Computer-Aided Bleeding Detection in Wireless Capsule Endoscopy Images Using Deep Convolutional Neural Networks

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Wireless capsule endoscopy (WCE) is a minimally invasive alternative to traditional endoscopy focusing on the small intestine; however, it is costly due to physician labor costs for manual analysis. Existing solutions for bleeding detection in WCE images have low accuracy and utilize complicated preprocessing. In this project, a deep convolutional neural network (CNN) approach is employed to address these problems. For the CNNs, Google's TensorFlow is utilized with Python code. First, a simplified preprocessing procedure is proposed by converting color images to normalized greyscale. For training of CNNs, three different sizes are selected, i.e., 70%, 80%, and 90% of the dataset accordingly, while the remainder is used for testing. Then, the number of convolutional layers and sizes of filters are optimized for each training size. After training and testing for the three architectures, the CNNs' results are evaluated through comparison with ten other machine learning methods from Python's sklearn library. The average accuracy for the three architectures is 97.78%, the average sensitivity is 98.15%, and the average specificity is 97.22%. However, the accuracies of Python's sklearn methods range from 40% to 86.70% with large discrepancies between sensitivities and specificities. The results show that the proposed CNN approach can provide an accuracy up to almost 2.5 times higher than common machine learning methods. In addition, the CNN approach uses less training data and simpler preprocessing, which demonstrates efficiency. Future research includes testing full-length WCE videos with unbalanced datasets and classifying bleeding by severity.