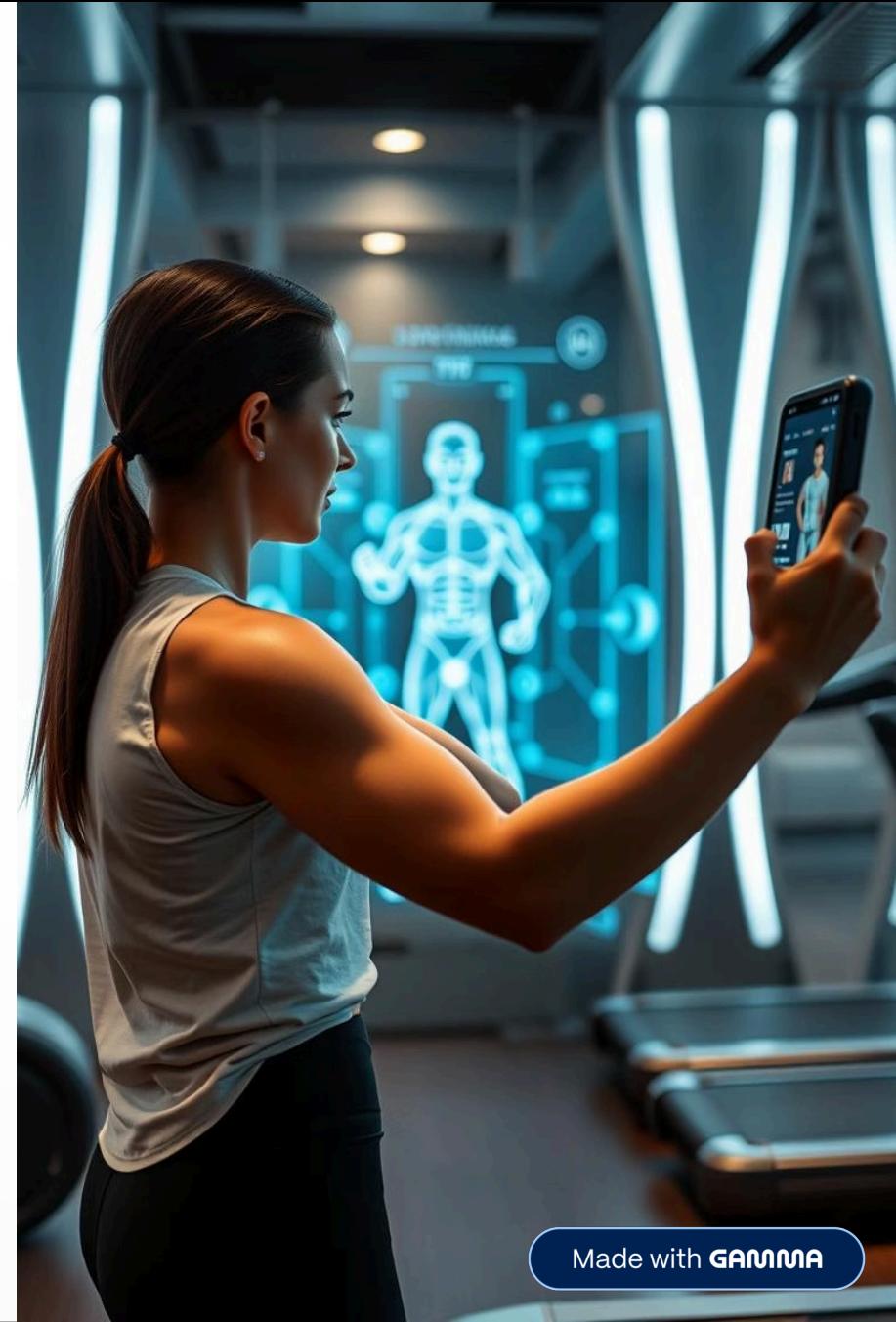


# Virtual Gym Trainer: AI-Powered Fitness Guidance

Leveraging computer vision and AI for real-time workout guidance.

