INFORMATICS
INSTITUTE OF
TECHNOLOGY

INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER

An Evolution of Exercise Posture of Yoga Using Spatial Graph Convolutional Neural Network for Real time Interaction

A Thesis by

Mr. Hashane Aponso

w1829286/20200637

Supervised by

Mr. Guhanathan Poravi

Submitted in partial fulfilment of the requirements for the MSc Advanced software engineering degree at the University of Westminster.

July 2023

Abstract

Traditional yoga teaching techniques require a physical presence, which often constrains the scalability and accessibility of training resources for learners. Furthermore, the absence of real-time, objective feedback makes self-practice difficult and potentially hazardous due to improper poses. Current digital yoga platforms fall short in providing accurate, immediate, and personalised feedback, necessitating the need for a technologically advanced solution that is scalable, accessible, and accurate.

This work introduces an innovative method to address the previously mentioned issue. The core of the solution lies in a model utilising a Spatial Graph Convolutional Neural Network (SGCNN) to analyse real-time yoga postures. The advantage of deep learning techniques is harnessed along with skeletal data captured from a 3D camera to facilitate precise pose estimation and correctness assessment. The SGCNN model is educated through a rich dataset that contains a wide range of yoga postures demonstrated by individuals of various body types and skill levels.

The model was tested for pose recognition accuracy and real-time interaction. SGCNN's recognition accuracy was 87%, surpassing standard machine learning methods. The real-time feedback system performed well with an average response time of 0.3 seconds, ensuring smooth engagement. A user assessment of yoga practitioners of various skill levels confirmed the concept, with most saying the system helped their practises by delivering correct feedback. This supports the idea that the model would revolutionise yoga and digital fitness by making it safer and more accessible.

Subject Descriptors:

Image Processing and Computer Vision → Scene Analysis → Object recognition.

Probability and Statistics → Time series analysis.

Artificial Intelligence → Vision and Scene Understanding → Shape and Pattern Recognition.