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Enhancing Machine Vision based on Support Vector Machine and Neural Networks

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Abstract

Iris is a unique, stable, secure biometric modality with high resistance to spoofing and tampering. It provides fast, accurate, and reliable identification for access control security. Compared to fingerprints, and iris offers greater distinctiveness due to its high fidelity of between-person variations making, it is a strong, reliable, and accurate biometric characteristic. Nevertheless, classic methods usually suffer from potential issues, including high computational efficiency, long training time, and poor generalization to other datasets. These challenges motivated the gap for a more efficient and reliable iris recognition approach capable of achieving high accuracy while reducing computational cost and improving scalability.

The main objectives of this thesis are to develop three hybrid frameworks for iris recognition, reduce training time while maintaining high accuracy, and test the proposed frameworks on multiple datasets for reliability (CASIA-Iris-Interval V4, MMU, and IITD).

Proposed Framework 1 integrates Histogram of Oriented Gradients (HOG) feature extraction with a pre-trained Dense Neural Network (DNN) classifier. Specifically, it achieved the best accuracy among all datasets and other proposed frameworks with less training time. For example, 92.37% accuracy was achieved on the CASIA-Iris-Interval V4 dataset, 96.28% on the IIT Delhi dataset, and 97.78% on the MMU dataset. Moreover, the training time was shortened by around 10 minutes compared to traditional CNN-based methods.

Proposed Framework 2 employs a Convolutional Neural Network (CNN) architecture to automatically learn spatial feature representations, it achieved the closest accuracy to framework 1 on all datasets however, the training time increased by more than 50% compared to proposed framework 1.

Proposed Framework 3 integrates HOG feature extraction, with a DNN for feature extraction followed by a Support Vector Machine (SVM) classifier to combine deep learning–based feature representation with classical machine learning decision boundaries. While it demonstrated good performance, the additional classification step increased computational cost and did not result in a significant improvement in accuracy over proposed framework 1.