A Project Report

on

YOGA POSE CORRECTOR

*carried out as part of the **Minor Project IT3270** Submitted*

by

Arin jain
229302350

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in

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CERTIFICATE

Date: 17/04/25

This is to certify that the minor project titled **YOGA POSE CORRECTOR** is a record of the bonafide work done by **ARIN JAIN** (229302350) submitted in partial fulfilment of the requirements for the award of the Degree of Bachelor of Technology in Information Technology of Manipal University Jaipur, during the academic year 2024-25.

Mr. Ravinder Kumar
Assistant Professor (Senior Scale)
Project Guide, Department of Information Technology
Manipal University Jaipur

Dr. Pratistha Mathur
HoD, Department of Information Technology
Manipal University Jaipur

ABSTRACT

Yoga, a discipline emphasizing precise body alignment for maximum benefit and injury prevention, has seen increased home practice, often without expert guidance. This project addresses the need for accessible feedback by developing an AI-powered Yoga Pose Corrector using Python, OpenCV, and MediaPipe. The system provides real-time analysis of human body posture during yoga practice, enhancing safety and effectiveness for practitioners at home.

The methodology involves capturing video feed via webcam, utilizing MediaPipe Pose for accurate detection of 33 key body landmarks, and calculating critical joint angles using NumPy and trigonometric principles. These calculated angles are then compared in real-time against pre-defined angles of ideal yoga postures selected by the user. The system provides immediate corrective feedback through visual overlays and textual guidance (e.g., "FIGHTING!" indicating deviation, "PERFECT" for correct alignment, and specific instructions like "Extend the right arm at elbow"). This work successfully demonstrates a cost-effective, real-time solution to improve yoga practice accuracy, bridging the gap between technology and personal wellness.

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1. Introduction

1.1. Introduction

Accurate posture is crucial in yoga for achieving benefits and preventing injury. While traditionally learned with instructors, many now practice at home using online resources, often lacking real-time alignment feedback. This project addresses this gap by creating an AI-powered Yoga Pose Corrector using accessible technology (Python, OpenCV, MediaPipe) and a standard webcam.

The system analyzes the user's posture in real-time, identifies key body landmarks using MediaPipe Pose, calculates joint angles, and compares them to a selected ideal pose. This provides immediate, corrective feedback, empowering users (especially beginners) to improve form, practice safely, and enhance self-study. The motivation is to offer a cost-effective, interactive tool that leverages computer vision for personal wellness, potentially applicable to physiotherapy or other fitness domains.

1.2. Problem Statement

Practicing yoga at home without expert supervision often leads to incorrect posture execution due to the lack of real-time feedback. This diminishes the practice's effectiveness and increases the risk of musculoskeletal strain or injury. An accessible technological solution is needed to provide immediate, objective feedback on posture alignment during self-practice.

1.3. Objectives

- Develop an AI system for real-time yoga pose estimation (MediaPipe, OpenCV).
- Implement joint angle calculation for quantitative analysis (NumPy).
- Compare user angles against selected pre-defined ideal pose angles.
- Provide instant, actionable feedback (visual overlays, text guidance).
- Ensure reasonable accuracy and real-time performance.

1.4. Scope of Project

This project focuses on real-time pose correction against a user-selected target pose, not pose classification. Key aspects include:

- Webcam video input.
- MediaPipe Pose detection (33 landmarks).
- Calculation of 8 specific joint angles.
- Comparison based on angular deviation from stored target data for selected poses (e.g., Warrior II, Tree Pose).
- Real-time feedback (skeleton overlay, text advice) in an OpenCV window.
- The system is an assistive tool, not a replacement for instructors. Accuracy depends on environmental factors and model limitations.

2. Background Detail

2.1. Conceptual Overview / Literature Review

This project utilizes concepts from Computer Vision and Human Pose Estimation.

