

Posture flow: A hybrid deep learning and OpenPose framework for yoga posture tracking with Ayurvedic alignment feedback

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Yoga provides an encompassing way to well-being, promoting body strength, mental health, emotional balance, and spiritual belief. However, traditional video tutorials or group classes often fail to provide individual monitoring to address individual differences in anatomy, movement patterns and guidance and cause poor physical health, and it leads to minor to major injuries, health issues. This study aims to develop a Posture Flow, a deep learning enhanced yoga posture tracking and evaluation system that efficiently empowers accurate practice of yoga. The proposed system fuses Traditional Ayurvedic principles with deep learning to develop an efficient system that supports both modern technology and the ancient wellness wisdom as they provide posture alignment, timing and control of the body. For that, the study employs the hybrid framework that combines VGG19 CNN, a pretrained model for extracting high-level features, and OpenPose is used to accurately detect the key points in the body. The system provides real-time feedback, integrating Ayurvedic principles related to posture alignment, timing, and body control. As for pose validation, the decision is made to verify the poses based on the predefined rules derived from the Ayurvedic insights. The obtained result is assessed against the set of Ayurvedic principles of posture alignment for a particular pose. The alignment rules focus on the crucial things such as symmetry of the body, spinal stage or alignment, position of limbs, and flow of energy through the body. The model's performance was evaluated on multiple datasets, achieving a classification accuracy of 94.57% alongside strong precision, recall, and F1 scores. The average response time per pose was measured at 0.8 seconds, demonstrating suitability for live and interactive applications. The proposed hybrid framework effectively combines modern machine vision techniques with ancient Ayurvedic wisdom or principles to provide accurate posture classification and verifications of body alignment. The real-time feedback mechanism of the system tends to provide precise yoga practice that helps to reduce wrong postures and enhance safety. The obtained highest accuracy and responsiveness make the system suitable for integrating it into mobile apps, web apps, wearable fitness devices, and virtual live practice sessions. This study offers a scalable solution for personalised yoga practice by enabling all skill level users to get instant, individualized guidance.

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