ABSTRACT

Handwriting is a natural way to communicate and record information. A large amount of important historical data is written on papers. Machine simulation to recognize handwriting has opened new horizons to improve human-computer interface and perform repetitive task of reading by computers. Despite of more than four decades of intensive research, off-line unconstrained cursive handwriting recognition is still an open problem and an active area of research these days. Currently, accuracy of off-line cursive handwritten word recognition schemes is below acceptable level and is computationally expensive for real world applications. In a cursive handwritten word, touched characters are not uncommon and are the main cause of low segmentation and recognition accuracy.

This thesis presents enhanced approaches for character image preprocessing, untouched as well as touched character segmentation and feature extraction for the purpose of handwritten words recognition. The performance evaluation of the two neural network classifiers has been done by fusion of the two feature extraction techniques. The techniques to optimize the training parameters of a back-propagation MLP are evaluated and common situations during BP learning with possible causes and potential remedies are also presented.

Preprocessing techniques include Grayscale conversion, Binarization, Global Thresholding and Background Noise Removal, Thinning and Skeletonization, Foreground Noise Removal, Character Image Cropping and Size Normalization. Character segmentation from the word image is also a focus of this thesis because poor segmentation contributes to inaccuracy in character and word recognition processes. In this regard, two improved segmentation techniques are proposed and evaluated. The first technique is based on connected component analysis and is proposed to segment untouched characters in a word image and in the second technique, a heuristic vertical dissection based approach is proposed to segment touched characters in a word image.

For feature extraction; Binarization technique and Projection Profile Techniques are proposed to extract features of a handwritten character / numeral image. For character
recognition, two variants of artificial neural networks, namely, Feed Forward Back-Propagation neural network and Radial Basis Function Neural Network are proposed and their performances are analyzed in terms of accuracy, speed and computational complexity.

Various techniques and strategies for optimizing the recognition accuracy of the classifier are also proposed in this research. All the experiments are evaluated on a local database of handwritten characters and digits. Favorable accuracy for each phase of the OCR system is achieved and reported in this research with high speed and accuracy with minimum computational complexity.