Artificial Intelligence in Medicine and Dentistry: Transforming Research into Clinical Impact

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Abstract

Artificial Intelligence (AI) is revolutionizing medicine and dentistry, driving advancements that enhance clinical decision-making, optimize workflows, and improve patient outcomes. This presentation explores AI's impact in two key areas: medical image segmentation and early Parkinson's disease (PD) detection. Medical image segmentation remains a crucial yet labor-intensive process, traditionally requiring expert input. The advent of convolutional neural networks (CNNs) has enabled fully automated segmentation. In one of our projects, we developed an in-house segmentation software and benchmarked it against commercial cloud-based solutions, an inexperienced user, and an expert as the ground truth. While established solutions demonstrated high accuracy (Dice similarity coefficient: 0.912–0.949) with segmentation times ranging from 3'54" to 85'54", our model achieved 94.24% accuracy with the shortest mean segmentation time of 2'03". This collaboration between academia and industry highlighted challenges in clinical implementation and the need for ongoing refinement.

In neurology, AI facilitates early PD detection through speech and handwriting analysis. Parkinson's disease, the fastest-growing neurological disorder, presents significant socio-economic challenges, with cases projected to double by 2040. Our transdisciplinary studies leveraged AI models to analyze biomarkers from biosensors, such as running speech and continuous handwriting, revealing distinct patterns between PD patients and controls. One of our CNN-based models, ParkinsonNet, achieved predictive accuracy with F1 scores of 95.74% (speech) and 96.72% (handwriting), demonstrating the potential of AI-driven biomarkers for early diagnosis.

These case studies illustrate AI's transformative role in medicine and dentistry, emphasizing the need for interdisciplinary collaboration to ensure seamless clinical integration. Further research and validation will be essential to fully harness AI's potential through decision support systems (DSS), maintaining ethical medical principles.

Keywords: Artificial Intelligence (AI); Convolutional Neural Networks (CNNs); Decision Support Systems (DSS).

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