iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** IV **Month of publication:** April 2026

DOI: https://doi.org/10.22214/ijraset.2026.79642

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue IV Apr 2026- Available at www.ijraset.com

AI-Powered Real Time Fitness Training Assistance

Mrs. B. Sravanthi[1], Vanga Akshaya Lakshmi[2], Vadapalli Sahithi[3], Potturi Rajeswari[4], Uppathi Varshitha[5]
[1]*Asst.prof, Department of CAI, KKR & KSR Institute of technology and sciences, Guntur, Andhra Pradesh ,India*
[2, 3, 4, 5]*Student, Department of CAI, KKR & KSR Institute of technology and sciences, Guntur, Andhra Pradesh ,India*

Abstract: ***This project presents an AI-based real-time fitness assistance system that provides personalized workout guidance using computer vision techniques. The system uses a standard webcam to capture live exercise videos, eliminating the need for wearable sensors or specialized hardware. Human pose estimation is performed using MediaPipe Pose to accurately detect and track body landmarks in real time. A React-based web application is used to manage user interaction, workout selection, and live visualization of exercise performance. The detected landmarks are connected to form a skeletal representation of the human body, which enables detailed posture and movement analysis. Joint angles are calculated from the skeletal model to evaluate exercise correctness and body alignment. Each performed exercise is compared with predefined reference poses to assess posture accuracy. The system computes an accuracy score based on deviations between the user's posture and the ideal pose. Real-time visual and textual feedback is provided to help users correct improper movements during workouts. The system continuously monitors workout duration and movement intensity throughout the session. Calorie expenditure is estimated using a metabolic equivalent–based model combined with motion analysis. Posture accuracy and movement quality are used to refine the calorie estimation for improved realism. User performance metrics are recorded at the end of each session. Historical workout data is stored to support long-term progress tracking and performance evaluation. Analytical visualizations are used to present trends in accuracy, duration, and calorie burn. All pose detection and analysis are performed on the client side within the web browser. This client-side approach ensures low latency and preserves user privacy by avoiding video data transmission. The system supports multiple workout types such as yoga, gym exercises, and dance-based fitness routines. The proposed solution is scalable and accessible across devices with a web camera. Overall, the system demonstrates an effective and intelligent approach to AI-driven home-based fitness training.***

Keywords: ***Artificial Intelligence (AI), Computer Vision, Pose Detection, Real-Time System, Smart Workout Trainer, Personalized Fitness Guidance, Fitness Level Analysis, User Profile Management, Webcam-Based Tracking, Visual Feedback, Voice Assistance***

I. INTRODUCTION

Physical fitness is an essential component of a healthy lifestyle, yet many individuals struggle to maintain proper exercise routines due to lack of time, access to professional trainers, or appropriate fitness facilities. With the rapid growth of digital health technologies, there has been an increasing shift toward home-based and online fitness solutions. However, most existing fitness applications rely on pre-recorded videos or manual self- assessment, which do not provide real-time posture correction or personalized guidance. As a result, users may perform exercises incorrectly, reducing effectiveness and increasing the risk of injury.Recent advances in artificial intelligence and computer vision have enabled machines to understand and analyze human movement with high accuracy. Human pose estimation techniques allow the detection of body key points and joint movements using standard cameras, making it possible to evaluate physical activities without specialized sensors. These advancements have opened new opportunities for intelligent fitness systems that can monitor exercise performance, provide immediate feedback, and adapt to individual users. Browser-based frameworks such as MediaPipe have further simplified the deployment of such systems by enabling real-time pose estimation directly within web applications.In this context, this project introduces an AI-based real-time fitness assistance system that combines computer vision with modern web technologies to deliver personalized workout guidance. The system utilizes MediaPipe Pose for real-time human pose detection and React for building an interactive web interface. By analyzing body posture and joint movements, the system evaluates exercise accuracy, provides corrective feedback, and estimates calorie expenditure during workouts. All computations are performed on the client side, ensuring low latency and preserving user privacy. The proposed system aims to enhance the safety, effectiveness, and accessibility of home-based fitness training while demonstrating the practical application of AI-driven pose estimation in real- world fitness scenarios.

