**BICEP CURL DETECTION**

**A PROJECT REPORT**

**BY**

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**A close up of a sign

Description automatically generated**

**SUBMITTED TO**

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**GREATER NOIDA, 201310, UTTAR PRADESH, INDIA**

**November 2024**

**Abstract:**

A real-time project for pose estimation and repetition counting is described. The study develops real-time system through the use of pose detection model, YOLOv8. By analysing key points corresponding to body joints, joint angles are computed to further identify arm movements in exercises such as bicep curls. The project provides visual feedback with graphical annotations and counters for repetitions on left and right arms. This work is intended for fitness tracking, and provides a non-invasive and efficient way of monitoring exercise performance.

**Introduction:**

The search for intelligent systems that help track exercise is making the world thrive with fitness consciousness. Although conventional fitness devices- wearable sensors- are a tad cumbersome and uncomfortable, the use of camera vision with deep learning models like YOLOv8 offers an encouraging alternative by using video feeds to estimate body pose and movement. This project harnesses YOLOv8 for pose estimation purpose to monitor arm angles during exercises like bicep curls and also count repetitions. The end goal is to design a highly dependable user-friendly system to aid workout monitoring without the need for further hardware.

**Proposed Work:**

The proposed project presents the implementation of a vision-based exercise tracking system with YOLOv8 for pose detection. The system receives video input, extracts the body key points, calculates joint angles relative to the threshold, and counts the repetitions. The main contributions include the following:

1. Real-time detection of the key points using the pose model of YOLOv8.
2. Dynamic computation of joint angles to monitor movement.
3. Accurate counting of repetitions using angle thresholds.
4. Visual feedback for enhancing user involvement and understanding.

**Methodologies:**

1. Pose Detection:

* YOLOv8's pretrained pose detection model (yolov8s-pose.pt) is used to detect key points of the wrist, the elbow, and the shoulder.
* These key points are utilized in calculating the angles.

1. Angle Calculation:

* The angles of the joints are tracked and computed using the principles of vector mathematics. The wrist, elbow, and shoulder serve as the key points through which the vectors to measure the angle are formed.
* The vector operations and angle calculations are done using Numpy.

1. Repetition Counting:

* Defining Thresholds for an Entire Movement Cycle:

Motion-Upward, angle >=100°

Motion-Downward, angle <=70°

* Changing direction will increment the respective counters.

1. Visualization:

* Key points and angle lines are drawn on each frame for real-time status feedback.
* Repetition counts and current angles are visualized using cvzone.

1. Video Processing:

* The input video is resized to be processed faster and analyzed on a frame basis.
* It also uses OpenCV to obtain control over video processing and graphical overlays.

**Experimental Results:**

The system was tested on recorded video footage of the bicep curl exercises. The following observations were made:

* Accurate identification and counting of repetitions for both arms resulted in very few false positives.
* Real-time processing of frames at∼ 30 FPS on a moderately powerful GPU.
* Clear and responsive visual feedback of angles and repetition count for easy usability.
* Some minor inaccuracies due to occluded or off-screen body parts.

Example Outputs:

* Left Arm Repetitions: 10
* Right Arm Repetitions: 10
* Angle tended to vary between 50° and 120° depending on the script of movement enacted.

**Conclusion:**

This project successfully demonstrates a real-time exercise repetition counting system through computer vision and pose estimation. Using YOLOv8 allows end-to-end real-time accurate key point detection, while movement tracking through angles proves to be very useful and accurate for tracking arm movements. This particular system offers an alternative that does not require wearables and provides ease and convenience for fitness enthusiasts and trainers alike.

**Future Scope:**

1. Multi-person tracking:

* Extended systems for the group workout sessions will tackle multiple individuals at once.

1. Diversity of exercises:

* Generalize the model for different exercises other than the current tests by involving complex movement detection and other more key points.

1. Advanced Visualization:

* Design graphical performance charts or live motion graphs.
* Such feedback could involve real-time corrective suggestions on form.

1. Mobile Integration:

* To facilitate the provision of the system through smartphone cameras, a mobile application must be produced.

1. AI-Assisted Training:

* To identify the quality of exercise and offer personalized feedback.

1. Occlusion Handling:

* Advanced interpolation techniques will enhance robustness against the scenarios of occlusion and out-of-frame.

In such refinements and expansions, this very utility may serve the purposes of smart training in full measure.