

# Chapter 19

## Application of Nature-Inspired Technique to Odia Handwritten Numeral Recognition

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### ABSTRACT

*In this chapter an effort has been made to develop a hybrid system using functional link artificial neural network (FLANN) and differential evolution (DE) for effective recognition of Odia handwritten numerals. The S-transform (ST) is chosen for feature extraction from handwritten numerals and these are further reduced by using principal component analysis (PCA). After reduction of feature the reduced features are applied to FLANN model for recognition of each numeral. Further differential evolution algorithm (DE) is used for the optimization of weights of FLANN classifier. For performance comparison, genetic algorithm (GA) and particle swarm optimization (PSO) based FLANN models (FLANN\_GA and FLANN\_PSO) are also designed and simulated under similar condition. The efficiency of proposed DE based FLANN (FLANN\_DE) method is assessed through simulation with standard dataset consisting of 4000 handwritten Odia numerals. The results of three models are compared and it is observed that the FLANN\_DE model provides the best result as compared to other models.*

### INTRODUCTION

Over the last ten decades optical character recognition (OCR) is the most demanding area which comes under the field of pattern recognition, artificial intelligence and machine vision. There are varieties of applications of handwritten character such as postal pin code verification, passport verification, digital library system, document processing, forgery detection in banks and many more. OCR is the translation of handwritten and printed images of character into editable character. The challenging task lies in the recognition of optically processed characters. In off-line recognition method characters are recognized

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later, after their creation. But the characters are recognized immediately after their creation in an on-line method. OCR can recognize both printed and handwritten characters, but the efficiency of recognition precisely depends on the constraints associated with the characters. More constrained the character is, greater is the efficiency of the OCR system. It is very difficult to develop OCR system for totally unconstrained handwritten characters. Recognition of handwritten characters and numerals is more complex task than the printed character. Many variations are observed in handwritten character due to the style of writing, added noise, missing part, devices and medias used for image acquisition. These may be due to different size, stroke and slant of the image. Therefore there is a requirement to develop robust system which can recognize effectively any handwritten characters. This chapter develops a recognition model for offline handwritten Odia numerals using FLANN as classifier and a bio-inspired technique such as differential evolution (DE) for the weight optimization of the FLANN model. Preprocessing is the first step of OCR followed by feature extraction and classification. Before developing the recognition model preprocessing and feature extraction tasks are performed. The numeral images are preprocessed first. Then feature based recognition method is applied to measure and extract significant features from the numerals image. Then a hybrid system is developed by using FLANN classifier where the weights of FLANN classifier are optimized with DE algorithm. The features are compared to the prototypes developed in training phase. The description which provides the closest match provides the recognition. For feature extraction the recently developed S-transform (M. Hariharan et.al, 2014) is applied which retains the significant features of the pattern. These features being more in dimensions are then reduced by applying principal component analysis (PCA). For the classification task FLANN model is used, the weights of which are adjusted by minimizing the squared error value using the DE algorithm.

## **BACKGROUND**

A concise study of the chronicle background related to the advancement of OCR is as follows. A hybrid system (S. Rajasekaran, 2003) is the integration of one or more techniques to solve complex problem in efficient way. The objective of hybrid system is to provide a better solution by suitably mixing various techniques so as to overcome the weakness of each technique. In literature several research works have been reported for recognition of characters by using hybrid techniques. A hybrid of GA and Harmony Search algorithm (HS) is suggested in (M.Y.Potrus, 2014) for online Arabic text Recognition. The problem is solved in two phases: text segmentation using dominant point detection, and recognition-based segmentation using GA and HS. The performance of the system is evaluated on 4500 Arabic words and benchmark (ADAB) dataset consisting of 7851 Arabic words with a recognition rate of 93.4% and 94–96% respectively. A feed forward neural network with evolutionary algorithms has been employed by the authors (S.Srivastava et.al, 2011) for recognition of handwritten English alphabet. A new method has been developed in (T. Pourhabibi et.al, 2011) by combining Simulated Annealing (SA) and GA for selection of feature subset using Persian fonts and a good recognition performance is suggested. The convergence rate of Guided Evolutionary Simulated Annealing is found to be better than the GA. A hybrid approach has been proposed in (N. Ozturk et.al, 2004) for feature recognition problem to step down the computational complexity with neural networks (NNs) and GAs to step down the computational complexity. Optimum network architecture has been developed by using GA based input selection approach. In (N.Das et.al, 2012) for recognition of Bangla compound character the authors have developed

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