Chapter 7

Conclusions

7.1 Conclusions of the research work

The thesis is focused on the performance evaluation of biometric systems for personal identification. The recognition of individuals based on biometric features obtained from a specific physiological or behavioral traits are efficient and robust. The biometric systems are accurate and reliable compared to traditional security systems such as cards, PIN, password etc, which can be stolen, forgotten or lost. The biometric system consists of enrolment, test and classification sections. The biometric database is created, samples are preprocessed and features are extracted in the enrolment section. The biometric trait to be tested is considered, preprocessed and features are extracted in the test section. The features of test biometric sample are compared with enrolled biometric database in the classification section to recognize a person. The standard database CASIA iris database version 1.0, GPDS and local signature database are used for experimentation.

The spatial domain based iris recognition using DFB is introduced in chapter three. The preprocessing operations performed on iris using canny edge detection, IDO, Hough transform for removing the occlusions and contrast-limited histogram equalization for image enhancement to obtain better features. The normalized iris is divided into two parts. The DFB is applied on region 1, which is
nearer the pupil to obtain more number of features that is sixty four features, since the region has more information. The DFB is applied on region 2 to extract less number of features that is thirty two features, since the region has less information. The test iris features are compared with database iris features using HD. The percentage decidability index of the proposed algorithm is higher compared to existing algorithms. The transform domain based iris recognition using DWT and IWT is also presented. The iris and pupil boundaries are located using IDO. The preprocessed iris is normalized by Daugman’s rubber sheet model. The DWT and IWT are applied on normalized iris to generate features. The DWT and IWT features are fused using concatenation to generate final features. The final features of test iris are compared with final features of iris in database using HD. The percentage EER of the proposed algorithm is lower compared to exiting algorithms.

In chapter four, fusion of PCA and FFT features of iris is proposed. The preprocessing operations performed on eye image are resizing, binarizing, cropping and splitting the iris image into left and right parts. The FFT is applied on left part to generate FFT coefficients and PCA is applied on right part to generate PCA coefficients. The FFT and PCA coefficients are fused using arithmetic addition to obtain final features. The test iris features are compared with database feature set using ED to identify a person. The percentage TSR of the proposed algorithm is higher compared to existing algorithms.
The off-line signature recognition based on geometric centers and angular features are presented in chapter five. The preprocessing operations performed on off-line signatures are resizing, skeletonization, filtering to remove noise, reducing signature image to its exact area and random forgery detection. The geometric centers and angular features are extracted from the preprocessed signatures. The geometric centers of test and database signatures are compared using correlation. The angular features of test signature and database signatures are compared using distance formula. In both the cases, it is observed that the percentage values of EER are better compared to existing algorithms.

The intra-modal score level fusion for off-line signature recognition is proposed in chapter six. The signatures are preprocessed, geometric centers and angular features are extracted. The geometric features are compared using correlation and angular features are using distance formula to compute FRR, FAR and EER. The value of FRR, FAR and EER computed from geometric centers and angular features are fused using efficiency parameters. The percentage EER of the proposed algorithm is lower compared to existing algorithms.

7.2 Contributions of the research work

- In the case of iris recognition using DFB, canny edge detection is used to remove occlusions. The circular and linear Hough transform are used to localise an iris. The preprocessed iris is normalised and fragmented into two regions. The DFB is used to
extract directional information from two regions to generate features. The HD is used for matching. The decidability index is computed for comparing the proposed system with existing systems.

- In the case of iris recognition using DWT and IWT, IDO is used to localise an iris. Contrast-limited histogram equalisation is performed for image enhancement to obtain better features. The DWT and IWT features are extracted and fused to generate final features. The HD is used for comparison. The value of EER obtained is lower in the case of proposed algorithm compared to existing algorithms.

- The iris image is resized, cropped and split into two portions. The FFT is applied on the left portion and PCA applied on right portion of an iris image to obtain two features sets. The two feature sets are combined to produce single feature. The ED is used for matching the features. The value of TSR obtained is higher in the case of proposed algorithm compared to existing algorithms.

- The off-line signatures are resized to bring all images to uniform size. The signature images are skeletonized and reduced to their exact area. The signature image is split into sixty blocks by vertical and horizontal splitting to obtain geometric centres. The test and database signatures are compared using correlation. The technique results in lower EER.
• The off-line signatures are resized and skeletonized and exact signature area is considered. The angular features are generated in two phases. In first phase, the signature image is split into one hundred and twenty eight blocks by counting the number of black pixels. The angular feature in each block is determined to generate one hundred and twenty eight angular features. In second phase, the signature is divided into forty blocks from each of the four corners of the signature to generate forty angular features. Totally one hundred and sixty eight features are considered from two phases. The difference between the angular features of the genuine and test signatures are computed and compared with the threshold value to authenticate the signature to obtain lower EER value compared to existing methods.

• The geometric centers of signature are compared using correlation and the angular features are compared using distance formula. The value of FRR, FAR and EER obtained from geometric center features are fused with angular features using efficiency parameters to obtain lower FRR, FAR and EER compared to existing algorithms.

7.3 Scope for future research

The iris recognition and off-line signature verification models are explained. The algorithms presented in this thesis were able to perform efficiently, however there are still a number of issues which
need to be addressed and there are scopes for future work in off-line signature and iris recognition.

- In case of iris recognition, the decidability index may be improved by increasing the number of iris fragments and then applying filter banks.
- The error rates of iris recognition can be reduced by considering Dual Tree Complex Wavelet Transform (DTCWT), which is shift invariant and directionally selective transform.
- The efficiency of the iris recognition can be improved using classifiers.

- In case of off-line signature verification, the error rates can be further reduced by applying extended local binary pattern and singular value decomposition.
- The performance of off-line signature verification can be improved by fusing the spatial and transform domain features.
- Multimodal biometrics based on more than one biometric trait can be developed to identify a person more accurately.
- The accuracy and efficiency can be improved by fusion at various levels.
- The matching scores with different classifiers and distance formulae can be fused at verification stage.