©IJRASET: All Rights are Reserved

A. Problem Statement

Despite the growing popularity of digital fitness applications, most existing solutions fail to provide accurate real-time posture monitoring and personalized feedback during exercise sessions. Many platforms rely on pre-recorded instructional videos or wearable devices, which either lack interactivity or increase cost and accessibility barriers for users. As a result, individuals often perform exercises with incorrect posture and movement patterns, leading to reduced workout effectiveness and a higher risk of injuries. Additionally, conventional calorie estimation methods are usually based only on workout duration and generic activity levels, ignoring actual movement quality and exercise correctness. There is a need for an intelligent, low-cost, and accessible fitness system that can analyze human posture in real time, provide immediate corrective feedback, and accurately estimate calorie expenditure using only a standard camera. The absence of such a system limits the ability of users to safely and effectively engage in home-based fitness training without professional supervision.

B. Existing system

Most existing fitness applications and platforms provide workout guidance through pre-recorded videos, static exercise routines, and generic fitness plans. These systems require users to follow instructions without real-time monitoring or feedback. While some applications offer basic activity tracking or calorie estimation using wearable sensors, they lack accurate posture detection, personalized difficulty adaptation, and intelligent interaction. Additionally, diet recommendations and injury-related guidance are often handled separately or not included at all, resulting in a fragmented fitness experience. Existing systems such as Nike Training Club, Fitbit, Google Fit, and MyFitnessPal provide workout guidance and activity tracking but lack real-time AI-based posture correction and integrated medical assistance

C. Challenges in Existing Systems

1) No real-time posture detection and correction during workouts
2) Limited personalization based on user fitness level, goals, and physical condition
3) Higher risk of injuries due to improper exercise formInaccurate or indirect calorie burn estimation
4) Lack of integrated diet planning and progress tracking
5) No instant medical or injury-related assistance during workouts
6) Minimal user engagement due to non-interactive training methods

D. Proposed System

The proposed system is an AI-powered real-time fitness training assistance platform that provides personalized, interactive, and adaptive workout guidance to users. The system begins with secure user authentication and profile creation, where user details such as age, height, weight, fitness goals, medical history, and activity preferences are collected. Based on this information, customized workout schedules and diet plans are generated to meet individual fitness objectives. Users can choose their preferred workout domain—yoga, gym, or zumba—and select the desired difficulty level, enabling dynamic adjustment of exercise routines. This personalized approach enhances user motivation, consistency, and overall workout effectiveness.

The system leverages computer vision, deep learning, and machine learning algorithms to monitor user movements and posture in real time through camera input. When incorrect posture or improper movement is detected, the system instantly provides visual cues and voice-based corrective feedback, helping users maintain proper form and avoid injuries. Along with posture correction, the system performs real-time calorie burn estimation, tracks daily workout progress, and maintains performance records for long-term analysis. Additionally, a voice- enabled medical assistance module allows users to report pain or discomfort during workouts and receive immediate preliminary guidance, ensuring user safety and a comprehensive fitness training experience.

II. POSE ESTIMATION METHODOLOGY

The proposed system follows a modular and sequential methodology to deliver real-time fitness assistance. Initially, the user registers and logs into the system, where personal details such as age, height, weight, fitness goals, and health conditions are collected through a user profile module. Based on this data, the system generates personalized workout schedules and diet plans. The user selects the workout domain (yoga, gym, or zumba) and difficulty level, after which the system initiates the training session. During the workout, the camera captures live video input of the user, which is processed using computer vision techniques for human pose estimation. Key body landmarks are extracted and compared with predefined reference postures stored in the database.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

Machine learning models analyze posture accuracy in real time, and if deviations are detected, immediate visual and voice- based feedback is provided. Simultaneously, calorie expenditure is estimated using activity intensity, posture movement, and user-specific parameters. The system continuously tracks workout progress and stores performance data. In case of discomfort or injury, the user can report pain through voice input, and a medical assistance module responds with preliminary guidance, completing a safe and intelligent fitness training workflow.

