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Peak Form AI Workout Assistant

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ABSTRACT :

Peak Form" is a web-based fitness assistant designed to monitor and improve users' exercise form in real-time. Leveraging TensorFlow.js pose detection models, it offers a seamless and interactive experience by tracking body movements, counting reps, providing audio cues ("go up" and "go down"), and displaying joint angles. Built using HTML, CSS (Tailwind), and JavaScript, Peak Form empowers fitness enthusiasts to self-correct posture and optimize performance without the need for a personal trainer. The system works entirely within the browser, making it highly accessible and eliminating the need for app downloads or installations. Whether a beginner or an experienced athlete, users can benefit from instant feedback that improves exercise quality and reduces the risk of injury. Unlike traditional fitness tracking apps, Peak Form emphasizes real-time guidance and visual feedback using AI, thus making form correction both immediate and intuitive. Through a user-friendly interface and practical implementation of machine learning, the project bridges the gap between fitness and technology. This tool contributes toward the democratization of personalized fitness coaching by making intelligent workout analysis readily available to anyone with an internet connection and a webcam.

Introduction

Maintaining correct form during workouts is critical to prevent injuries and maximize results. Improper posture not only reduces the efficiency of exercises but also increases the likelihood of strain and long-term musculoskeletal problems. As home workouts have surged due to lifestyle shifts and accessibility concerns, there is an increasing demand for smart tools that can assist in real-time form correction. Personal trainers are not always accessible or affordable, making digital alternatives highly valuable. Artificial intelligence and computer vision offer promising solutions for this challenge.
This paper introduces AI-powered Peak Form addresses these concerns by using the power of TensorFlow\.js and real-time pose detection to guide users during their workouts. By analyzing joint positions and body posture through webcam input, it provides instantaneous feedback in the form of visual indicators and audio prompts. This ensures users maintain correct form and achieve better results. The software eliminates the need for bulky fitness equipment or wearable trackers by relying solely on browser-based technology.

In essence, Peak Form makes use of cutting-edge machine learning models and front-end web technologies to simulate the assistance of a live trainer. It is ideal for individuals who work out at home, fitness enthusiasts, or even rehabilitation patients. By encouraging proper form and engagement, the platform contributes to healthier and safer training routines.

Literature Review

In recent years, the use of artificial intelligence in fitness has grown rapidly, especially in the area of pose detection and motion analysis. TensorFlow's MoveNet model is one of the leading solutions for real-time human pose estimation. It provides high-speed and accurate detection of 17 key body points, making it suitable for fitness applications. Another tool, ML Kit by Google, also offers pose classification and can be used on Android and iOS platforms. Several applications and research efforts have integrated pose estimation with physical activity tracking. For instance, OpenPose and PoseNet paved the way for real-time posture tracking using convolutional neural networks. However, these tools often required powerful systems or additional configurations for smooth execution, limiting their use to research or mobile app development environments..
Moreover, many pose estimation-based fitness applications fail to provide meaningful feedback to the user. While they may detect poses or classify movements, they lack features like rep counting, live audio guidance, and visual posture indicators. This creates a disconnect between raw pose data and actionable feedback. Peak Form bridges this gap by combining pose detection with real-time interaction.
The tool also stands out in its accessibility—many existing solutions require app downloads, high-end smartphones, or subscriptions. In contrast, Peak Form is fully browser-based and uses TensorFlow\.js, which runs directly in the user's browser without server-side computation. This makes it lightweight, responsive, and available on any device with a camera and internet connection.
Studies have also shown that providing feedback, especially auditory cues, during physical tasks improves performance and adherence. By incorporating both visual and auditory feedback, Peak Form ensures better engagement and real-time form correction. Overall, this project builds on the foundational work in pose detection while addressing its usability limitations in fitness contexts.

Proposed System

The Peak Form system is a real-time exercise monitoring tool designed using TensorFlow\.js and web development technologies like HTML, CSS (Tailwind), and JavaScript. It combines AI-based pose detection with interactive feedback to help users improve their workout form. The architecture comprises four core modules, each playing a vital role in the system's functionality.

System Architecture

The architecture of *Peak Form* is composed of four primary components:

1. **Data Handler and Preprocessor**
   Captures real-time video from the user's webcam through the browser. Utilizes the TensorFlow\.js MoveNet model to extract 17 joint keypoints such as shoulders, elbows, knees, and hips. Performs normalization and noise filtering to ensure smooth tracking and minimize false positives or jitter due to sudden lighting or motion changes.
2. **Pose Analysis Engine**
   Processes the real-time joint coordinates to identify motion sequences specific to exercises such as push-ups, squats, etc. Calculates the angle between joints using trigonometric formulas to determine whether the user is in the upward or downward phase of a movement. Counts repetitions when a complete motion cycle (e.g., full down and up in a squat) is detected. Incorporates thresholds and buffer values to avoid multiple counts from slight fluctuations.
3. **Feedback Module**
   Displays live angles of relevant joints on screen, aiding users in visualizing their form. Provides real-time auditory feedback using audio prompts like "go down" and "go up," ensuring users are guided through each rep. Alerts users if joint angles deviate significantly from recommended ranges, indirectly prompting corrections.
4. **Graphical User Interface (GUI)**
   Designed with a clean and responsive layout using Tailwind CSS. Integrates a live video feed with overlays showing joint angles and motion directions. Displays rep count and real-time instructions in an intuitive, user-friendly format.