Team Members: Pavan Konam, Ashlesha Ahirwadi



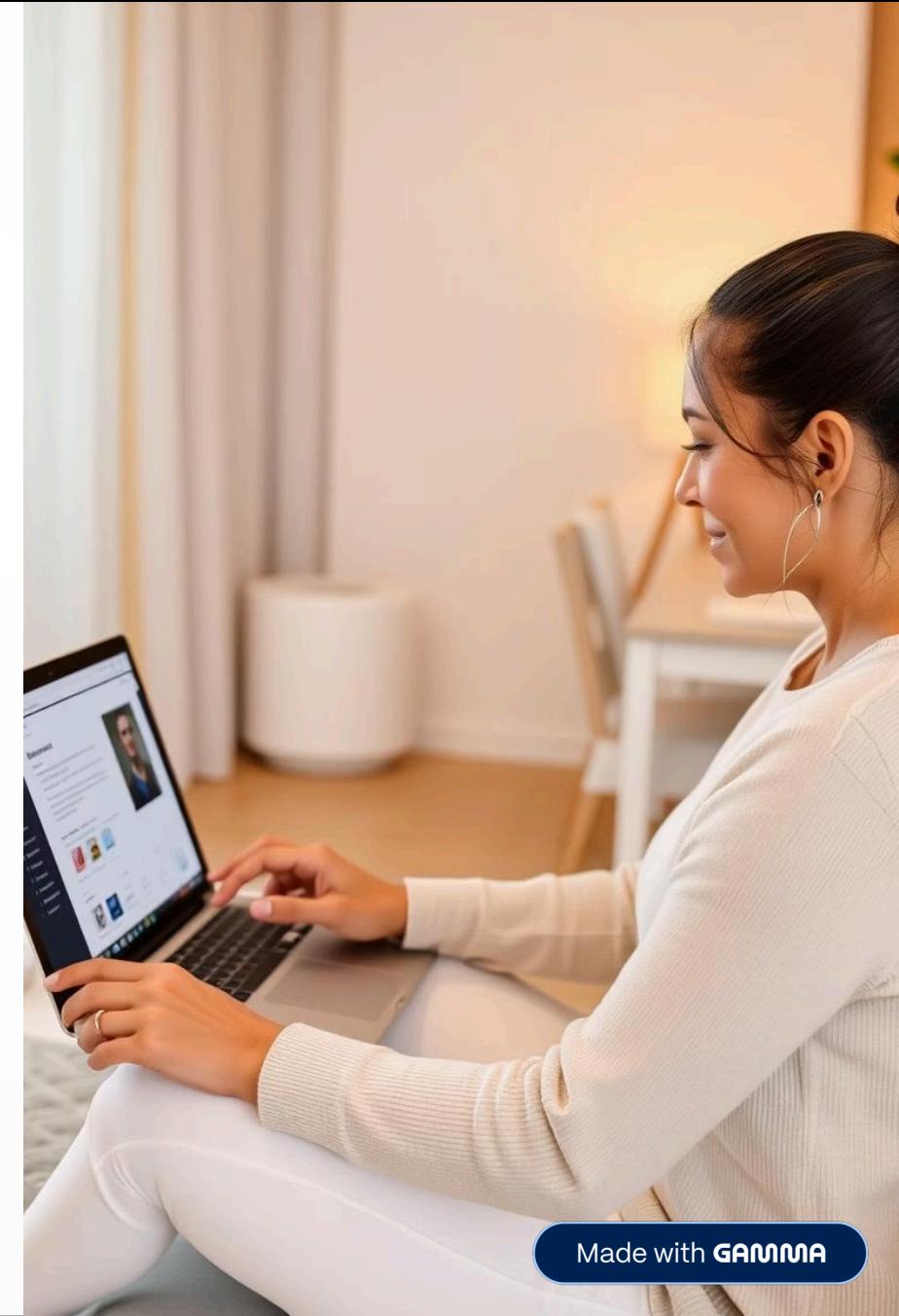
# Project Objectives: Accessible AI Fitness

