FitTrackAI: AI-Driven Real-Time Human Activity Recognition for Enhanced Gym Training

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1. Introduction

Traditional fitness apps lack real-time exercise feedback, manual logging inaccuracies, and personalized trainer interactions. **FitTrackAI** bridges this gap by:

- **Real-Time AI Analysis**: Detects gym exercises via live camera feed, validates form, and counts repetitions using pose estimation (OpenPose/MediaPipe) and ML models.
- **Trainer Collaboration**: Secure request-based connections for guided feedback.

2. Motivation

Limitations of Existing Solutions:

- **Nike Training Club**: Passive video guidance, no real-time feedback.
- **Hevy**: Manual logging prone to errors, no AI-driven insights.

FitTrackAI's Innovations:

- Observation 1: AI-powered pose estimation reduces rep-counting errors to <5% vs. manual methods.
- Observation 2: Real-time feedback latency of 300–400ms ensures seamless user experience.
- Observation 3: Trainer-user interaction model enhances accountability and progress tracking.

3. Proposed Technique

MVC Framework:

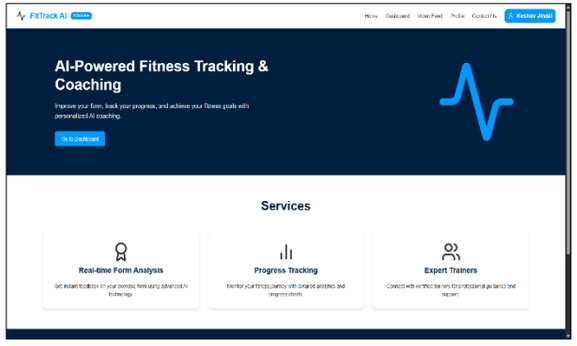
- **Model**: Pose estimation, activity classification, MongoDB for user data.
- **View**: React-based dashboard with live video streaming and charts.
- **Controller**: Node.js/Express.js backend, and WebRTC for real-time communication.

AI Workflow:

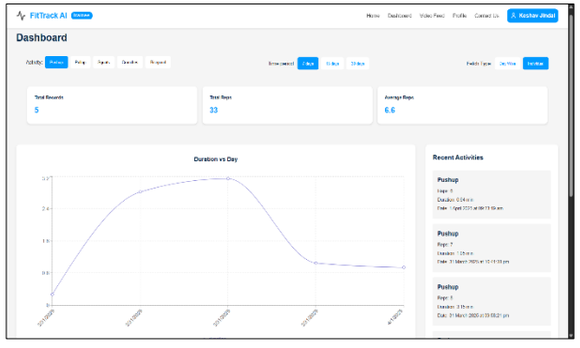
- **Video Capture**: HD camera feeds processed asynchronously.
- **Pose Estimation**: Joint-angle analysis for form validation.
- **Activity Classification**: ML model predicts exercise type and counts reps.
- **Feedback**: Real-time UI alerts and analytics reports.

4. UI Previews

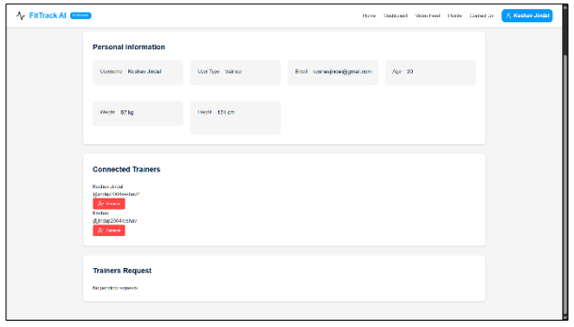
1. Home Page



2. Dashboard



3. Trainer-Trainee Connection



5. Experimental Results

Testing Outcomes:

- **White Box Testing**: MongoDB queries achieved 100% success rate; JWT authentication validated.
- **Black Box Testing**: 95% user satisfaction in UI/UX trials.

System Efficiency:

Component	Performance
Video Processing	25 FPS @ 720p
API Response Time	<200 ms

6. References

1. Pose Estimation: MediaPipe (Google, 2023)
2. Real-Time Streaming WebRTC (W3C, 2023)