ABSTRACT

Development of a practical and efficient system for classifying forward head posture is essential for digital-device users as a preventive measure against injury. An approach that uses keypoints as input to a machine-learning classifier can address this challenge. However, both keypoint extraction and classification models still struggle with image quality issues—such as blurriness—and imbalanced class distributions. This study aims to implement and evaluate the optimal combination of extraction and classification methods under various imbalance-handling scenarios. Comparing YOLOv8n-pose against MoveNet Lightning and MediaPipe Pose for keypoint extraction and Random Forest against XGBoost for classification. Each classifier is tested under four imbalanced-handling strategies (SMOTE, class weighting, sample weighting). Results show that classifiers trained on MoveNet Lightning keypoints achieve the most stable performance. Moreover, Random Forest proves more consistent and robust than XGBoost, with the combination RF + MoveNet Lightning yielding the highest accuracy for FHP classification (70%). Meanwhile, for balanced FHP detection under imbalanced data, the sample-weightXGBoost + MoveNet Lightning model is optimal, achieving 68% accuracy and small inter-class f1-score range (⊿0.16).

Keywords: *FHP, keypoint extraction, head posture classification, YOLOv8n-pose, Random Forest, imbalanced data*