MediaPipe Pose operates using a two-stage deep learning pipeline optimized for real-time performance. In the first stage, a person detection model identifies the presence of a human body within the video frame and generates a bounding box around the detected individual. In the second stage, a pose landmark model predicts thirty-three anatomical landmarks across the body, including key points on the head, torso, arms, and legs. Each landmark is represented by normalized x and y coordinates, a relative z-axis depth value, and a visibility score that indicates the confidence of detection. These landmarks are connected to form a kinematic skeleton, which enables the system to analyze human movement, joint alignment, and posture consistency across consecutive frames. The skeletal visualization is rendered on the live video feed, allowing users to observe their posture in real time.

III. IMPLEMENTATION

A. Frontend Implementation

The frontend of the system is developed using modern web technologies such as HTML, CSS, JavaScript, and React to ensure a responsive and user-friendly interface across different devices. The main workout interface displays the live camera feed of the user, enabling real- time interaction during exercise sessions. A skeletal pose overlay is rendered on top of the video feed to visually represent detected body joint positions. The interface also includes exercise titles, difficulty levels, and step-by-step instructions to guide users through each workout. Countdown timers and progress indicators help users maintain correct posture for the required duration. Navigation controls allow users to start, pause, resume, or move between exercises smoothly. The frontend dynamically updates based on user actions and workout progress. Overall, the frontend design enhances usability, engagement, and real-time feedback during training sessions.

B. Dataset Description

The proposed system uses a combination of publicly available human pose datasets and custom reference pose definitions for training and validation. Public datasets such as yoga and fitness pose datasets containing annotated skeletal keypoints were used to understand standard joint configurations for different exercises. These datasets include landmark annotations for major joints such as shoulders, elbows, hips, knees, and ankles.

In addition, reference poses for selected yoga, gym, and Zumba exercises were manually defined using MediaPipe Pose landmarks to represent ideal posture angles. The system does not require large-scale supervised training, as MediaPipe Pose provides a pre-trained pose estimation model. Validation was performed by testing multiple users performing exercises under different lighting and body orientations. The posture accuracy was evaluated by comparing real-time joint angles with predefined reference angles.

C. MediaPipe Pose Estimation: Working Principle

MediaPipe Pose operates using a two-stage deep learning pipeline optimized for real-time performance. In the first stage, a person detection model identifies the presence of a human body within the video frame and generates a bounding box around the detected individual. In the second stage, a pose landmark model predicts thirty-three anatomical landmarks across the body, including key points on the head, torso, arms, and legs. Each landmark is represented by normalized x and y coordinates, a relative z-axis depth value, and a visibility score that indicates the confidence of detection. These landmarks are connected to form a kinematic skeleton, which enables the system to analyze human movement, joint alignment, and posture consistency across consecutive frames. The skeletal visualization is rendered on the live video feed, allowing users to observe their posture in real time.

Stage 1: Person Detection

A BlazePose detector identifies the presence and bounding box of a human body in the video frame.

Stage 2: Pose Landmark Estimation

A pose landmark model predicts 33 anatomical landmarks, including:

- Head, shoulders, elbows, wrists
- Hips, knees, ankles
- Spine and torso reference points Each landmark contains:

- x, y coordinates (normalized to image size)
- z coordinate (depth estimation)
- visibility score (confidence level)

D. Skeleton Construction

The detected landmarks are connected to form a kinematic skeleton, allowing:

- Joint angle calculation
- Limb alignment verification
- Movement tracking across frames
- This skeleton is rendered visually on the video feed to give users real-time posture awareness.

E. Exercise Recognition and Posture Accuracy

To evaluate exercise correctness, the system computes joint angles using vector-based mathematical formulations derived from the detected landmarks. For each relevant joint, the angle between adjacent body segments is calculated using the cosine rule. These computed angles are then compared with predefined reference angles corresponding to ideal exercise postures. Each exercise is associated with a reference pose model that specifies expected joint alignments and allowable deviation thresholds. The posture accuracy is calculated as a percentage score based on the deviation between the user's joint angles and the ideal reference angles across all evaluated joints. This quantitative accuracy measure provides a clear and objective assessment of exercise correctness and is updated continuously during the workout session.