 Real-time posture detection

 Accurate rep counting

 Visual and audio feedback

 Structured workout routines

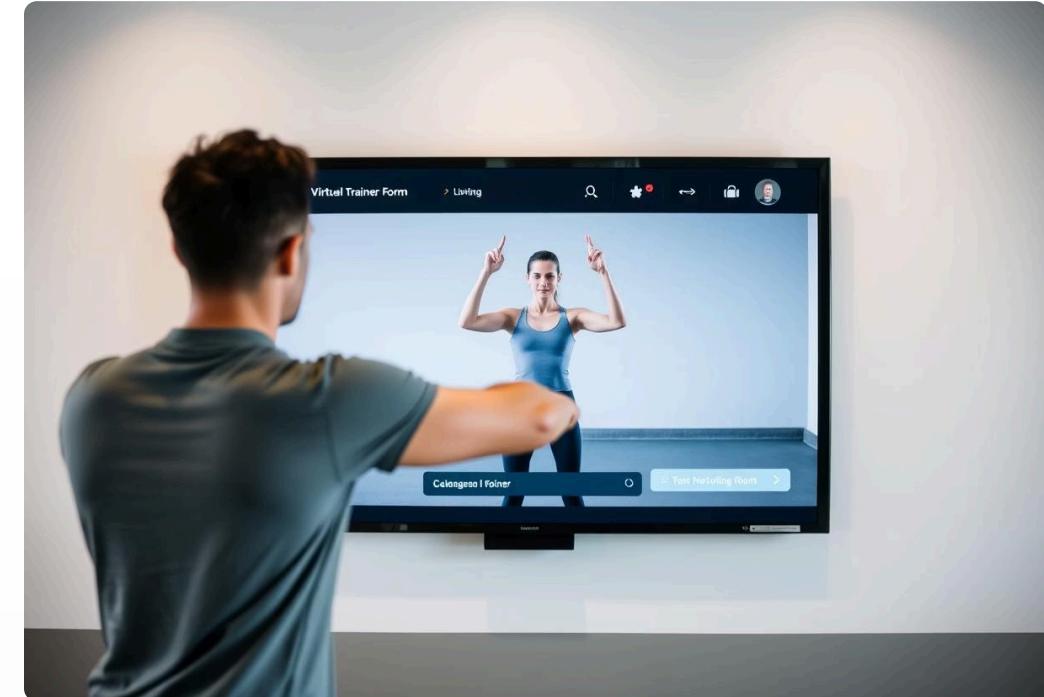


# Addressing Home Workout Challenges



## Lack of professional guidance

Poor form can lead to injury.



## Simulating a personal trainer

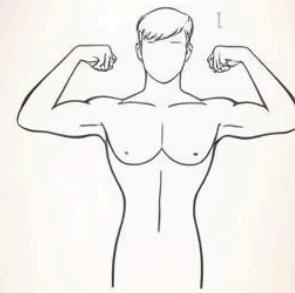
Intelligent system for proper training.

## Biicep curls



Lateral cuists

## Lateral raises



1

Bicep Curls

2

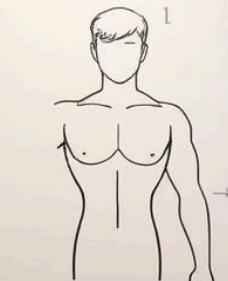
Lateral Raises

3

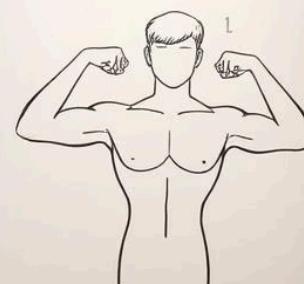
Tricep Extensions

4

Shoulder Presses



Tricep preses



Shoulder press

# Upper-Body Exercise Scope



System detects joint angles, tracks movement patterns, and ensures correct form.

# System Architecture Overview

Comprised of five core components:



## Video Input

Webcam captures real-time feed.

## Audio-Visual Feedback

Guidance for user performance.

## Pose Detection

MediaPipe identifies body landmarks.