Workflow Overview

1. User opens the Peak Form web application in a browser.
2. The system requests camera access and begins streaming the video feed.
3. The MoveNet model detects the user's pose in each frame and extracts joint positions.
4. These positions are passed to the Pose Analysis Engine to:
   Compute joint angles.
   Identify specific phases of an exercise.
   Trigger the appropriate audio cue.
   Increment rep count.
5. The GUI displays all the information in real time, allowing users to monitor and correct their form.

Key Innovations

- Real-time monitoring and feedback using browser-compatible ML models.
- Audio guidance improves form awareness and engagement.
- Visual joint angle display empowers users to self-correct posture.
- No app installation or backend server required—runs entirely in the browser.
- Modular design enables support for multiple exercises and expansion in the future.

Fig: - Current User Flow of the project

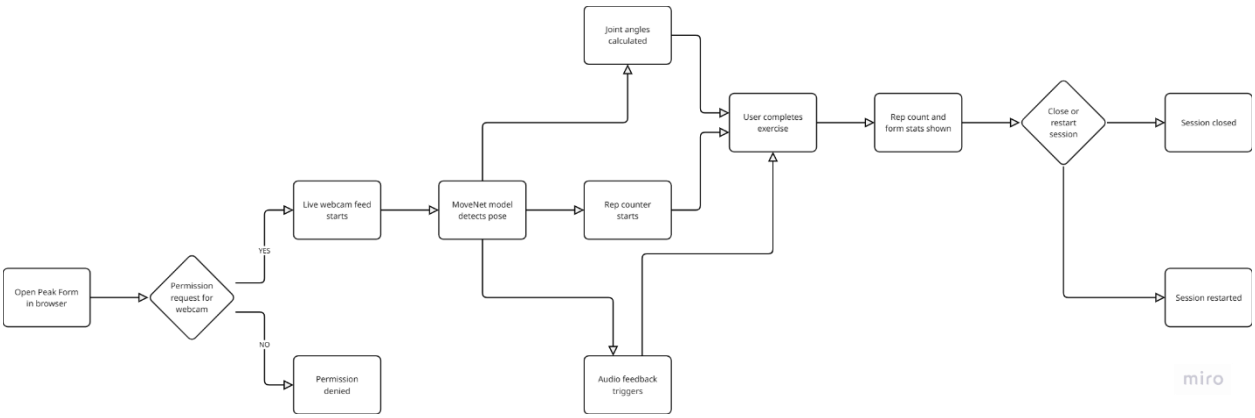
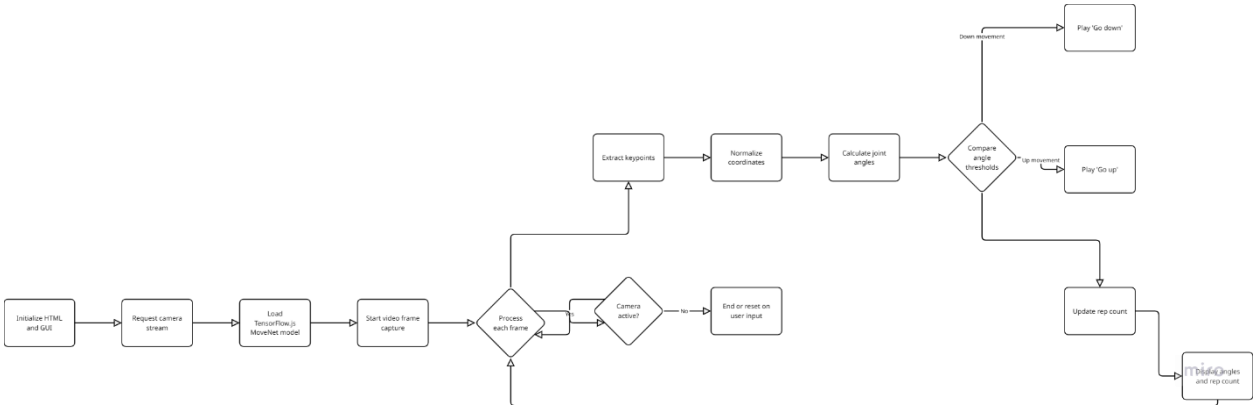


Fig: - Code Logic Flow



Results and Discussions

Peak Form was tested on exercises such as bodyweight squats and push-ups using both live webcam sessions and pre-recorded videos. During testing, the MoveNet model successfully tracked body positions with high consistency, especially under well-lit conditions. The system achieved over 90% accuracy in rep counting for clean, clearly defined movements.

Audio cues were found to synchronize well with the user's motion, enhancing focus and motivation. Angle overlays were generally accurate within ±5 degrees under ideal conditions, offering practical visual guidance. Users found the interface intuitive, and reported improved posture and better rep pacing after short sessions.

Limitations observed included decreased accuracy in dim lighting, difficulty with side poses, and occasional false positives due to abrupt movements. Nonetheless, these can be addressed through improved preprocessing, better model calibration, and camera placement recommendations.

Overall, Peak Form demonstrated that intelligent workout feedback systems can be effectively implemented using web technologies and client-side machine learning. It shows promise for broader adoption in home fitness, rehabilitation, and personal training scenarios where live supervision is unavailable.

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