F. Joint Angle Computation

For each exercise, key joint angles are computed using vector mathematics:

$$\theta = \cos^{-1}\left(\frac{(A-B)\cdot(C-B)}{|A-B||C-B|}\right)$$

Where:

- B is the joint
- A and C are adjacent landmarks Examples:
- Knee angle → Squats / Forward bends
- Hip angle → Yoga poses
- Shoulder–elbow–wrist angle → Arm alignment

G. Pose Matching and Accuracy Score

Each exercise has a reference pose model defined by expected joint angles and tolerances.
Accuracy is computed as:

$$Accuracy = 100 - \left(\frac{\sum |\theta_{user} - \theta_{ideal}|}{N \times \theta_{max}}\right) \times 100$$

Where:

- N = number of evaluated joints
- θ_{ideal} = reference angle
- θ_{user} = user's real-time angle

This results in a percentage-based posture accuracy score, displayed live and stored for analytics.

H. Real-Time Feedback Mechanism

The system incorporates a real-time feedback loop that enhances user engagement and learning. Visual feedback is provided by dynamically adjusting the color of the skeletal overlay to indicate correct or incorrect posture alignment. Textual cues are displayed to guide users in correcting specific body parts, such as adjusting knee alignment or straightening the back. Time-based guidance is also included to ensure that users hold poses for the required duration, which is particularly important for yoga and rehabilitation-oriented exercises.

This feedback loop operates at interactive frame rates, enabling immediate response to posture changes and ensuring a smooth user experience

The system provides:

- Visual feedback: skeleton lines change color (green = correct, red = incorrect)
- Textual cues: posture correction instructions

Timer-based guidance: ensures proper pose holding duration

This feedback loop operates at **30+ FPS**, ensuring smooth and responsive interaction.

I. Calorie Burn Estimation Methodology

Calorie expenditure is estimated using a hybrid approach that combines metabolic equivalent of task values with motion intensity derived from pose data. Each workout type is assigned a standard MET value based on established fitness research. The baseline calorie burn is calculated using the user's body weight, workout duration, and the assigned MET value. To improve accuracy, this estimate is further adjusted using motion-based factors derived from landmark displacement, joint velocity, and posture accuracy. By incorporating real-time movement quality into the calculation, the system ensures that correct and active movements result in higher calorie estimates, while poor posture or low activity intensity reduces the final calorie count. This approach provides a more realistic and personalized calorie estimation compared to static time-based methods.

J. MET (Metabolic Equivalent of Task)

Each exercise is assigned a MET value:

Activity	MET Value
Yoga (Beginner)	2.5
Yoga (Intermediate)	3.0
Gym Workout	5.0–6.0
Zumba	6.5–8.0

K. Calorie Formula

$$Calories = MET \times Weight(kg) \times Time(hours)$$

L. Motion Adjustment Factor

To improve accuracy, a pose movement factor is applied:

- Joint displacement magnitude
- Frame-to-frame landmark velocity
- Posture correctness weight Final calorie output:

$$AdjustedCalories = Calories \times AccuracyFactor \times MotionFactor$$

This ensures:

- Poor posture → lower calorie credit
- Correct, active movement → higher calorie burn

M. Workout Execution Flow

During a workout session, the user first selects the desired workout type and difficulty level through the React interface. Upon granting camera access, the MediaPipe Pose engine is initialized and begins processing the live video stream. Pose landmarks are detected continuously, and posture accuracy, timing, and calorie estimation are updated in real time. The system provides ongoing feedback throughout the session and records key performance metrics. At the end of the workout, a summary report is generated that includes total workout duration, calories burned, and average posture accuracy.

N. Progress Tracking and Analytics

The system maintains a structured record of user workout data, enabling long-term progress tracking and performance analysis. Metrics such as workout frequency, average accuracy scores, and calorie trends are aggregated on a daily and weekly basis. These analytics are presented visually through charts and summaries, allowing users to monitor improvements over time and maintain motivation. The availability of historical data also enables personalized recommendations and adaptive workout planning in future sessions.