## Angle Calculation

Vector math computes joint angles.

## Repetition Tracking

Finite state machine counts reps.

# Technical Stack: Python Libraries



**Python**

Primary programming language.



**OpenCV**

Video capture and overlays.



**MediaPipe**

Advanced pose detection.



**NumPy**

Numerical operations.

# Pose Estimation with MediaPipe

MediaPipe provides 33 key body landmarks in real-time.

Used to compute joint angles during movement.

Shoulders

Elbows

Wrists

Hips

Knees

Ankles



# Joint Angle Calculation Logic

Exercises rely on specific angular changes between three body joints.

## Bicep Curls

- Shoulder
- Elbow
- Wrist

## Lateral Raises

- Hip
- Shoulder
- Elbow

Angles calculated using vector mathematics and monitored frame by frame.

# Accurate Repetition Counting

Finite state machine with three stages ensures accuracy.

1

**Resting Stage**

Initial body position.

2

**Active Stage**

Movement begins.

3

**Completion Stage**

Returns to rest.

# Form Validation



## Good Form

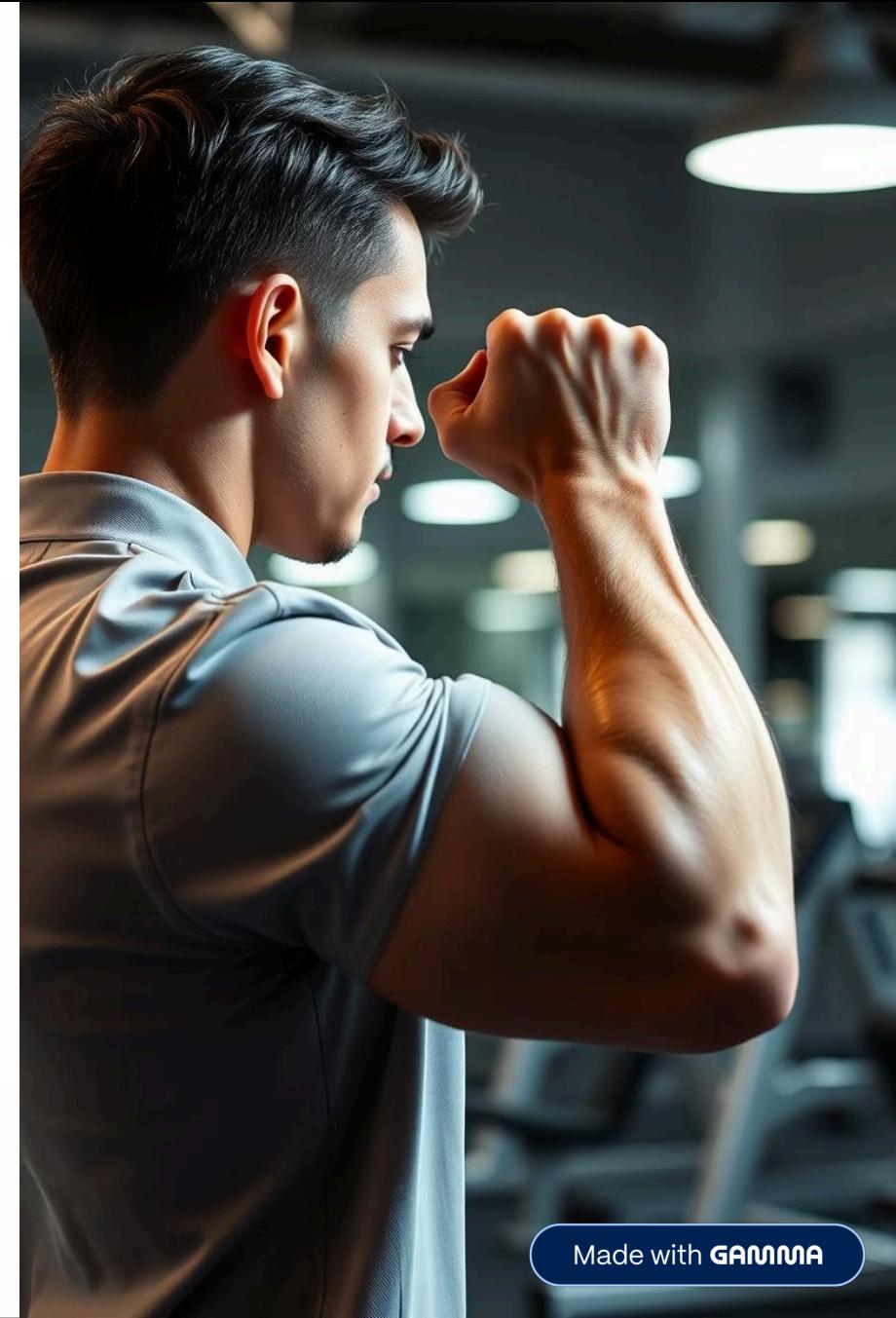
Correct elbow positioning and shoulder alignment.