- Computer Vision & OpenCV: Enables processing the webcam feed and displaying output visuals.
- Human Pose Estimation: The task of locating human joints/landmarks from images/video.
- MediaPipe Pose: Google's framework providing pre-trained models for real-time pose estimation. The model used detects 33 key landmarks with 2D/3D coordinates and visibility. Its efficiency enables real-time performance.
- Angle Calculation: Joint angles are calculated from landmark coordinates using vector math, specifically the 'atan2' function for robustness, allowing quantitative comparison of poses.

3. System Design & Methodology

3.1. System Architecture

The system employs a real-time processing pipeline: Webcam Input -> Frame Processing -> Pose Estimation (MediaPipe) -> Landmark Extraction -> Angle Calculation -> Comparison -> Feedback Generation -> Display Output (OpenCV).

3.2. Development Environment.

- Hardware: Standard Laptop/PC (macOS/Windows/Linux) with webcam. GPU optional.
- Software: Python 3.12.x, OpenCV 4.9.x, MediaPipe 0.10.x, NumPy 1.26.x. Developed using VS Code/Jupyter Notebook

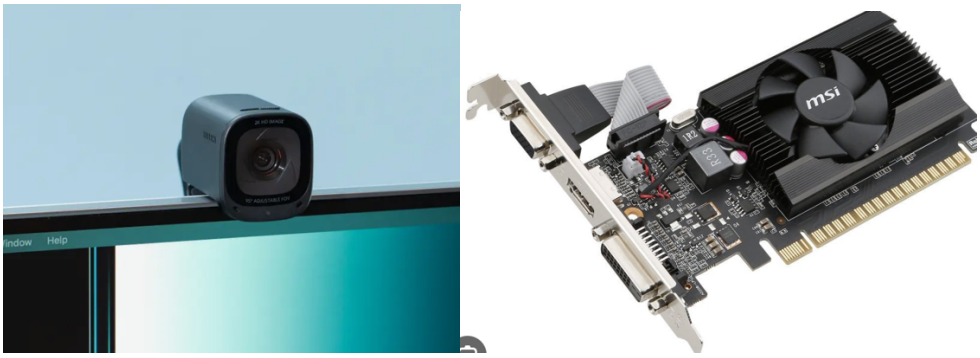

Figure 3.1(Hardware requirements)

Figure 3.2(Software requirements)

3.3. Methodology:

1. Load pre-calculated angles (TARGET_POSES). Prompt user to select target.
2. Initialize pose detector (mp_pose.Pose) and webcam (cv2.VideoCapture).
3. Start video loop:
    - Capture frame, convert to RGB
    - Detect landmarks.
    - extract coordinates, calculate 8 joint angles.
    - Compare user angles to target; give visual/textual feedback.
    - Draw skeleton and feedback using OpenCV.
4. End loop on exit key. Release camera, close windows.

Figure 3.3 Example Target Pose Angles

4. Implementation and Result

4.1. Modules/Classes of Project

Key Python functions: calculateAngle, compare_pose. Main loop controls webcam input, landmark processing, and output.