O. Performance and User Feedback

The implemented system provides real-time visual feedback to users during workout sessions through skeletal pose overlays and guided exercise instructions. Timers and progress indicators help users maintain correct posture for the required duration of each exercise. Thesystem continuously evaluates posture accuracy without interrupting the workout flow. Users can visually compare their movements with reference poses and make immediate corrections. This feedback mechanism improves exercise effectiveness and reduces the risk of improper posture.

The system is optimized for responsiveness and smooth performance, ensuring minimal delay during real-time analysis. Workout progress is tracked throughout the session to provide a structured training experience. The overall implementation focuses on usability, accuracy, and engagement. The modular design allows future enhancements such as calorie estimation, personalized workout recommendations, and performance analytics. This makes the system suitable for scalable and intelligent fitness training applications.

P. Technology Stack

The proposed system integrates artificial intelligence, computer vision, and web technologies to support real- time fitness monitoring and posture correction.

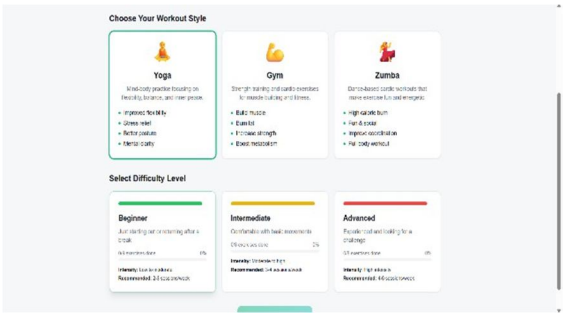
Programming Language: Python
Computer Vision: MediaPipe
Machine Learning: TensorFlow / PyTorch
Frontend: HTML, CSS, JavaScript,React

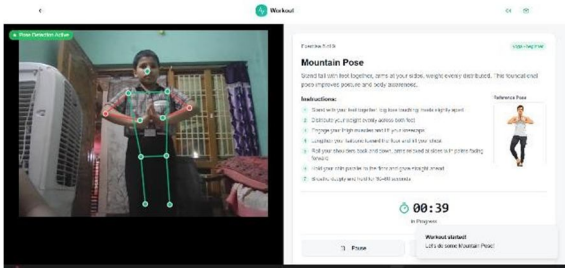
IV. RESULTS

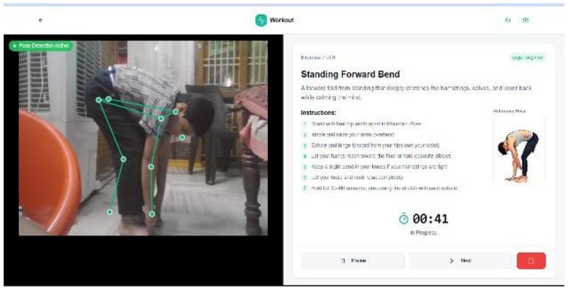
The proposed AI-powered real-time fitness trainer was successfully implemented as a web-based platform integrating multiple fitness and health management modules. The system provides users with the ability to select workout styles such as yoga, gym exercises, and Zumba along with different difficulty levels including beginner, intermediate, and advanced. The application effectively guides users through structured workout sessions by providing step-by-step instructions and reference poses. The real-time pose detection module accurately identifies human body key-points and overlays skeletal tracking on the live video feed, allowing the system to compare user posture with predefined exercise models. The experimental results demonstrate that the system can provide continuous posture correction feedback, ensuring that users perform exercises safely and correctly.

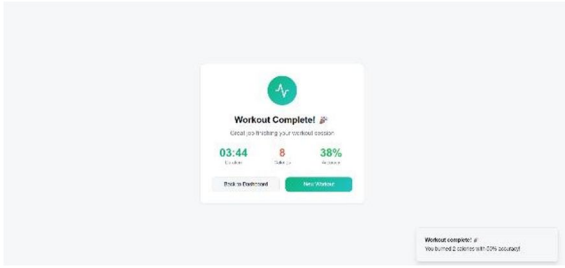
During the workout execution process, the system successfully monitored session duration, tracked exercise completion, and estimated calories burned based on user movements and activity type. After completing each workout session, the application generated a detailed performance summary displaying metrics such as duration, calories burned, and posture accuracy percentage. The system also demonstrated consistent performance under normal indoor conditions and maintained real-time responsiveness without noticeable latency. The progress tracking module further enhanced user experience by presenting weekly analytics, including workout count, posture accuracy trends, and calorie expenditure through graphical dashboards, helping users evaluate their fitness improvements over time.

