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Assessing the Reliability of AI-based Angle Detection for Shoulder and Elbow Rehabilitation

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Angle assessment is crucial in rehabilitation and significantly influences physiotherapistsŠ decision-making. Although visual inspection is commonly used, it is known to be approximate. This preliminary study aims to integrate and evaluate AI image-based approaches for assessing upper-limb angles. The study involved 28 participants performing four different rotational joints movement in the shoulder and elbow complex. Two AI algorithms, utilizing MediaPipe Holistic and Yolo v7, were employed for angle estimation. The accuracy of the estimations was evaluated against a wall-mounted compass, considering the ground truth. The results showed that the AI image-based algorithms displayed promising capabilities in assessing the exercises. Yolo v7 achieved the highest quality of estimations, with MAE equal to or less than 5ž, while MediaPipe, despite producing poorer results, where the MAE reaches values of 17ž, offered more features and required lower computational power than Yolo v7. However, it is worth noting that Yolo v7 was limited to exercises in 2D and did not estimate the position of key body points in 3D. Nevertheless, Yolo v7 would provide a cost-effective and easily implementable solution for measuring angles in rehabilitation activities for 1 Degree of Freedom (DOF) exercises. Overall, this study demonstrates the great promise of angle estimation for rehabilitation purposes of the AI approach.

Keywords: Join Angle Measurement · Artificial Intelligence · Motion Capture · Robotic Rehabilitation