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Research In-Progress

AI-Driven Hand Motion Analysis for Distinguishing Novice and Expert Skills in Medical Education

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Introduction: Artificial intelligence (AI) may be able augment the assessment of learner task performance by faculty educators. We aimed to develop an innovative tool that can track and analyze hand motions during suturing tasks using computer vision and AI to discriminate between novices and expert performance.

Methods: We videorecorded simple interrupted suturing tasks by one author (JAM) who simulated expert and novice performances on a suturing pad. Videos were recorded for each task using a depth camera and open-source machine learning and computer vision tools (Figure). Video frames were retrieved using OpenCV library and then passed to Google MediaPipe library that tracks 21 landmarks on each hand. Intel pyrealsense2 was used to extract the coordinates of the landmarks in 3D space every 0.1 seconds. In total, 16 metrics were defined for characterizing hand motions. Pooled group data from these metrics were used to train a multi-layer perceptron neural network to differentiate between experts and novices. A scoring system was built for quantitative evaluation. Once the tool was created, the same author simulated more expert and novice performances and allowed the tool to predict level of performance based on the scoring system:

Preliminary Results: The neural network was trained using 50 simulated expert and 50 novice videos. Fourteen of 16 metrics could differentiate between novice and expert groups (p-value < 0.05). The scoring system was validated on another 10 expert and 10 novice videos. The accuracy and precision of scores were found 85% and 90%, respectively.

Next Steps: We developed an innovative AI-based video analysis framework capable of distinguishing between expert and novice for basic suturing skills. This tool has the potential to be used in other medical tasks to make a meaningful contribution in medical education by reducing the need for faculty to train and assess learners.

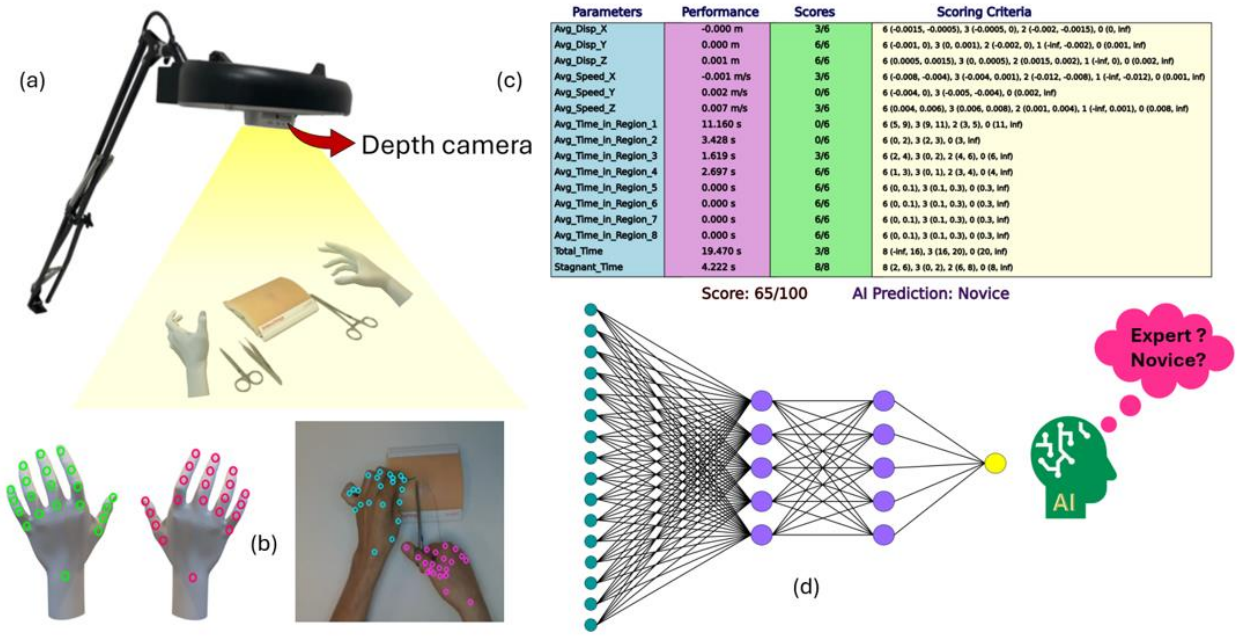

Figure. (a) The setup for recording the videos. (b) Detecting 21 landmarks on each hand. (c) Detailed feedback to the learner. (d) Prediction of skill level using a trained neural network