

Abstract

This doctoral dissertation focuses on the application of modern machine learning methods in recognizing Parkinson's disease based on handwritten images obtained using a graphic tablet as a measurement device. The aim of the study was to investigate the impact of the handwriting image preparation process on the accuracy of a Parkinson's disease recognition system utilizing a convolutional neural network as a classifier. This process involved planning handwriting sample registration experiments, selecting a method for converting recorded data into images, and processing the obtained images for use in a convolutional network-based classifier.

The most significant aspect of the obtained results was the determination of the impact of prolonged writing time on the manifestation of handwriting changes resulting from the disease. Unlike previous studies in the literature, which mainly focused on individual letters, words, or drawings, this dissertation considered samples consisting of multiple full sentences written by a participant in a single registration session. This approach not only highlighted characteristic graphomotor changes caused by the disease but also increased the amount of training data, thereby improving the model's generalization ability. Additionally, a technique utilizing different handwriting patterns as training data for a single network was applied, representing an innovative approach to handwriting analysis in the context of Parkinson's disease recognition. This method enabled the model to focus on key disease-related handwriting changes regardless of the specific content of the written sentences.

This study presents the results of three key experiments using the AlexNet network to classify individuals as either Parkinson's patients or healthy controls. The first experiment analyzed a single sentence, following the approach commonly used in the literature. The second experiment evaluated classification performance based on all sentences written by each participant, significantly improving accuracy. The final experiment analyzed individual words, further enhancing the disease recognition performance. Additional studies investigated the effect of adjusting the network's learning depth and employing more complex convolutional neural networks.

The obtained results confirmed the effectiveness of the proposed approach and its potential for improving early diagnosis of Parkinson's disease using artificial intelligence technology.

Keywords: convolutional neural networks, classification, Parkinson's disease, diagnostics, handwriting