CHAPTER 7

CONCLUSIONS AND FUTURE ENHANCEMENTS

7.1 CONCLUSIONS

In this research work, four different face recognition models are developed and assessed with different classical databases. First two models deal with 2D face images and other two models work with 3D face images. In the first stage of research work, a new model is developed using sparse representation for face recognition from various images taken under practical conditions named as SRFR model. Its performance is evaluated with UPC database. Later, it is compared with the existing results. The SRFR Model achieves extremely stable performance with a higher recognition rate under a wide range of variations in illumination, misalignment, pose and occlusion. In the second stage of the research work, an advanced face recognition model is developed using Dual Tree Complex Wavelet Transform named as WFR model. The model uses Discrete Cosine Transform for normalization to overcome the effect of illumination variation. A post processing algorithm is used to reduce corner outliers. Total Variation Minimization helps to reduce blocky noises. The WFR model improves the efficiency of the Face Recognition System. This model is assessed with FRI CVL and Yale face datasets. In the third stage of research work, a new framework for 3D face reconstruction using SfM-based method robust to self-occlusion is developed. A Facepix dataset is used to evaluate the performance of this model. The model uses RASL for robust
Face Alignment. The Simultaneous inverse compositional algorithm is used for Sparse Feature Extraction and Multi-Stage Linear Approach used for Structure from Motion based 3D Face Reconstruction. Further, Generalized Poly Cube Trivariate Splines are employed for 3D Dense Mean Model Adaptation. The existing and proposed framework is compared using RSV and RMS parameters. The proposed FRMSOI model improves the efficiency of the 3D reconstruction based face recognition. In the fourth stage of research work, the face recognition approach, robust to artificial occlusions and other challenges like expressions and pose is developed. The ARM based Face restoration method is implemented in this model enabling high efficiency in face restoration. The removal of artificial occlusion improves the recognition rate of the model. The model developed with the above techniques handles three-dimensional images. This model is evaluated using 3D UMB-DB dataset and provides efficient results for face recognition.

7.2 CONTRIBUTIONS

In the course of this research the following contributions have been made in the area of face recognition for 2D and 3D images. They are as follows.

- In the first step of this research, a new SRFR model is developed using sparse representation technique. To achieve this, accurate measure of error in alignment is required. The Primal Augment Lagrange Multiplier (PALM) technique is used to find accurate error measure for face alignment. The problem of occlusion is addressed by Tree based Multiscale Pursuit method. The Homotopy method is used to perform global sparse representation that results in
discriminative representation in terms of the entire training set. Finally, the sparse representation is achieved by computing residual to prune unpromising candidates from the global optimization and is discussed in chapter 3.

- In the second work, a new WFR model is developed based on 2D Dual Tree Complex Wavelet Transform (2D DT-CWT) technique to reduce the computational complexity. In this framework, the image quality can be addressed by different limitations of our peripheral vision. Peripheral vision serves to direct the attention and fixation to objects of interest. This problem is solved by using periphery pixel constant extension process. The series of sub-band generation is achieved by 2D DT-CWT. The sub-band normalization is performed using Discrete Cosine Transform (DCT). The Corner Outlier removal is addressed by Post Processing algorithm. Even after the removal of Corner Outliers, unwanted noise in the image results in improper representation of face image. The Total Variation Minimization (TVM) method is used to reduce the blocky and mosquito noises and Vectorization is applied to construct large vector by combining small vectors and the model is discussed in chapter 4.

- In the third work, 3D FRMSOI model is developed to address self occlusion problem in 3D images. The 3D Shape Conversion Matrix (SCM) is constructed to eliminate self occlusion in 3D images. Simultaneous Inverse Compositional algorithm is used to extract sparse features and Structure from Motion (SfM) based 3D face
reconstruction is performed by Multi stage linear approach using the sparse feature. The 3D dense mean model adaptation is done by Generalized Poly Cube Trivariant Spline method and the model is discussed in chapter 5.

- In the fourth work, 3D FRMAOI model is developed to address artificial occlusion in 3D images. Eigen face approach is used for face detection and wavelet transformation is employed for face normalization. After face normalization, the facial feature extraction is done by using Dual Tree Discrete Wavelet Transform (DT-DWT). The 3D occlusion detection and face reconstruction is done using Gappy Principle Component Analysis (GPCA) method. Finally, the Average Regional Model (ARM) is used for face recognition and the model is discussed in chapter 6.

7.3 FUTURE ENHANCEMENTS

The face recognition model will be further discussed the self occluded image without the frontal images. The face recognition model could be further enhanced to address reconstruction of 3D images from 2D images. Color conversion techniques have to be adopted in face detection algorithms.

The heterogeneous face recognition system that helps to match images of two different modalities (probe and gallery) will be addressed in future. Further the research work will be extended to develop a cloud based image coding for face recognition.