POLITECHNIKA ŚLĄSKA W GLIWICACH

WYDZIAŁ INŻYNIERII BIOMEDYCZNEJ

Automatyczna klasyfikacja sygnałów migotania przedsionków serca przy użyciu hybrydowych metod sztucznej inteligencji

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Summary of the dissertation entitled “Automatic classification of atrial fibrillation signals using hybrid artificial intelligence methods”.

The sharp increase in mortality observed in recent years is associated with the development of diseases of civilization. One such group of diseases is heart disease, which is a challenge for today's cardiology. In the United States, atrial fibrillation will affect 6 to 12 million people by 2050, and in the European Union 17.9 million by 2060. Atrial fibrillation has a definite negative impact on quality of life, causing pathological, hemodynamic and thrombotic changes. Rhythm control therapy to maintain sinus rhythm is an important part of arrhythmia management in patients with atrial fibrillation. Advanced artificial intelligence methods enable rapid interpretation of ECGs, and signals and patterns largely unrecognizable to humans can be accurately detected by multilayer artificial intelligence networks.

The dissertation presents the physiology of the heart and the stimulus-conduction system, and reviews the literature related to the automatic classification and detection of arrhythmias using various artificial intelligence models. In this dissertation, a wavelet neural network (WNN) model is proposed.

A hybrid WNN system was created based on the analysis of the cardiac ECG signal using a continuous wavelet transform (CWT) and a neural network system that allows the classification of the signal based on extracted wavelets (from the ECG signal). An analysis of the effect of the number of hidden layers in the neural network was carried out. The final stage of the experiment was a comparison with the currently used method - a convolutional neural network model was chosen here along with deep learning.

The results obtained (sensitivity: 94.16%, accuracy: 94.39%, specificity: 94.85%) showed that the WNN classifier model proposed in this dissertation does not deviate from the one based on the CNN along with the deep learning algorithm. The undoubted advantage of the new method is that it does not require huge GPU-based computational resources, which is usually a major blocking factor in potential applications in wearable devices such as smartwatches and medical wristbands, which could have excellent applications in common arrhythmia screening.