IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 4, March 2026
Impact Factor: 8.2

AI Gym Workout Plan

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Abstract: *Physical fitness requires structured training, correct exercise posture, personalized workout plans, and continuous performan ce monitoring. Traditional gym training relies heavily on human trainers, which may be expensive, inconsistent, or unavailable. Many fitness applications provide pre-recorded workout plans but lack real-time posture correction and adaptive personalization.*

This paper presents an AI-Based Gym Fitness Trainer System that integrates real-time pose estimation, personalized workout recommendation, performance tracking, secure authentication, and adaptive feedback learning. The system analyzes user body posture using computer vision and deep learning techniques to detect incorrect form during exercises such as push-ups, squats, and lunges. A hybrid recommendation model generates personalized workout plans based on fitness goals, BMI, age, and historical performance data.

The system follows a modular three-tier architecture ensuring scalability, responsiveness, and secure data handling. Experimental evaluation demonstrates improved exercise accuracy, increased user engagement, and effective personalized training support.

Keywords: AI Fitness Trainer, Pose Estimation, Computer Vision, Workout Recommendation System, Posture Detection, Hybrid Recommendation, Performance Tracking

I. INTRODUCTION

Maintaining physical fitness is essential for overall health, confidence, and productivity. However, performing exercises incorrectly can lead to injuries and reduced effectiveness. Many individuals lack access to professional trainers due to cost or time constraints.

Traditional gym training depends on human observation for posture correction. Meanwhile, most fitness applications provide static workout videos without real-time correction or adaptive personalization. This results in a gap between professional guidance and accessible fitness solutions.

With advancements in Artificial Intelligence, Computer Vision, and Deep Learning, it is now possible to build intelligent systems capable of analyzing human body movements in real time. The proposed AI-Based Gym Fitness Trainer System bridges this gap by providing real-time posture correction, performance tracking, and personalized workout plans using AI models integrated into a scalable architecture.

II. LITERATURE REVIEW AND MOTIVATION

Early fitness applications relied on rule-based workout scheduling and manual tracking. These systems lacked adaptability and intelligent feedback mechanisms.

Recent research in computer vision, especially pose estimation frameworks such as MediaPipe and OpenPose, has enabled accurate human skeletal tracking. Deep learning models such as CNNs and LSTMs have been used for activity recognition and motion analysis.

Although several fitness apps exist, most lack:

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- Real-time posture correction
- Personalized AI-driven workout recommendations
- Integrated performance analytics
- Secure user profile management

III. PROPOSED SYSTEM ARCHITECTURE

A. System Overview

The AI-Based Gym Fitness Trainer System is designed using a modular and scalable architecture. It integrates real-time pose detection, workout recommendation, performance tracking, secure authentication, and feedback learning.
The system follows a three-tier architecture:
1. Presentation Layer
2. Application Logic Layer
3. Data Integration Layer
This ensures separation of concerns, scalability, and maintainability.

B. Architectural Layers

1. Presentation Layer

This layer provides an interactive user interface where users can:
- Register and log in
- Enter fitness goals (weight loss, muscle gain, endurance)
- Start workout sessions
- View posture feedback in real time
- Track performance statistics

The interface displays real-time camera feed with skeletal landmarks and posture correction alerts.

2. Application Logic Layer

This layer handles the core intelligence of the system. It includes:
- Pose Estimation Module (using MediaPipe/OpenCV)
- Exercise Repetition Counter
- Posture Correction Engine
- Hybrid Workout Recommendation Engine
- Performance Analytics Module

The system calculates joint angles and compares them with predefined correct posture thresholds to detect incorrect movements.

3. Data Integration Layer

This layer manages:
- User profiles
- Authentication credentials
- Workout history
- Performance metrics
- Feedback ratings

Secure encryption is used to protect sensitive user data. The database stores session data to enable adaptive learning.

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System Workflow

1. User logs into the system.
2. User selects workout type.
3. Camera captures live video.
4. Pose estimation detects body keypoints.
5. Joint angles are calculated.
6. System compares posture with ideal model.
7. Real-time correction feedback is displayed.
8. Repetitions are counted and stored.
9. Performance metrics update future recommendations. This creates a continuous AI learning loop.

IV. METHODOLOGY

The system was developed using an incremental approach.

