five layer AANN model for each subject captures the distribution of data using backpropagation training algorithm. The combination of multi-resolution wavelet transform features and AANN FM results give good classification even though the images are corrupted with noise and occlusion.

7.2 FUTURE WORK

This thesis aims to build a system which can recognize faces from database images. This work can be extended to recognize people from a video sequence of faces.

The face localization technique developed in the thesis uses only the elliptical shape of the face to locate the face. There may be images which are greatly tilted or oriented due to change of camera axis so that elliptical shape cannot be detected. So in this case, the elliptical shape of the eyes can also be used to localize the face region.
It would be possible to build 3D model of the face using moment information which can solve the problem of illumination efficiently. Feature selection schemes can be adopted to fine tune the discriminated features which improves the recognition rate. The performance of face localization and recognition can be analyzed for larger databases to prove its efficiency and generalization.