

List of figures

| | | |
|------|--|----|
| 1.1 | Basic steps of document processing | 2 |
| 1.2 | Typical OCR System | 4 |
| 2.1 | Sample document images: (a) printed document, (b) handwritten Kannada document, (c) printed Telugu document, (d) a single word, (e) a single character. | 13 |
| 2.2 | The feature extraction grid for simple bar mask encoder. One of the regions is shown in detail. | 16 |
| 2.3 | Graphical representation of dilation | 22 |
| 2.4 | Plot of features extracted by a simple bar mask encoder method | 28 |
| 2.5 | Plot of features extracted by a moment invariant method | 29 |
| 2.6 | Plot of the features extracted from the developed method | 30 |
| 3.1a | A single floppy disk containing instructions in five languages. | 32 |
| 3.1b | An HP Product written in seven languages | 33 |
| 3.1c | Product instructions written in eight languages | 34 |
| 3.2 | Document image samples in three scripts and the results obtained by morphological modifications using 3 x 3 masks in horizontal, vertical, left diagonal and right diagonal directions. | 39 |
| 3.3 | The plot of feature values for 300 document images, 100 each in English, Hindi and Kannada languages. (i) to (v) correspond to feature number 1 to 5. | 39 |
| 3.4 | Scatter plot of two sample features | 40 |
| 3.5 | Developed system, C1, C2 and C3 are component networks | 41 |
| 3.6 | Feedforward neural network | 42 |
| 4.1 | Sample document images in nine language scripts | 49 |
| 4.2 | Effect of introducing noise in document image (a) original image (b) 20 pixels noisy image (c) 40 pixels noisy image (d) 60 pixels noisy image | 50 |
| 4.3a | The original document images and their corresponding modified versions | 52 |
| 4.3b | Bar mask encoder. H1, H2, H3, H4, and H5 are horizontal capture regions and V1, V2, V3, V4, and V5 are vertical capture regions. | 52 |
| 4.4 | Single RBF neuron model | 55 |
| 4.5 | Radial basis function | 56 |
| 4.6 | Radial basis network | 57 |
| 4.7 | Radial basis neural network classifier based document image script identification system. E, H, K, T, G, M, O, P and Te corresponds to English, Hindi, Kannada, Tamil, Gujarati, Malayalam, Oriya, Punjabi, and Telugu respectively. | 62 |
| 4.8 | Probabilistic neural network classifier based system. E, H, K, T, G, M, O, P and Te, corresponds to English, Hindi, Kannada, Tamil, Gujarati, Malayalam, Oriya, Punjabi and Telugu respectively. | 63 |
| 4.9 | The variation of classification accuracy for various spreads for radial basis neural network based system. | 65 |

| | | |
|------|---|-----|
| 4.10 | The variation of classification accuracy for various spreads for probabilistic neural network based system. | 66 |
| 5.1 | Horizontal run of each word | 70 |
| 5.2 | Stroke features used for the segmentation of (a) Bengali (b) Devnagari script | 71 |
| 5.3 | Sample English, Hindi and Kannada word document images obtained by segmentation process on document images. | 77 |
| 5.4 | Results of the first stage of the dynamic feature extractor | 79 |
| 5.5 | The scatter plot of two randomly chosen features | 80 |
| 5.6 | Developed system | 81 |
| 5.7 | Behaviour of spread of PNN versus classification accuracy | 83 |
| 6.1 | PR System-1 : Individual word script identification system | 92 |
| 6.2 | PR System-2: Introduction of genetic algorithms in PR System-1 | 93 |
| 6.3 | Behaviour of spread versus classification accuracy for PR System-1 | 103 |
| 6.4 | Sample results of the GA engine | 104 |
| 6.5 | PR system-3: k features are selected by BIF engine | 106 |
| 6.6 | Obtained recognition rates of individual fetures | 107 |
| 7.1 | Genetic-Neuro Script Identification system | 112 |
| 7.2 | Neuro-genetic nine-language script identification system - E, H, K, T, G, M, O, P, and Te, are English, Hindi, Kannada, Tamil, Gujarati, Malayalam, Oriya, Punjabi, and Telugu respectively | 116 |
| 7.3 | The classification accuracy for various spreads for probabilistic neural network based system | 121 |
| 7.4 | Sample GA engine results | 122 |
| 7.5 | Genetic-neuro modular script identification system | 123 |
| 8.1a | Bank cheque containing two languages, English and Hindi | 132 |
| 8.1b | A Bank challan printed in three languages, Kannada, Hindi and English | 133 |
| 8.2 | Multi-lingual OCR proposed by Tan | 136 |
| 8.3 | Neural network based multi-script, multi-lingual document processing model | 138 |
| 8.4 | Sample of multi-script document processed | 140 |
| 8.5 | Character script class confirmation system | 146 |
| 8.6 | Sample characters in two scripts, English and Kannada languages | 147 |
| 9.1 | Character model | 153 |
| 9.2 | Developed system | 156 |
| 9.3 | Sample Kannada document images | 165 |
| 9.4 | Results of Kannada OCR system in the graphical display format for the samples shown in figure 9.3 | 165 |
| 9.5 | Results of Kannada OCR system in ASCII format for the samples shown in figure 9.3 | 166 |
| 10.1 | Diagrammatic structure of the OCR system to read two languages as proposed by B.B. Chauduri and U.Pal | 168 |
| 10.2 | Developed bilinugal OCR system | 169 |
| 10.3 | Sample English alphabet used in English OCR system | 171 |
| 10.4 | English character recognition system | 172 |
| 10.5 | (i) Sample English input document image (ii) corresponding | 174 |

| | | |
|-------|--|-----|
| | output file of English OCR system. | |
| 10.6a | Sample input bilingual document image | 175 |
| 10.6b | Results obtained for the sample shown in figure 10.6a. | 176 |
| | (i) English text file (ii) Kannada text file | |