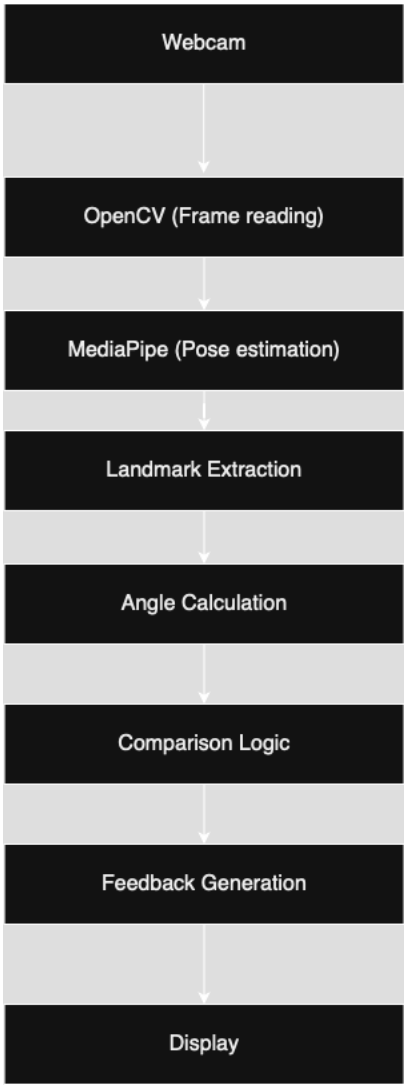

Figure 4.1 System Architecture Block Diagram

4.2. Implementation Detail

- Mediapipe Pose detects 33 landmarks using pre-trained ML model.
- Angles are calculated with numpy.arctan2 using vector math.
- Pose comparison uses thresholds (±15 degrees) to give feedback.
- OpenCV displays results: skeleton + text feedback

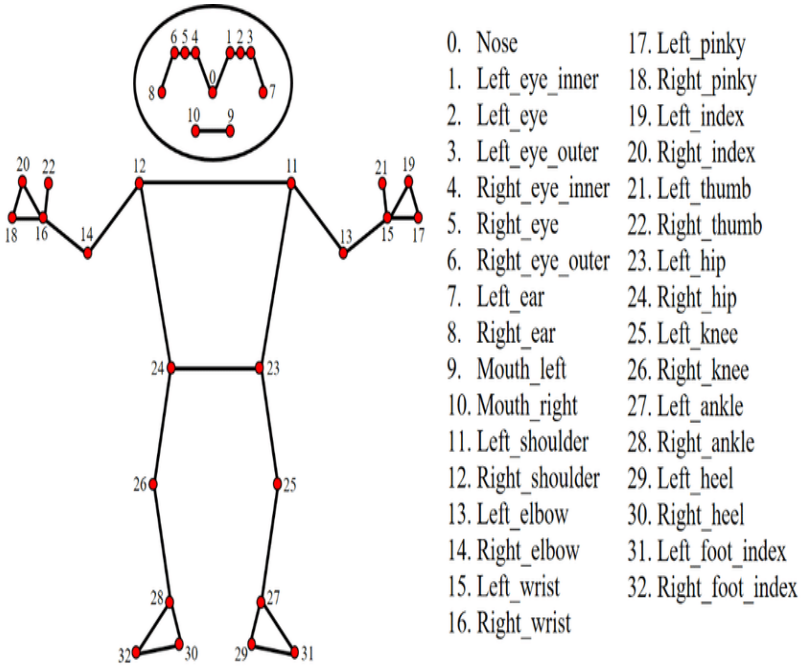

Figure 4.2 MediaPipe Pose Landmark Detection

4.3 Results and Discussion

- MediaPipe reliably detects poses in good lighting.
- Feedback is immediate: "FIGHTING!" or "PERFECT" with guidance.
- Performance is real-time on standard hardware.
- Limitations: relies on angle data quality, lighting, fixed threshold.

