AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer Engineering and Systems

Automatic Recognition of Arabic Handwritting using Hybrid Intelligent Networks

A Thesis submitted in partial fulfillment of the requirements of
Doctor of Philosophy in Electrical Engineering
(Computer and Systems Engineering)
by

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Date: 2020

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Statement

This thesis is submitted as a partial fulfillment of Doctor of Philosophy in Electrical Engineering, Faculty of Engineering, Ain Shams University. The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

Key words: Arabic Handwriting Recognition, Random Forest, Kullback-Leibler Divergence, Pyramid Histogram of Gradient, Support Vector Machine, Agglomerative Hierarchical clustering, Deep Convolutional Neural Network

Automatic Recognition of Arabic Handwriting is a pervasive field that has many challenging complications to solve. Such complications include big databases and complex computing activities. Chapter 1 introduces our motivation and challenges, while chapter 2 presents our related work. Our approach is a multi-stage cascading system, and is proposed in Chapter 3. It is based on applying hybrid machine learning techniques consecutively. Hybrid cascading recognition systems aim to improve the learning ability and increase recognition rates. The approach stages start with data-mining which is essentially needed to work effectively on big databases. Agglomerative hierarchical clustering technique is followed to split the database into partially inter-related clusters for the data mining process. Each test image is matched to one cluster. Cluster members are then ranked in an ascending order based on our new proposed ranking algorithm. This ranking algorithm begins with computing Pyramid Histogram of oriented Gradients (PHoG), followed by measuring divergence by the Kullback-Leibler method. Finally, the classification process is applied only on the highly ranked matching classes, to assign a class membership to each test image. Adjusting the classification process to only consider the highly ranked database classes supports classification and enhances the overall performance.

Recently, the field of computer vision and building recognition systems is being switched to the concept of deep learning to serve the field of feature engineering. Deep learning techniques demonstrated efficiency in building a better performing machine learning model. This thesis assesses the effect of six different deep Convolution Neural Networks (DCNNs) architectures in the field of offline Arabic handwriting recognition. Different neural networks' architectures and design aspects are applicable in a very challenging manner.

Chapter 4 displays our experiments. The approach is tested on the IFN-ENIT Arabic database. Enhanced classification results are achieved relative to recent proposed systems. Chapter 5 discusses the complexity analysis.

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