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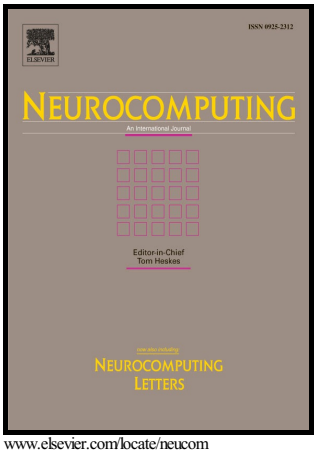

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Synchronous Multi-Stream Hidden Markov Model for Offline Arabic Handwriting Recognition without Explicit Segmentation

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Abstract

Arabic handwriting recognition is still a challenging task due especially to the unlimited variation in human handwriting, the large variety of Arabic character shapes, the presence of ligature between characters and overlapping of the components. In this paper, we propose an offline Arabic-handwritten recognition system for Tunisian city names. A review of the literature shows that the Hidden Markov Model (HMM) adopting the sliding window approach are the mainly used models, which gives good results when a relevant feature-extraction process is performed. However, these models are utilized especially to model one dimensional signal. Consequently, to model bi-dimensional signals or multiple features, a solution based on combining multi-classifiers and then a post-treatment selecting the best hypothesis is applied. The problem considered in this case consists in searching the best way to combine the contribution of these classifiers. In this study, we put forward an extension of the HMM, which can surmount this problem. Our proposed system is based on a synchronous multi-stream HMM which has the advantage of efficiently modelling the interaction between multiple features. These features are composed of a combination of statistical and structural ones, which are extracted over the columns and rows using a sliding window approach. In fact, two word models are implemented based on the holistic and analytical approaches without any explicit segmentation. In the first approach, all the classes share the same architecture nevertheless, the parameters are different. In the second approach, each class has its own model by concatenating their components models. The results carried out on the IFN/ENIT database show that the analytical approach performs better than the holistic one and that the data fusion model is more efficient than the state fusion model.

Keywords: Multi-Stream Hidden Markov Model, Implicit segmentation, Arabic Handwriting Recognition, Dynamic Bayesian Network.

1. Introduction

In the last years, a great interest has been devoted to offline Arabic handwriting recognition, which has become a very popular research topic. It has been applied in many fields, including education, finance, government agencies, healthcare, legal industry and banking by form editing and processing, automatic sorting of postal mail, bills processing, passport validation, check processing and, more recently, text to speech applications, helping blinds to read and recognizing handwritten historical documents to facilitate their indexation and storage [1, 2, 3, 4]. Generally, Arabic handwriting recognition consists in developing systems that are able to convert human writing into text. According to the literature, there have been several approaches which deal with printed text lines, words and isolated characters. To recognize these latter, different structural, statistical and stochastic approaches have shown their effectiveness [5]. However, handwritten word recognition is still a challenging task. Thus, to

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