IMPLEMENTATION OF ARTIFICIAL INTELLIGENCE ALGORITHMS IN BIOMEDICAL SIGNALS PROCESSING AS SUPPORT FOR DECISION-MAKING IN SPINAL DISEASES DIAGNOSIS

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The goal of this abstract is to show how artificial intelligence algorithms can be used in biomedical signals processing as a support for decision-making in the diagnosis of spinal diseases. There were two main focus areas:

i. automated approach was proposed in the diagnosis of lumbar disc herniation using MR images in the axial and sagittal planes. The goal was to develop a decision support system that will help doctors both in terms of the accuracy of establishing a diagnosis, as well as in terms of the speed of decision-making. The proposed methodology consisted of several key steps:
    a. The first step was to automatically detect and segment the L4/L5 and L5/S1 spinal discs using the U-net convolutional neural network, achieving high accuracy in both planes - axial (Dice was 0.961, Jaccard's similarity coefficient was 0.925) and sagittal (Dice was 0.897, Jaccard similarity coefficient was 0.813).
    b. In the second step, after contrast adjustment and cropping region of interest, each cut region with the spinal disc was classified based on the created convolutional neural network into classes (healthy, bulge, central, right or left hernia for the axial plane and healthy, L4/L5, L5/S1 hernia level in the sagittal plane). Classification accuracy was 0.87 on axial and 0.91 on sagittal images, while accuracy was 0.8 when combined axial and sagittal images were used.
ii. application of a specially designed hardware platform for measuring force was investigated, in order to capture the "phenomenon" of foot muscle weakness, which originates from the pressure of the nerve in the spinal canal due to herniation. After recording the signal, several different classification algorithms were implemented (logistic regression, decision tree, random forest, naive Bayes, support vector method, K nearest neighbors), along with different normalization methods, for the purpose of diagnosing disc herniation at the L4/L5 or L5/S1, on the left or right side. The obtained results show that some non-linear classifiers such as decision trees or naive Bayes show better accuracy compared to other classifiers, and some normalization methods show even 10% higher accuracy compared to others.

The main advantage of the applied methodology lies in fast and automatic analysis of large amounts of data, reducing waiting time and serving as a support system for medical personnel in decision-making.

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