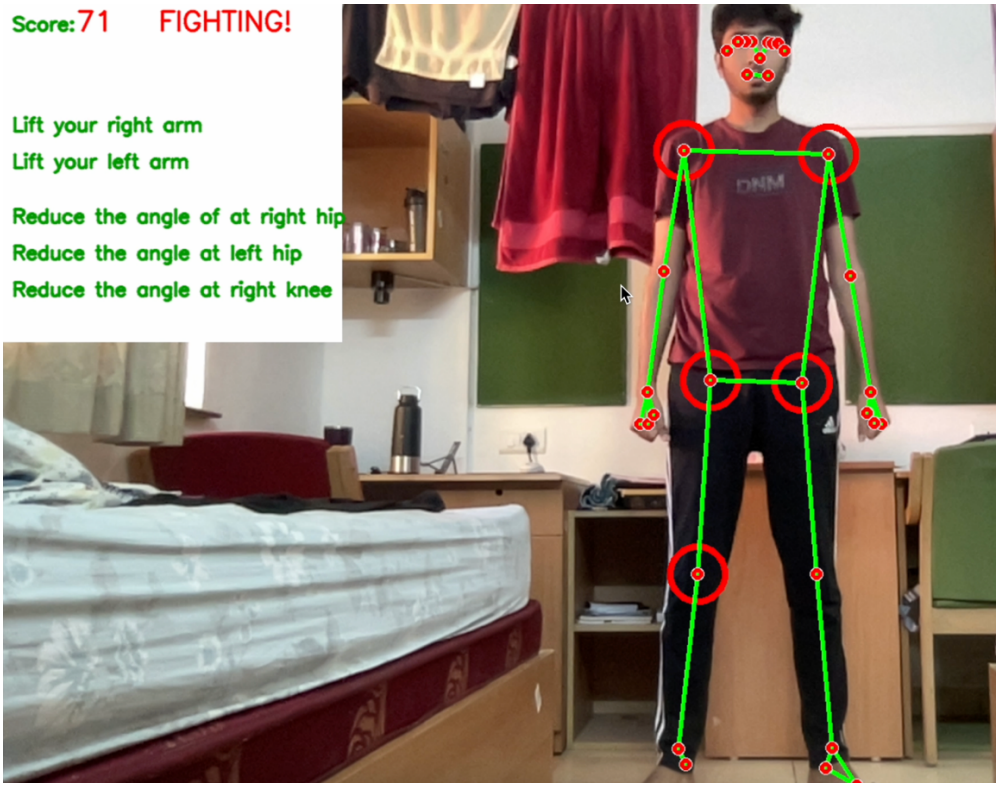

Figure 4.3.1 Screenshot: "FIGHTING!" Pose 1

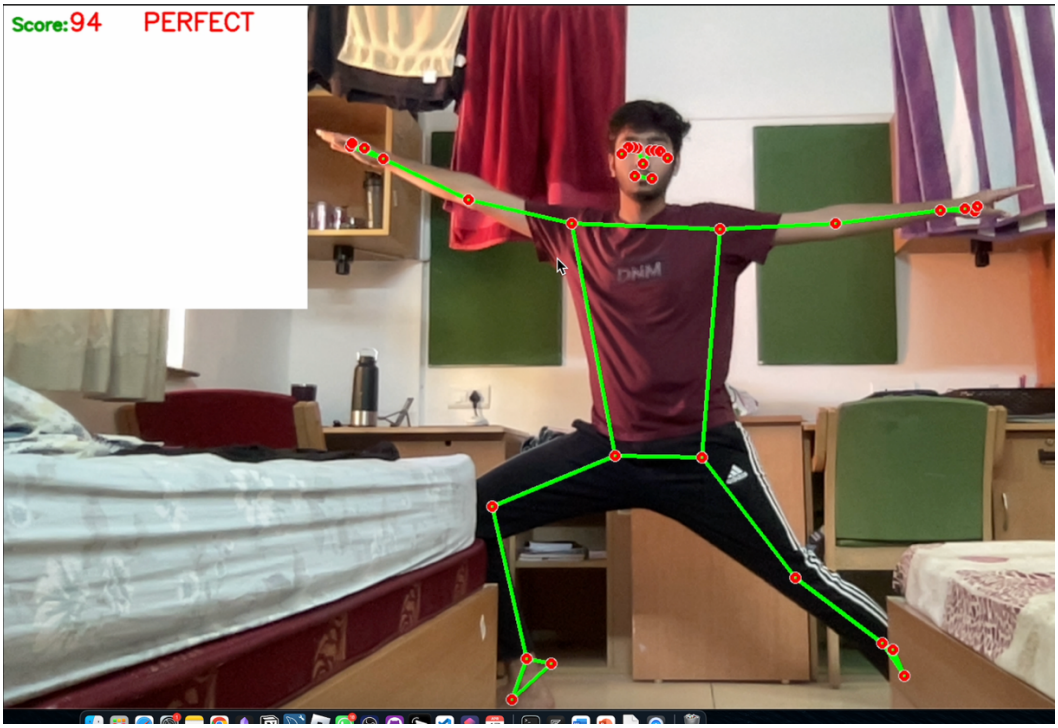

Figure 4.3.2 Screenshot: "PERFECT!" Pose 1

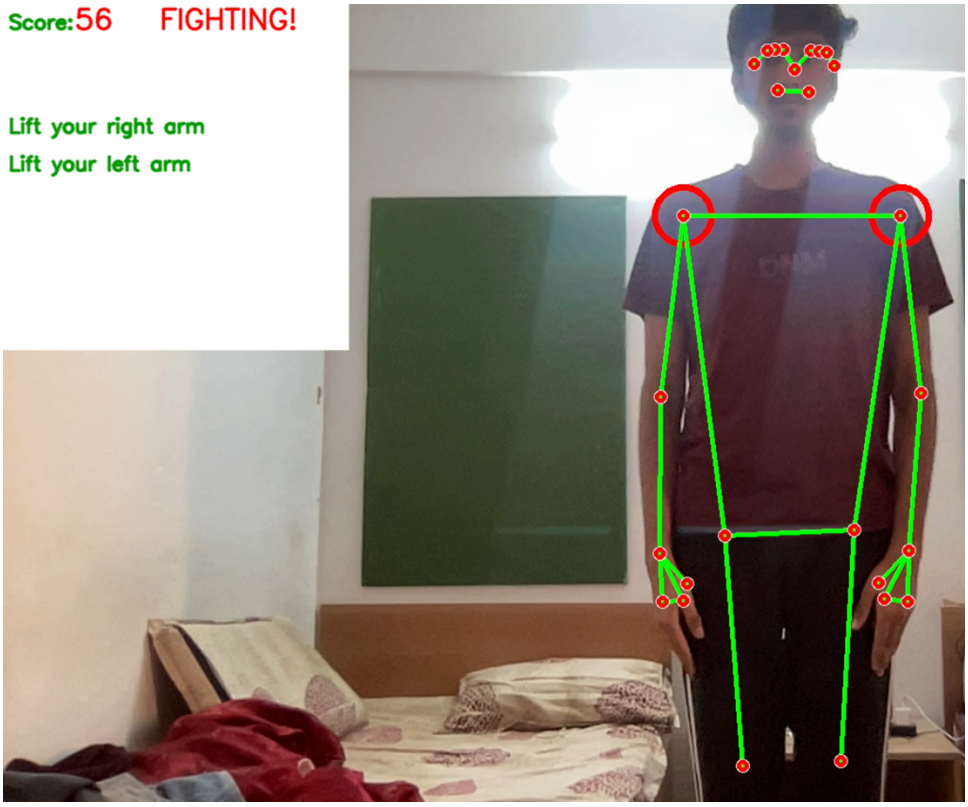

Figure 4.3.3 Screenshot: "FIGHTING!" Pose 2

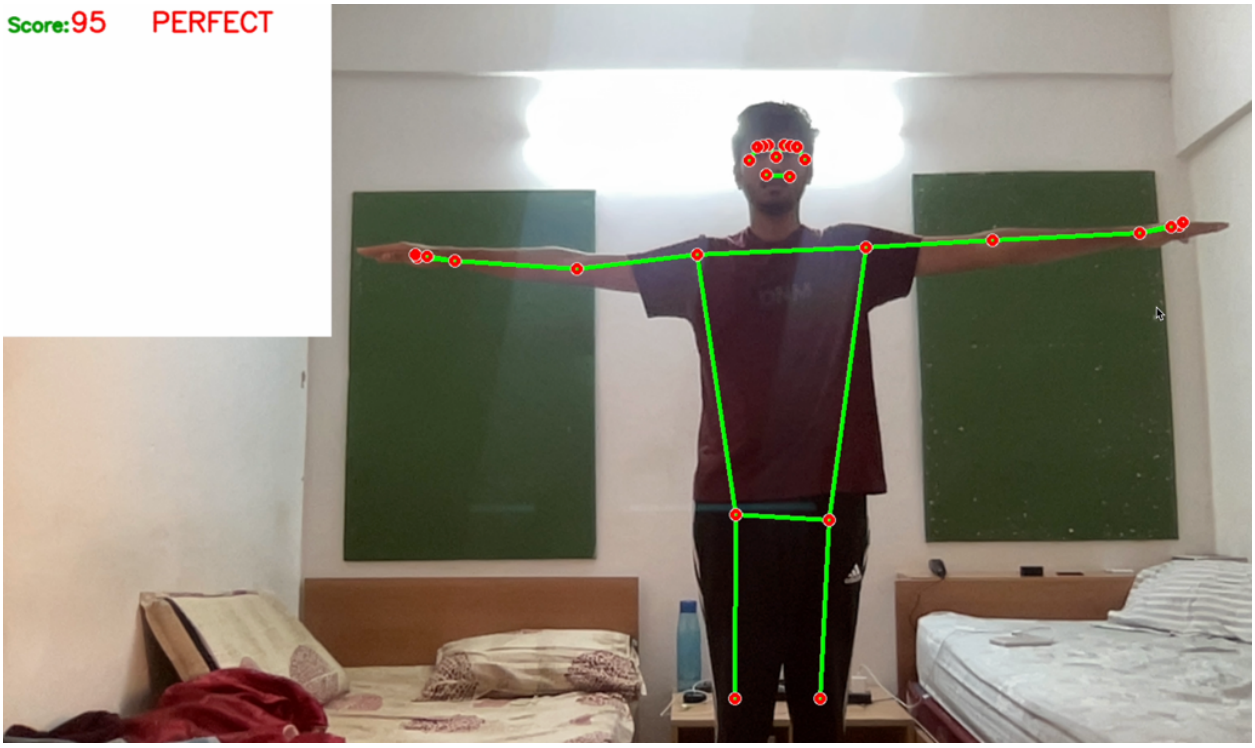

