DEVELOPMENT OF AN ALGORITHM AND SOFTWARE FOR THE ANALYSIS OF MEDICAL DIAGNOSTIC IMAGES FOR EARLY DISEASE DETECTION

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Abstract: Early detection of diseases is a critical component of modern healthcare, enabling timely diagnosis and improving the effectiveness of treatment. This study focuses on the development of an algorithm and software for analyzing medical diagnostic images to support the early identification of pathological changes. The proposed approach involves digital image preprocessing, noise reduction, image enhancement, segmentation of anatomical structures, and identification of potentially abnormal regions using image analysis and machine learning techniques. The software is designed to support the interpretation of medical images, improve diagnostic efficiency, and assist healthcare professionals in identifying early-stage pathological changes. The proposed system is intended to provide a foundation for computer-aided diagnostic solutions in clinical practice.

Keywords: medical image analysis, early disease detection, diagnostic imaging, image processing, machine learning, image segmentation, computer-aided diagnosis, medical software.

Introduction. Early detection of diseases plays an essential role in reducing diagnostic delays and improving patient outcomes. Conventional medical image interpretation may be time-consuming and depends on the experience of healthcare professionals. The application of computational algorithms to medical diagnostic images offers opportunities for automated image processing, identification of abnormal patterns, and decision-support systems. The objective of this study is to develop an algorithm and software capable of analyzing medical diagnostic images and assisting in the early detection of pathological changes.

Materials and methods. The proposed system is based on a sequential image-processing workflow consisting of image acquisition, preprocessing, segmentation, feature extraction, and classification. Depending on the selected imaging modality and disease, machine learning or deep learning methods may be incorporated to identify potentially abnormal regions.

Table 1. Main stages of the proposed diagnostic image analysis algorithm

Stage	Method	Purpose
Image acquisition	Medical image loading	Obtain diagnostic images
Preprocessing	Noise reduction and normalization	Improve image quality
Segmentation	Region-based or deep learning methods	Identify anatomical structures
Feature extraction	Texture, shape, and intensity analysis	Identify relevant image features
Classification	Machine learning or deep learning	Detect potentially abnormal patterns

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Result visualization	Highlighting suspicious regions	Support clinical interpretation

Proposed software architecture. The software is designed as a modular system that integrates image processing, analytical algorithms, and visualization tools. Its architecture enables the processing of medical images and the presentation of analysis results in a format suitable for clinical review.

Module	**Function**
Image input	Import medical diagnostic images
Image preprocessing	Enhance image quality
Analytical module	Extract features and analyze image patterns
Detection module	Identify potentially pathological regions
Visualization module	Display images and analysis results
Reporting module	Generate a structured analysis report

Expected results and discussion. The expected outcome is a software prototype capable of processing medical diagnostic images and highlighting regions that may require further clinical examination. The proposed approach is intended to support early identification of pathological changes, reduce the time required for image analysis, and improve the consistency of diagnostic assessment.

Table 3. Key performance indicators for future experimental evaluation

Indicator	**Purpose**
Accuracy	Overall classification performance
Sensitivity	Ability to detect pathological cases
Specificity	Ability to identify non-pathological cases
F1-score	Balance between precision and recall
Processing time	Computational efficiency

The effectiveness of the proposed system should be evaluated using clinically validated datasets and compared with expert assessments. The software is intended to support, rather than replace, professional medical diagnosis.

Conclusion. An algorithm and software architecture for the analysis of medical diagnostic images for early disease detection are proposed. The system integrates image preprocessing, segmentation, feature extraction, and automated identification of potentially abnormal patterns. Its further development and clinical validation may contribute to the advancement of computer-aided diagnostic technologies and support more efficient interpretation of medical images.

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