Chapter 39
Bio-Inspired Optimization Algorithms for Arabic Handwritten Characters

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ABSTRACT

There are still many obstacles for achieving high recognition accuracy for Arabic handwritten optical character recognition system, each character has a different shape, as well as the similarities between characters. In this chapter, several feature selection-based bio-inspired optimization algorithms including Bat Algorithm, Grey Wolf Optimization, Whale optimization Algorithm, Particle Swarm Optimization and Genetic Algorithm have been presented and an application of Arabic handwritten characters recognition has been chosen to see their ability and accuracy to recognize Arabic characters. The experiments have been performed using a benchmark dataset, CENPARMI by k-Nearest neighbors, Linear Discriminant Analysis, and random forests. The achieved results show superior results for the selected features when comparing the classification accuracy for the selected features by the optimization algorithms with the whole feature set in terms of the classification accuracy and the processing time. The experiments have been performed using a benchmark dataset, CENPARMI by k-Nearest neighbors, Linear Discriminant Analysis, and random forests. The achieved results show superior results for the selected features when comparing the classification accuracy for the selected features by the optimization algorithms with the whole feature set in terms of the classification accuracy and the processing time.

INTRODUCTION

Arabic Alphabet is not only used by Arabic spoken but also by other languages like Persian, Kurdish, Malay and Urdu, therefor, Millions of people especially in Africa and Asia use it (Khorsheed, 2000).

The Arabic alphabet has 28 basic characters, However, they can be expanded to become more than 80 different shapes according to the position of a character (beginning, middle, end or isolated), as well as according to the style of writing (Naskh, Roqa'a, Farisi and others, see the first row of Table 1.

Sixteen Arabic letters have one, two or three secondary components (dots), we call them secondaries, and the secondaries are character components that are disconnected from the main body. Type and position of the secondaries are very important features of Arabic letters.

The position of secondary is not only a significant feature, but also, it can be the only feature that distinguishes a character from another as seen in the second row of Table 1. Although they have the same shapes, however, the only different feature is the number or the position of secondaries (Abandah & Anssari, 2009).

Also, one of the most challenging issues in Arabic handwritten systems is that Arabic alphabets included several kinds of secondaries. Here are a couple of characters that their secondaries can be written separated or dashed line like the third row of Table 1.

There are also three writing styles for secondaries of the same character "SHEEN", that secondaries can be linked to a character or as one big shape (the fourth row of Table 1). Also, there is a special kind of secondaries called Hamza, this secondary is specific only for Alif and Kaaf characters as shown in the last row of Table 1, however, as seen that those characters can be written with or without the Hamza.

There are many applications handwritten characters such as writer identification and verification, form processing, interpreting handwritten postal addresses on envelopes and reading currency amounts on bank checks and others (ASHO & RAJAN, 2010).

Lots of researches have been done to solve the problem of handwritten Arabic character recognition. One of the most important steps in any classification system is the feature selection step. The main purpose of feature selection is to choose/select the best features subset via eliminating unnecessary features. Features with little or no predictive information should be eliminated and the strongly correlated redundant features should be ignored in order to extract as much information as possible from a given

Table 1. Characters variation based on writing styles

	Character Shapes	
Beginning, middle, end or isolated form	ح ـع ـعـ ع	ھـ ـهـ ـہ
Position of secondary	خ ج ح	ثـ ـنـ ـبـ بـ
Style of secondary	ي ي	ٹ ت ث
Writing Style	ᴖ ـس ش شـ	أ ك

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