Figure 4.3.4 Screenshot: "PERFECT!" Pose 2

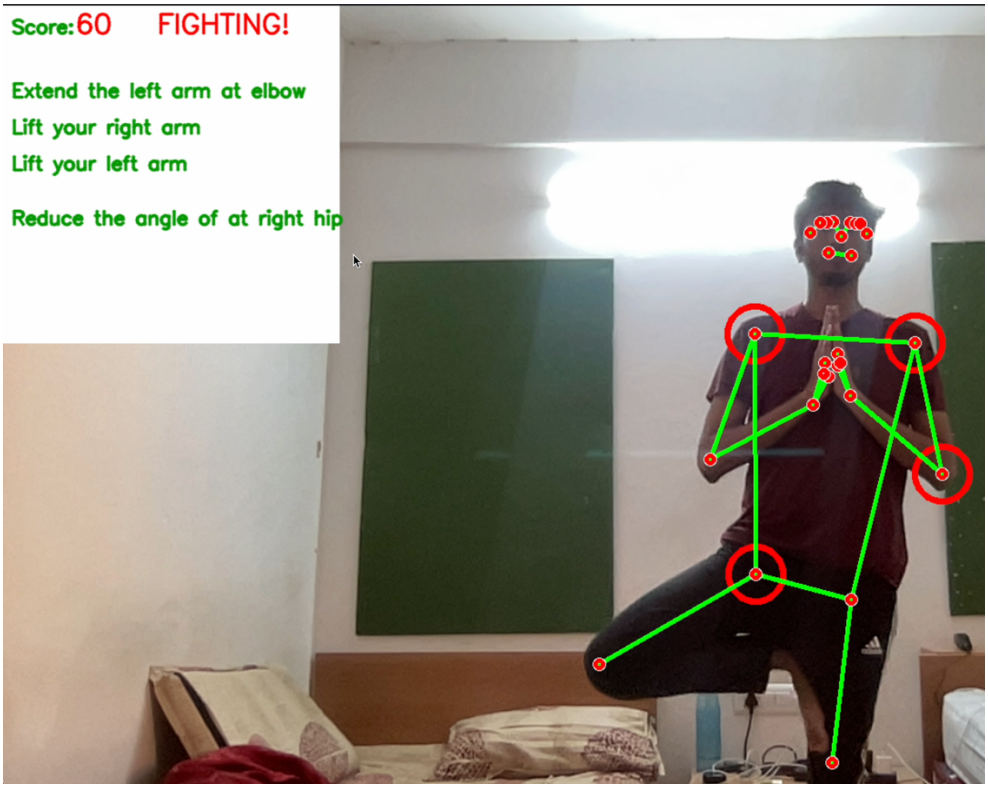

Figure 4.3.5 Screenshot: "FIGHTING!" Pose 3

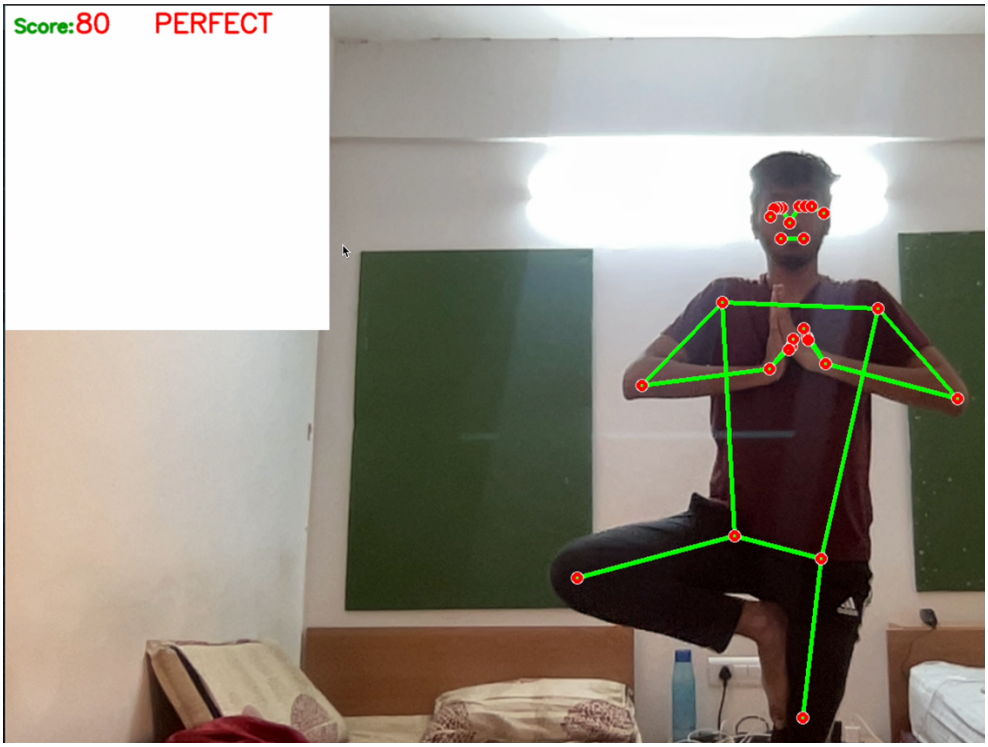

Figure 4.3.6 Screenshot: "PERFECT!" Pose 3

4.4 Month wise plan of work

- Month 1: Setup, Research, Initial Detection
- Month 2: Angle Logic, Comparison Logic
- Month 3: Feedback System, Integration
- Month 4: Testing, Debugging, Documentation

5. Conclusion and Future Plan

5.1 Conclusion:

This project successfully demonstrates a real-time AI-based system to assist yoga practitioners by correcting poses using MediaPipe, OpenCV, and Python. It improves alignment and promotes safe self-practice.

5.2 Future plan:

- Add more poses to the system.
- Introduce audio and visual scoring.
- Create GUI/Web interface.
- Enhance robustness to lighting/backgrounds.
- Explore use in physiotherapy and fitness applications.

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