## Bad Form

Incorrect elbow positioning or shoulder alignment.

## Real-time Feedback

The system provides immediate feedback for elbow positioning, shoulder alignment, and symmetry.



# Visual Feedback Interface



The system provides real-time visual feedback through a comprehensive user interface, displaying key performance indicators to guide users:

- Live video feed with pose overlay for immediate form correction.
- Clear exercise instructions to ensure proper execution.
- Accurate repetition counter for tracking workout progress.
- Progress bar to visualize workout completion.
- Instant form status (good/bad) for real-time adjustments.
- Convenient break timer when switching between exercises.

# Audio Feedback

Audio cues enhance the user experience by providing clear, immediate signals during workouts:

- A beep after every completed rep
- A chime at the end of each exercise
- Countdown tones during breaks



# Workout Routine Design

The workout is structured as a sequence of exercises. Each entry includes the name, type (for logic selection), rep target, and a description. This modular structure makes it easy to add new exercises.

Bicep Curls	Strength	10-12	Stand upright, hold dumbbells with palms facing forward, and curl arms towards shoulders.
Lateral Raises	Strength	8-10	Stand with dumbbells, raise arms out to the sides until parallel to the floor, forming a "T" shape.
Push-ups	Strength	As many as possible	Start in plank position, lower chest towards the floor, then push back up.
Overhead Press	Strength	8-12	Hold dumbbells at shoulder height, then press them directly overhead until arms are fully extended.

# Results

**90%+**

Accuracy in well-lit conditions

**<0.2s**

Delay between movement and feedback

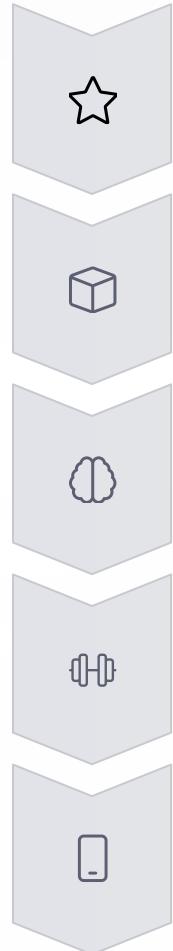
# Challenges

During the development and testing of the Virtual Gym Trainer, several key challenges were encountered:

- **Motion blur:** Occurred during fast movements, making accurate pose estimation difficult.
- **Background noise:** Affected landmark detection, leading to potential inaccuracies.
- **Lighting variations:** Inconsistent lighting conditions impacted visibility and the system's ability to correctly interpret poses.

These challenges were mitigated through the implementation of smoothing techniques and adaptive threshold adjustments, significantly enhancing the system's robustness and accuracy.

# Future Work



Integration with wearable sensors

3D pose estimation for better accuracy

Supervised learning for form correction

Support for lower-body exercises

Mobile app development

# Live Demo



# Conclusion

In conclusion, the Virtual Gym Trainer demonstrates how AI and computer vision can enhance fitness training. It provides accurate, real-time feedback without requiring special equipment. We hope this project contributes to accessible and effective home workouts for everyone.

