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AI-POWERED HISTOPATHOLOGY ANALYSIS

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ABSTRACT
Artificial intelligence (AI) has advanced digital histopathology by enabling automated, accurate cancer diagnosis. This paper presents a deep learning-based system using ResNet50 and VGG16 CNN models, trained on NCT-CRC-HE-100K and BreaK His datasets. The system achieved 94.2% accuracy for colorectal and 91.8% for breast cancer, with sensitivity and specificity of 93.1% and 95.3%, respectively. Ethical aspects such as bias, accountability, and regulation are addressed. The results highlight AI's potential to support pathologists, personalize treatment, and enhance patient outcomes.

Keywords:
Cancer detection, transfer learning, medical image analysis

INTRODUCTION

Manual histopathology is time-intensive and prone to variability, highlighting the need for faster, accurate diagnostics. AI, especially CNNs, enables automated cancer detection from Whole Slide Images with expert-level precision. Transfer learning and augmentation enhance performance, but challenges like interpretability and integration remain. This paper presents a deep learning system for cancer diagnosis, including model evaluation and clinical deployment.

OBJECTIVES

The objective of this study is to develop an AI-based system for automated cancer diagnosis using histopathological images. It aims to evaluate the performance of deep learning models, particularly CNN architectures like ResNet50 and VGG16. The study also addresses interpretability, clinical integration, and ethical considerations in deploying AI in pathology.

METHODOLOGY

We collected histopathological image datasets including NCT-CRC-HE-100K for colorectal cancer and BreaKHis for breast cancer. Images were preprocessed using normalization, resizing, and data augmentation techniques to improve model generalization. Deep learning models (ResNet50 and VGG16) were fine-tuned using transfer learning and trained on the prepared datasets. Performance was evaluated using metrics such as accuracy, sensitivity, specificity, and AUC. Gradient-based visualization techniques were applied to enhance interpretability of model predictions.

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RESULTS AND DISCUSSION

The proposed models achieved high classification performance, with ResNet50 reaching 94.2% accuracy for colorectal cancer and VGG16 achieving 91.8% for breast cancer. Sensitivity and specificity values were 93.1% and 95.3%, indicating robust diagnostic reliability. Visualization techniques like Grad-CAM confirmed that models focused on relevant histological regions. While results demonstrate AI's strong potential in assisting pathologists, challenges such as interpretability, clinical validation, and system integration must be addressed for real-world deployment.

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CONCLUSION

This study demonstrates the effectiveness of deep learning models, particularly ResNet50 and VGG16, in automated cancer diagnosis using histopathological images. High accuracy, sensitivity, and specificity highlight the potential of AI to support clinical decision-making. Future work will focus on improving model interpretability and seamless integration into clinical workflows.

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