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Persian Signature Verification using Fully Convolutional Networks

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ABSTRACT

Fully convolutional networks (FCNs) have been recently used for feature extraction and classification in image and speech recognition, where their inputs have been raw signal or other complicated features. Persian signature verification is done using conventional convolutional neural networks (CNNs). In this paper, we propose to use FCN for learning a robust feature extraction from the raw signature images. FCN can be considered as a variant of CNN where its fully connected layers are replaced with a global pooling layer. In the proposed manner, FCN inputs are raw signature images and convolution filter size is fixed. Recognition accuracy on UTSig database, shows that FCN with a global average pooling outperforms CNN.

Keywords: fully convolutional network, Persian signature verification, offline signature verification

1. INTRODUCTION

Signature is a biometric characteristic that is used in person authentication [1]. Automatic signature verification is an interesting area of research, since biometric authentication is more trustable alternative to password based security systems. Biometric authentication is widely being used as it is relatively hard to be forgotten, stolen, or guessed [2]. Numerous biometric features have been studied and proved useful, including biological characteristics such as fingerprint, face, iris, and retina pattern or behavioral traits such as signature and speech [2-4].

Signature authentication can be considered as a low cost biometric system where awareness and uniqueness of person is necessary [2]. There are two main research fields in this area: signature recognition (or identification) and signature verification. The signature recognition involves on identifying the author of a signature when a signature database is searched to find the identity of a given signer. While signature verification defines the process of testing a signature to decide whether a particular signature truly belongs to a person or not. In this case, the output is either accepting the signature as valid or rejecting it as a forgery one [2,5].

Signature verification systems are classified either online or offline depending on the data acquisition method and involved application. Usually, online signature verification systems present a better performance than the offline signatures verification systems. In the online approach, the signature is captured using a special input device and the system uses the signature as well as the dynamic information obtained during the signing process (pen's position, inclination). However, in online signature verification system, the presence of the signer is required at both times of obtaining the reference signature and the verification process which is not welcomed by many applications. Consequently, offline verification methods have more practical application areas than the former. The offline approach only uses the digitalized image of a signature extracted from a document called static information. Therefore, it does not require any special processing devices. On the other hand, preprocessing is more difficult and time consuming in offline systems due to unavailability of the dynamic information [2,5,6].

Various techniques have already been applied in signature verification such as fuzzy logic [7], geometric features [8, 9], global characteristics [10], genetic algorithms [11], neural networks [12-14], hidden Markov models [15], discrete wavelet transform (DWT) and image fusion [16], dynamic time warping-based segmentation and Multivariate autoregressive model [17], convolutional neural networks (CNNs) and its variants [2,18], support vector machine (SVM) classifier and fixed-point arithmetic [19]. Clearly, most of researches in offline signature verification are involved in feature extraction.

Persian signatures are different from other nation signatures, since people usually do not use text in it and they draw a shape as their signature. Even if they use text in their signature, mostly it is in Persian which is so hard to distinguish using machine learning approaches. Persian signature verification has been done using DWT and image fusion, SVM