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Combination of Machine Learning Algorithms and Resnet50 for Arabic Handwritten Classification

Raidah S. Khudeyer, Noor M. Al-Moosawi
College of Computer Science & Information Technology, University of Basrah, Iraq
E-mail: raidah.khudayer@uobasrah.edu.iq, almoosawinoor2@gmail.com

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The recognition or classification of *Arabic handwritten characters is extremely crucial in many applications and,* at *the same time, one of the biggest challenges that machine learning f*aces. *The emergence of deep learning, particularly Convolutional Neural Networks (CNN), is* considered a *suitable technique to face these challenges. In this research paper, an investigation model is proposed to make recognition for Arabic handwriting utilizing one of CNN architectures: ResNet50 architecture, after* replacing the *last layer with one of two types of machine learning algorithms, Support Vector Machine (SVM) and Random Forest (RF), to reduce training time and increase overall accuracy. Our experimental work was performed on three data sets: Arabic Handwritten Character Dataset (AHCD), Alexa Isolated Alphabet Dataset (AIA9K), and Hijja Dataset. Experimental results show that combining ResNet50 with random forest produces more accurate and consistent results than the ResNet50 model produces by itself.*
Finally, the comparison with the other methods across all data sets demonstrates the robustness and effectiveness of the combination of random forest with the ResNet50 approach. Where the modified ResNet50 architecture has achieved a rate of 92.37%, 98.39%, and 91.64%, while the combination architecture has achieved 95%, 99%, and 92.4% for AIA9K, AHCD, and Hijja datasets, respectively.

Povzetek: Avtorji so razvili novo metodo kot nadgradnjo Resnet50 z dodatkom zadnjega nivoja v obliki SVM in RF. Na več domenah je dosegla boljše rezultate kot osnovni Resnet50.

1 Introduction

In recent years, methods that rely on deep learning, particularly Convolutional Neural Networks (CNNs), have excelled in several areas, such as the classification of images, object detection, facial recognition, fingerprint analysis, computer-aided diagnosis, and facial expressions. CNN is the most current method for extracting highly discriminative features that make our task more reliable [1].

Character recognition technologies provide users with an automatic mechanism for recognizing the text on an image. These technologies are used in many verification applications, e.g., verifying official documents and bank cheques.

Handwriting recognition is considered a more challenging task in computer vision because handwriting varies in the sizes and styles of a writer's handwriting characters [2]. However, the issue is that the majority of these experiments are conducted in English, as it is the most widely spoken language in the world [3]. Recognizing handwritten Arabic characters is a complicated process compared to English because of the nature of Arabic words and due to the Arabic script's unique characteristics, e.g., its cursive nature, diacritics, and diagonal strokes, developing an Arabic character recognition system is still challenging [4]. Deep learning techniques have become more prevalent in the field of Arabic recognition over the last few years.

Many Machine Learning (ML) algorithms have been successfully used for Arabic Handwritten Recognition and in recent years, deep learning techniques have become more prevent in this field. Where Arabic Handwritten Recognition technologies can be significantly improved by introducing Deep Learning (DL) architectures, especially Convolutional Neural Networks (CNNs) [2], [5], [6].

The survey paper of Alrobah1 et al. [7] presents a comprehensive review of all the works reported in Arabic Handwritten recognition that use deep learning approaches.

The combination of one or more systems is a popular way of improving accuracy in different tasks, where the new system performs the same task to exploit the unique advantage of each system and reduce some of the random errors [8]. In this work, we combine two commonly used Machine Learning (ML) algorithms: RF and SVM algorithm with CNN which are used for the classification task.

In SVM, in which you can visualize unprocessed data as points in an n-dimensional space (where n is the number of features you have). each feature's value is then connected to a specific coordinate, making it easy to classify the data. The data can be divided into groups and plotted on a graph using lines known as classifiers.