Exercise Form Detection: Posture Rules & Logic

1. Posture Rules Used
2. Bicep Curl Elbow Angle: Checks if the elbow angle reaches the top and bottom positions of a curl (approx. 50° at the top, 150° at the bottom).
3. Wrist-Shoulder Alignment: Ensures the wrist is vertically aligned with the shoulder within a small pixel tolerance.
4. Back Symmetry: Compares left and right shoulder heights to detect tilting or leaning.
5. Tricep Extension Angle: Ensures the elbow is fully extended (angle > 160°) when performing tricep exercises.

6. Optional Rule – Shoulder Shrug: Checks if shoulders are lifted unnecessarily during lifts.

7. Logic Behind the Rules

8. Angles are calculated using 3 keypoints (shoulder-elbow-wrist) with the cosine law to detect proper form.
9. Pixel distances are used for alignment checks and symmetry evaluation.
10. Hysteresis logic is applied for rep counting: detecting top and bottom positions prevents false positives due to small fluctuations.

11. Feedback messages are generated in real-time for each detected deviation, helping users correct form immediately.

12. Challenges Faced

13. Multiple Persons in the Frame: Current detection is single-person focused. For multiple people, a person-tracking algorithm (like YOLO + pose detection) can isolate individuals before applying posture rules.
14. Varying Camera Angles & Lighting: Could affect landmark accuracy; smoothing filters (Savitzky-Golay) are used to reduce jitter in angles.
15. Video Playback & GUI Synchronization: Handling live webcam feed and tutorial video simultaneously can cause frame delays. Threading is used to separate video and camera loops.

16. Rep Counting Accuracy: Small movement jitters can falsely increment reps; hysteresis thresholds reduce this.

17. Conclusion The system provides a simple, interactive way to evaluate exercise form, generate real-time feedback, and count reps. Enhancements like multi-person support and AI-based posture scoring could further improve accuracy and usability.