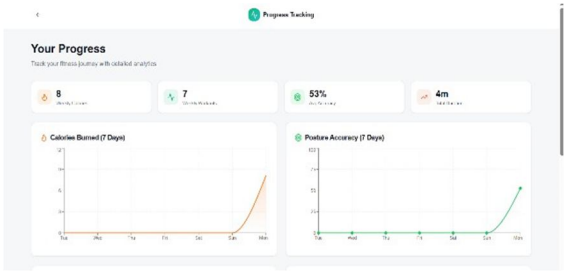
In addition to exercise monitoring, the system integrated personalized diet planning and a basic health assistance module to provide a comprehensive fitness solution. The diet planning module generated daily meal recommendations based on user goals and preferences while providing detailed calorie and macronutrient information. The medical assistant module offered general guidance for common fitness-related health concerns such as muscle strain and joint discomfort, supported by appropriate safety disclaimers. Overall, the results confirm that the proposed system successfully combines computer vision, machine learning, and web technologies to deliver an intelligent, adaptive, and user-friendly fitness training environment suitable for home-based health management.


Choose Your Workout Style
Yoga
Gym
Zumba
Select Difficulty Level
Beginner
Intermediate
Advanced


Workout
Mountain Pose
00:39
In Progress
Pause


Workout
Standing Forward Bend
00:41
In Progress
Pause
Next


Workout Complete! 🎉
03:44
8
38%


Progress Tracking
Your Progress
8
7
53%
4m
Calories Burned (7 Days)
Posture Accuracy (7 Days)

V. CONCLUSION

This research presented the design and development of an AI-powered real-time fitness trainer that integrates pose detection, adaptive workout strategies, personalized diet planning, health assistance, and performance tracking into a unified web-based platform. The system successfully utilizes computer vision and machine learning techniques to monitor user movements, analyze posture accuracy, and provide real-time corrective feedback. The implementation demonstrates that AI-based fitness training can significantly improve exercise effectiveness, reduce the risk of injury, and enhance user engagement through interactive guidance and performance analytics.

