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Knowledge-based deep learning system for classifying Alzheimer's disease for multi-task learning

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Abstract

Deep learning has recently become a viable approach for classifying Alzheimer's disease (AD) in medical imaging. However, existing models struggle to efficiently extract features from medical images and may squander additional information resources for illness classification. To address these issues, a deep three-dimensional convolutional neural network incorporating multi-task learning and attention mechanisms is proposed. An upgraded primary C3D network is utilised to create rougher low-level feature maps. It introduces a new convolution block that focuses on the structural aspects of the magnetic resonance imaging image and another block that extracts attention weights unique to certain pixel positions in the feature map and multiplies them with the feature map output. Then, several fully connected layers are used to achieve multi-task learning, generating three outputs, including the primary classification task. The other two outputs employ backpropagation during training to improve the primary classification job. Experimental findings show that the authors' proposed method outperforms current approaches for classifying AD, achieving enhanced classification accuracy and other indicators on the Alzheimer's disease Neuroimaging Initiative dataset. The authors demonstrate promise for future disease classification studies. © 2024 The Authors. CAAI Transactions on Intelligence Technology published by John Wiley & Sons Ltd on behalf of The Institution of Engineering and Technology and Chongqing University of Technology.

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Deep Learning (DL) is currently transforming health services by significantly improving early cancer diagnosis, drug discovery, protein–protein interaction analysis, and gene editing. The main purpose of this review study is to explore how the integration of the analytical capabilities of DL with medical datasets contributes to advancements in healthcare services. The scope of this study revolves around emphasizing the impact of DL strategies in contributing to healthcare services. It underscores how DL algorithms significantly improve accuracy in medical data analysis, helping diagnosis and treatment planning. It also highlights how integrating Artificial Intelligence (AI) with medical datasets can profoundly impact robotic surgery. The primary findings of the study involve exploring emerging ideas within this integrative field, particularly focusing on the roles of holography microscopic medical imaging and attention models in early disease identification. Also, the study examines Federated Learning (FL) concepts, with the primary focus on addressing the ethical implications of medical-related datasets. The authors further examine how Explainable AI (XAI) techniques such as Gradient-weighted Class Activation Mapping (Grad CAM), assist medical professionals in understanding the decision-making processes of AI algorithms promoting transparency and informed decision-making. After conducting an extensive review of DL in medicine, the authors have identified the challenges associated with this integrative journey and suggested emerging future research directions for researchers interested in this field.

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Deep learning in medicine: advancing healthcare with intelligent solutions and the future of holography imaging in early diagnosis

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Abstract

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Author keywords

Artificial Intelligence (AI); Deep Learning (DL); Early diagnosis; Explainable AI (XAI); Holography microscopic medical imaging; Image Processing; Neural Networks

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