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Integration of EfficientNetB0 and Machine Learning for Fingerprint Classification

Jenan A.Alhijaj, Raidah S. Khudeyer
Department of Computer Science, College of Computer Science and Information Technology,
University of Basarh, Basrah, Iraq
E-mail: jenan.alkereem@uobasrah.edu.iq, raidah.khudayer@uobasrah.edu.iq

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A fingerprint is a common form of biometric technology used in human identification. The classification of fingerprints is crucial in identification systems because it significantly reduces the time required to identify a person and allows for the possibility of using fingerprints to distinguish between genders and identify individuals. Fingerprints are the most reliable identifiers because they are unique and impossible to fake. As a method of personal identification, fingerprints remain the best and most trustworthy. Fingerprint classification is crucial in a wide variety of settings, such as airports, banks, and emergencies involving explosives and natural disasters. This study proposes a deep learning strategy for determining whether a fingerprint belongs to a male or female person. With the help of pre-trained convolutional neural networks (CNN) in computer vision and an extremely powerful tool that has achieved significant success in image classification and pattern recognition. This work includes the use of the SOCOFing fingerprint dataset for training and employing a state-of-the-art model for feature extraction called EfficientNetB0, which was trained on the ImageNet dataset. Then feeding the extracted features into a principal component analysis (PCA) to decrease the dimension of these features and random forest RF classifier for fingerprint classification. Lastly, the tests showed that the proposed strategy outperformed the previous categorization methods in terms of accuracy (99.91%), speed for execution time, and efficiency.

Povzetek: V članku je opisana metoda globokega učenja za ugotavljanje, ki skoraj 100% ugotovi, ali prstni odtis pripada moškemu ali ženski.

1 Introduction

Fingerprint identification is more reliable and efficient than ever before. The features of fingerprint, such as the ridge period, ridge ending, ridge flow, and delta or core points are all used by automatic fingerprint identification systems (AFIS) in the enrollment and verification processes. Several factors affect matching performance, including the user's age, race, gender, scars, finger pressure on the acquisition sensor, and the quality of the fingerprint scanner device[1]. Moreover, the pictures' or fingerprint alignment data's resolution should be adequate to accommodate augmentation operations like translation, rotation, or skin distortion. The ability to extract fine details may also be influenced by background noise and image rotation[2].

The level of accuracy and reliability of automated fingerprint identification systems (AFIS) is capable of reaching very high standards. However, when poor-quality, altered, or only partially complete fingerprint photos are used, AFIS's performance significantly degrades. Due to the intentional or accidental destruction of the dermatoglyphic crests seen on fingers, the AFIS system's error rate significantly increases when using a very large database of fingerprints during the identification process. The most significant benefit of CNN-based classifiers is feature extraction and classification can be performed automatically without the need for human intervention[3]. Deep learning alleviates this burden by drastically decreasing the computational cost of searching for a fingerprint image in large datasets. Expert pattern recognition is one reason why deep neural networks have attracted so much attention from researchers. The purpose of this research is to apply deep learning, transfer learning, and other machine learning techniques to the problem of fingerprint image gender-type classifying[4].

The following are some of the main contributions to this work: a) Extracting features and classifying fingerprint images using a pre-trained convolutional neural network (CNN) model (EfficientNetB0) and transfer learning technique to classify a fingerprint's gender as male or female[5]. b) The proposed model uses EfficientNetB0 for feature extraction, principal component analysis (PCA) for feature reduction, and random forest (RF) for fingerprint classification[6].
c) Evaluating the proposed method's precision in comparison to other contemporary approaches. The paper is set up as follows: in Section 2, which provides a review of comparable works from prior studies for researchers. The research methodology is presented in