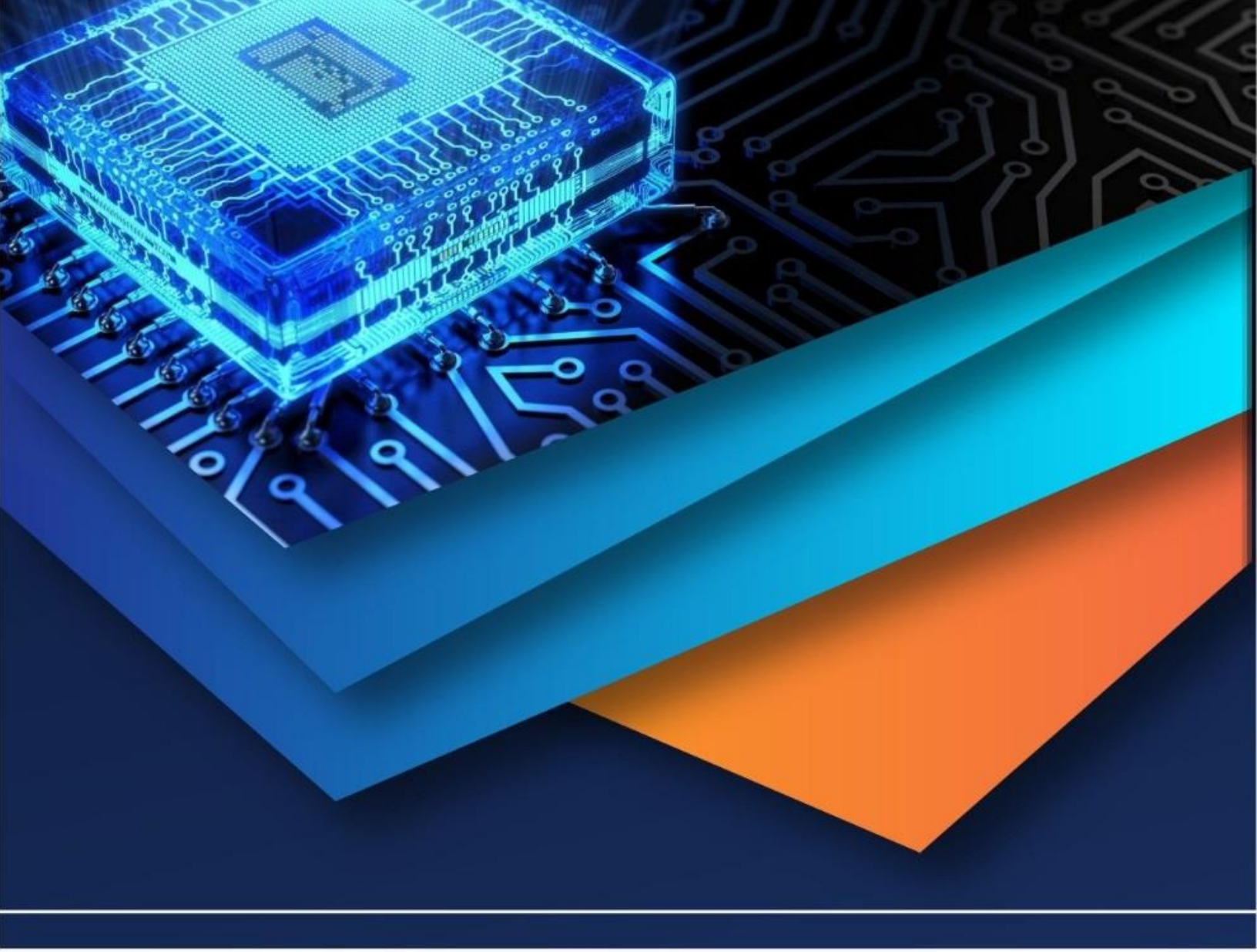
The experimental results confirm that the proposed system accurately detects body key-points, tracks workout sessions, estimates calorie expenditure, and generates personalized nutrition recommendations based on user preferences and fitness goals. The integration of progress tracking dashboards and health assistance features provides users with a comprehensive fitness monitoring experience. The web-based architecture ensures accessibility across multiple devices without requiring specialized hardware, making the system practical and cost-effective for everyday users.

Overall, the proposed solution demonstrates the potential of combining artificial intelligence, computer vision, and modern web technologies to create intelligent digital fitness platforms. The system offers a scalable and user- friendly approach to home-based fitness training and health management. Future enhancements can further improve system accuracy, expand exercise coverage, and incorporate wearable sensor integration to provide advanced fitness analytics and personalized healthcare support.

REFERENCES

[1] G. Abhinand et al., “AI Fitness Trainer Using Human Pose Estimation,” International Journal of Advanced Research in Computer Science, 2023.
[2] S. S. Pawar et al., “Accurate Gym Exercise Form Detection Using MediaPipe,” International Journal of Computer Vision and Robotics, 2024.
[3] V. Suryawanshi et al., “Gym Tracker System Using AI- Driven Pose Estimation,” Journal of Artificial Intelligence and Data Science, 2025.
[4] V. Bazarevsky et al., “BlazePose: On-Device Real- Time Body Pose Tracking,” in Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops, 2020, pp. 1–6.
[5] Y. Kwon and D. Kim, “Real-Time Workout Posture Correction Using MediaPipe,” IEEE Access, vol. 10, pp. 112345–112356, 2022.
[6] H. P. Chaudhari, “Virtual Fitness Trainer Using Artificial Intelligence,” International Journal of Computer Applications (IJCA), vol. 186, no. 12, pp. 45–50, 2024.
[7] C. Lugaresi et al., “MediaPipe: A Framework for Building Perception Pipelines,” Google Research, 2019.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)