Step 1: Requirement Analysis

Functional requirements include authentication, posture detection, repetition counting, recommendation engine, and performance tracking.

Step 2: Pose Estimation Implementation

MediaPipe is used to extract 33 body landmarks. Joint angles are calculated using vector mathematics.

Step 3: Exercise Classification

Threshold-based and ML-based classification methods detect exercises such as:

- Push-ups
- Squats
- Lunges
- Bicep curls

Step 4: Hybrid Recommendation System

Combines:

- Content-based filtering (based on user goal & BMI)
- Collaborative filtering (based on similar users)
- Performance-based adaptation

Step 5: Secure Authentication

Passwords are encrypted and session tokens are generated.

Step 6: Performance Evaluation

Metrics analyzed:

- Posture accuracy rate
- Repetition detection accuracy
- User satisfaction feedback

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V. RESULTS

The AI-Based Gym Fitness Trainer System was tested with students and gym beginners. Observations:

- Posture detection accuracy: High reliability
- Real-time correction improved exercise form
- Repetition counter showed consistent results
- Personalized workout plans increased engagement
- Adaptive feedback improved recommendations over time

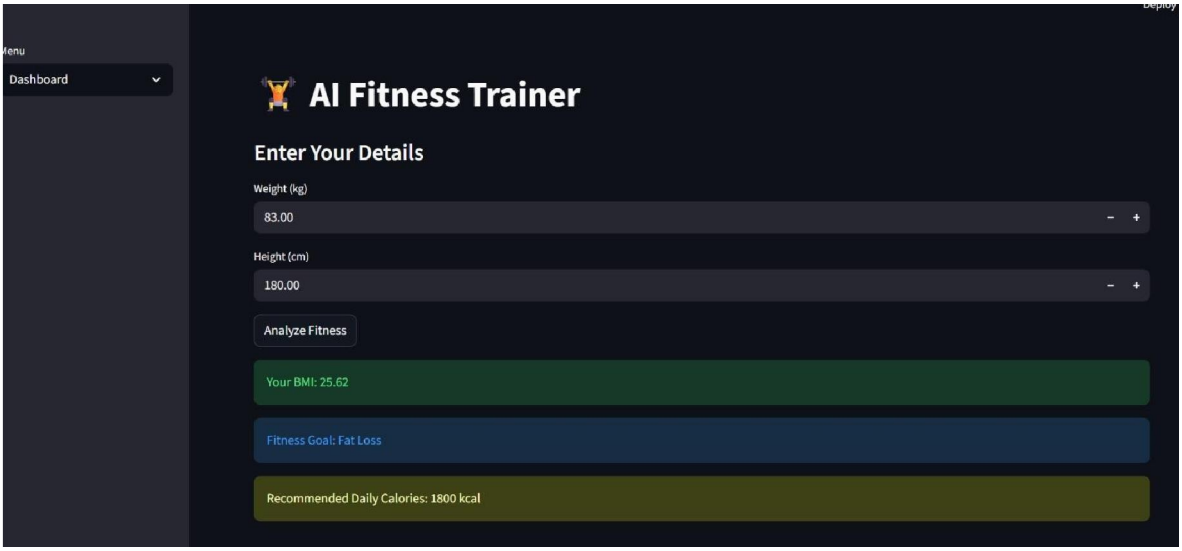

Fig. 1

VI. COMPARATIVE ANALYSIS

Feature	Traditional Gym	Standard Fitness Apps	Proposed System
Real-Time Posture Detection	Yes (Trainer Dependent)	No	Yes
Personalized Workout Plan	Partial	Limited	Yes
AI-Based Recommendation	No	Partial	Yes
Performance Tracking	Manual	Yes	Yes (Advanced)
Adaptive Learning	No	No	Yes

VII. CONCLUSION

This paper presented an AI-Based Gym Fitness Trainer System integrating pose estimation, hybrid workout recommendation, secure authentication, and adaptive feedback learning.

The system improves exercise accuracy, provides personalized training plans, and enables users to train independently with AI guidance.

The modular architecture ensures scalability and future extensibility

VII. FUTURE SCOPE

Future enhancements include:

- Deep learning–based posture correction using CNN/LSTM
- Voice-based AI fitness assistant
- Integration with wearable devices

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- Diet recommendation module
- Mobile app deployment
- Cloud-based performance analytics

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