CHAPTER 7

CONCLUSIONS AND FUTURE WORK

This chapter summarizes the salient features of the proposed HFRCE methods and opens a new direction for further research.

7.1 CONCLUSION

Summarizes the outcome of the research work developed for improving the security in multimodal biometrics using Hybrid Fuzzy Reconstructed Columb Energy Model (HFRCE) networks is delineated. The details of investigation of various sources of data’s are analyzed and presented for their contributions to overall performance of the system.

Fusion is significant problem in the field of multimodal biometrics that can be fused, which would expound important modalities. In this research, investigation of multimodal biometrics of face, fingerprint, iris and nail images are fused using fuzzy fusion. The investigations proved that hybrid fuzzy RCE networks elicit the high recognition rate with minimal FAR, FRR and EER for training and testing in different areas.

The key contributions of this research work are:

- The authentication security among users with this multimodal Hybrid Fuzzy RCE method were enhanced and recommended.
• The recognition rate of person’s authentication is augmented in this method and the performance measures FAR, FRR and EER are curtailed when compared to other methods.
• Reduction in the training and testing time in the fusion process.

The main objective of the analysis work is to form a cohesive multimodal biometric system for the user identification. The feature extraction and the multi modal fusion matching processes gains a paramount place in biometric authentication. In subsequently, a probe study allotted on the computation intelligent techniques for multi modal biometric authentication is conferred.

Chapter 2 presented the investigations on MSO-based element choice calculation for face acknowledgement by connecting to highlight the vectors removed by two component extraction procedures using MSO with DCT and DWT. MSO with DWT gives FAR of 0.24 % and FRR of 0.24%. MSO with DCT gives better FAR of 0.21 % and FRR of 0.27% with respect to the existing methods 2D –HMM, HMM, SVM with binary tree and Hybrid NN. Recognition rate for the MSO based DCT and DWT is 94.7 % and 96.8%. Proposed MSO based feature selections gives the better face recognition rate with the difference of 2% compared to other techniques.

Chapter 3 detailed segmentation based fingerprint recognition system augmented the accept rate of the fingerprint biometrics authentication. The error rates produced by the proposed segmentation method is 0.16 %. This proposed segmentation based fingerprint recognition gives the better recognition rate of 81% and an improvement of 2% compared to other methods such as image based, graph based and point based.
Chapter 4 elicited iris recognition system as the solution for mismatch problem in iris biometrics to improve the matching process feature extraction with better FAR, FRR, EER and Recognition rate. The experimental results show that proposed hybrid fuzzy model of iris recognition gave 93.2% recognition rate and comparatively better than ROI detection, DWT, Fuzzy C-Means in segmentation and KNN, Hamming distance based methods in classification.

Chapter 5 compiled the optimal solution for the finger nail plate user authentication using the Hybrid model based feature point extraction with the decision tree support. This proposed Nail plate model gives the better FAR of 1% and 1.3 % of FRR with 180 users. The recognition rate for the hybrid method is 98.3% with the improved recognition rate of 10% compared with fuzzy measures, finger nail and knuckle methods.

Chapter 6 elevated to proposed Fuzzy RCE classifier for the matching process which matches the template with high accuracy. This method implemented the combination of face, fingerprint, iris and nail. Fuzzy K-Means and HMM model are combined for segmentation and classification. The parameters FAR, FRR, EER are utilized for calculating the recognition rate. The desired FAR is 0.925%, FRR is 3.07%, and the recognition rate is 98.34%. When compared to existing methods such as SVM, Haudroff Distance, ANN and MLP.

It is concluded that the fuzzy RCE networks based fusion process models can be extensively used for security in the application of highly security areas. Multimodal biometric system using face, fingerprint, iris and nail biometric identifiers used for recognition. To combine the information from these four biometric identifiers, a new rank level fusion approaches has been introduced. The proposed fuzzy fusion which improves the response time and provides
more confidence information of the outcomes for the developed multimodal biometric system. The extensive experimentations with multimodal databases indicate that the proposed multimodal system outperforms other commonly used methods and can help government or public/private sectors to protect valuable property or information, as well as can ensure the overall security of the region or country. It is suggested to adopt the HFRCE model for effective human authentication in security areas.

### 7.2 FUTURE WORK

The findings of this research are based on test results that compile only a small sample set of datasets. It is coherent that more datasets should be considered for the evaluation of different fusions as the information growth in the recent technology is extending to heights beyond assumptions.

The experimental analysis was done only for static data. Technology advancements and data are by nature dynamic. It is essential that fusion in feature level multimodal of the entire system is in vogue and decision level fusion, score level fusion with fuzzy models can be implemented in the near future.

The scope of the future work can deal with incremental learning, which stores the existing model and processes the new incoming data more efficiently. More specifically, they can be categorized to improve following aspects.

- The system can further be enriched for used in specialized areas as in the field of medicine to maintain confidentiality of patient’s records.
• The security improvement can be extended to email network areas, social media like Facebook, Twitter, and WhatsApp in order to maintain security and protect account breach.

• In fingerprint images, dynamic or real data, can be taken for data analysis, which could be useful in many security systems. It can be further extended in the effective selection of fingerprint features.

• Color images and real time images can be considered for face, fingerprint, iris and nail images for security purposes.

• The multimodal biometric authentication can be improved with the genetic algorithm or evolutionary algorithm to improve the recognition rate and reduce the error rates such as FAR, FRR and EER.

When these extensions are incorporated in the multimodal system, it would ameliorate the performance and applications for the explicit security system.