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A Review on Arabic Handwritten Recognition Using Deep Learning

Handwriting recognition has gained a lot of attention in the field of pattern recognition and machine learning. Many researchers have proposed different technologies. In this review section we present previous works on Arabic handwritten recognition methods.

Elsawy et al., n.d. [1] claim that the performance of Arabic recognition is affected by the limited dataset. He uses Convolution Neural Networks (CNN) which has the best performance in images and big data. A CNN consists of a number of layers (convolutional layers, pooling layers, fully connected layers). Dataset collected and made by 60 participants between 19 to 40 years. Each participants wrote each character ten times on different form. This dataset composed approximately 16K. The accuracy of the experimental result is 94.9%. Therefore, Ahmad et al., 2020 [2] presented couple of the methods using Multi-Dimensional Long Short-Term Memory (MDLSTM) Networks and Connectionist Temporal Classification (CTC) for recognition Arabic characters. They investigated the capability of data augmentation methods to improve the performance of deep learning models on the KHATT dataset. They implemented data-augmentation techniques for increasing data images in pre-processing step (blurring, text-line contouring, edge enhancing, bleeding-through effect). The model achieved 80.02% recognition rate on KHATT dataset.

Alaasam et al. [3] Trained a Convolution Neural Networks (CNN) to recognize historical Arabic handwritten text. To avoid the limitation of historical handwritten text that might have loosely layout format and overlapping components in a historical text. Deep convolutional networks have been successfully applied to problems such as text recognition, image recognition, and character recognition. Convolutional Neural Networks (CNN) consist of convolutional layers and pooling layers followed by fully connected layers. This architecture uses the 2D structure of an image as direct input without the need to hand crafted features for representing image data. They studied two ideas to overcome the large dataset which are: extend a small labeled dataset of subwords by automatic synthesis of these sub words, then extend these labeled datasets by generating various forms of subwords using Naskh fonts. Experiments were conducted on three datasets: historical handwritten text images, synthesized text image dataset, and the printed text images dataset which used the same CNN architecture and same optimization algorithm. The best accuracy is 85%, that was obtained for combination of the handwritten text image dataset and synthesized text image dataset.

In this paper Elleuch et al., 2016 [4] proposed a new design based-Support Vector Machine (SVM) of Convolution Neural Network (CNN) classifier architecture with offline Arabic handwritten text recognition which CNN as an automatic feature extractor from raw images and it let SVM do classification by analyzing the error classification rate on the Arabic handwritten character. The target is to mix the CNN respective capacities and the SVM to obtain a new effectual recognition system inspired by the two formalisms and using HACDB database and IFN/ENIT database. The result of the experimental achieve a classification error rate of 6.95%. So, in order to improve this architecture, they added a dropout technique on the CNN based-SVM model to the only fully connected hidden layers, reduces the error to 5.83% with HACDB database.

Amrouch et al., 2018 [5] Deployed system to integrate Convolution Neural Networks (CNN) and Hidden Markov Models HMM classifier, to use HMM model the dynamic of Arabic handwriting and CNN to extract

salient features. The normalized input images are provided to the first convolutional layer and the designed CNN is trained by stochastic gradient descent (SGD) with momentum. The HMM baseline is trained by a new features vector obtained from the outputs of the hidden layer (FCL). Once the HMM classifier has been well trained, it performs the recognition task and makes new decisions on testing images with such automatically extracted features. They use the IFN/ENIT database that consists of 946 handwritten Tunisian city names and their corresponding post codes, which achieve a rate of 88.95%.

(El-Melegy et al., 2019) [6] proposed high performance of the Convolution Neural Networks (CNN) recognition system in the recognition of Arabic handwritten literal amounts that are used in bank cheques. They use AHDB standard dataset which consists 50 different Arabic literal amounts. They used 80% of the dataset for training and 20% for testing. The model achieved 96.58%, Therefore, they improved the model performance by applying the data augmentation that achieved 97.8% accuracy.

The table [1] summarize the literature reviewed on Arabic handwriting recognition. From the literature review, I observe that CNN is the most commonly used method to analyzing and processing images because it can learn highly abstract features and its very efficiently to identify object. However, CNNs require large datasets for training to achieve good results and this is what they all acknowledged especially in Arabic language due to its complicated overlapping alphabet compared to other languages.

Paper	Method	Dataset	Result

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