FITKIT: An AI-Powered Fitness Coach with Real-Time Posture Correction and Personalized Dietary Advisory

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Abstract- *The FitKit application is an innovative and comprehensive digital fitness solution designed to streamline personal health tracking and ensure safe workout practices through artificial intelligence. Traditional fitness applications primarily focus on manual logging and generic video tutorials. FitKit revolutionizes this by integrating real-time computer vision to provide live posture analysis and automated exercise logging. Built using Python and the Streamlit framework, the system leverages Google's MediaPipe Pose detection and OpenCV to monitor user movements during exercises such as Planks, Wall Sits, and Squats. The application features a robust SQLite backend for secure user data management, progress tracking, and exercise history. Additionally, the system provides real-time voice feedback using Pyttsx3 to correct user form instantly, reducing the risk of injury. FitKit also incorporates a personalized dietary advisory module that tailors nutrition and workout intensity based on the user's BMI, fitness goals, and dietary preferences. This project aims to replace unstructured workout routines with an intelligent, automated coach that enhances user motivation, ensures proper form, and provides actionable health insights.*

Keywords: Artificial Intelligence, Computer Vision, MediaPipe, OpenCV, Posture Correction, Python, SQLite, Streamlit, Real-time Monitoring.

I. INTRODUCTION

In the current era of digital health transformation, the intersection of Artificial Intelligence and personal fitness has opened tremendous possibilities for creating intelligent, accessible, and injury-preventive workout systems. The FitKit application is an advanced, AI-driven solution specifically designed to automate and personalize home fitness routines without requiring any expensive gym equipment or professional supervision.

Traditional fitness tracking methods and generic workout applications rely heavily on manual data entry and static video demonstrations. These legacy systems lack real-time interactive guidance, leaving users entirely dependent on their own judgment to maintain correct exercise posture. This gap often results in users performing repetitive movements with improper form, leading to severe musculoskeletal injuries such as lumbar strain, knee misalignment, and shoulder impingement — conditions that are largely preventable with proper guidance.

FitKit directly addresses these challenges through three tightly integrated core functionalities. First, its **Real-Time Posture Analysis** module employs Google's MediaPipe Pose estimation framework to track 33 anatomical landmarks on the human body at high frame rates using only a standard webcam. Second, the

Automated Exercise Logging subsystem continuously monitors session activity, computing joint angles via trigonometric calculations (numpy.arctan2) and automatically recording performance metrics — including duration, accuracy scores, and estimated caloric expenditure — directly into a local SQLite database. Third, the **Personalized Health Advisory** engine dynamically generates customized workout intensity plans and nutritional recommendations based on the user's Body Mass Index (BMI), stated fitness goals such as Weight Loss or Muscle Gain, and dietary constraints such as Vegan or Gluten-Free requirements.

Users can perform supported exercises — including Planks, Wall Sits, and Squat Holds — in front of their webcam while the system provides instantaneous spoken corrections through an integrated Pyttsx3 text-to-speech engine whenever their form deviates from the biomechanically safe range. This hands-free feedback loop eliminates the need for users to stop and consult a screen, creating a seamless, immersive training experience.

The entire solution is implemented using Python with a Streamlit-based web interface, making it deployable on any

standard personal computer without requiring cloud connectivity or specialized hardware. By consolidating posture monitoring, exercise logging, and nutritional advisory into a single cohesive platform, FitKit fundamentally redefines what an at-home fitness assistant can achieve — democratizing access to professional-grade fitness coaching for users at every experience level.

a. Objectives

The primary objectives of the FitKit Application are:

1. Implement real-time pose estimation using MediaPipe to accurately track user movements during exercises.
2. Provide instant, automated audio and visual feedback regarding posture to prevent injuries.
3. Streamline fitness tracking by automatically calculating exercise duration, posture accuracy, and caloric burn, saved to a secure SQLite database.
4. Offer personalized, dynamic dietary and workout plans based on BMI, goals (e.g., Weight Loss, Muscle Gain), and dietary preferences (e.g., Vegan, Gluten-Free).

b. Advantages

Real-time Form Correction: Eliminates the need for a physical trainer by using a standard webcam with integrated text-to-speech corrections.

Automated Logging: Automatically logs workouts and tracks posture accuracy scores, reducing manual data entry.

Highly Personalized: Dynamically adjusts workout intensity and dietary recommendations based on user profiles and calculated BMI.

Cost-Effective: Requires no specialized IoT hardware; operates entirely on standard PCs using a webcam.

II. LITERATURE SURVEY

A comprehensive review of existing research in digital fitness and automated coaching systems reveals various implementations of computer vision in sports science. Recent advancements in human pose estimation have shifted from requiring expensive multi-camera motion capture setups to utilizing single-lens RGB cameras [13].

Frameworks like Google's MediaPipe have been extensively researched for high-fidelity, real-time tracking of 33 3D bodily landmarks [1][2]. Many fitness applications use these models to count repetitions but fail to integrate real-time, granular audio feedback to correct specific joint angles [6][7]. Existing solutions also often fragment the user experience, separating workout execution from dietary planning and progress tracking [9]. FitKit bridges this gap by unifying AI posture detection, automated performance logging, and specialized nutritional advisory into a single cohesive web application.

III. SYSTEM ANALYSIS

1. Existing System

Existing fitness management solutions employ manual input mechanisms where users log their sets, reps, and weights after completing an exercise. For form guidance, users rely on pre-recorded video tutorials. While these provide a basic tracking framework, they fall short in actively assisting users during exercise execution.

2. Limitations of Existing System

Manual logging creates motivational bottlenecks and relies entirely on user memory. Video tutorials cannot observe the user and therefore cannot correct dangerous posture mistakes like rounding the lower back during a squat or letting knees cave inward [12][13]. Users without access to personal trainers are at high risk of injury and suboptimal results.

3. Proposed System

FitKit is a fully automated, AI-enabled fitness platform. When a user selects an exercise (Plank, Wall Sit, Squat Hold) and starts the camera, the system utilizes OpenCV [3] to capture the video feed and MediaPipe [1] to extract human pose landmarks. Mathematical algorithms calculate joint angles to evaluate posture in real-time. If form deviates from the safe range, a Pyttsx3-powered audio engine

[11] issues spoken corrections. Upon completion, session duration and accuracy are saved to an SQLite database [5]. A dashboard provides the user's BMI [10], personalized workout plans, and tailored nutritional advice.

4. Advantages of Proposed System

Users benefit from an interactive experience that acts as a virtual personal trainer. The system mathematically prevents injuries through automated angle validation [6]. It requires minimal setup, operating through a Streamlit web browser interface [4]. Real-time logging and personalized AI diet generation ensure users have all the tools necessary to achieve their fitness goals in one accessible platform.

IV. SYSTEM REQUIREMENTS

1. **Hardware Requirements**
    1. Standard PC/Laptop — Multi-core Processor (Intel i3 / Ryzen 3 or above)
    2. Minimum 4 GB RAM
    3. Built-in or External Webcam (for live posture tracking)
    4. Speakers or Headphones (for voice feedback)
2. **Software Requirements**
    1. Operating System: Windows 10/11, macOS, or Linux
    2. Programming Language: Python 3.8+
    3. Frontend Framework: Streamlit (streamlit==1.54.0)
    4. Computer Vision: OpenCV, MediaPipe (mediapipe==0.10.9)
    5. Database: SQLite3 (local file-based)
    6. Audio Engine: Pyttsx3 (text-to-speech)
    7. Data Processing: NumPy [8], Pandas

V. SYSTEM DESIGN

1. System Architecture

The system architecture follows a monolithic design tailored for high-speed local processing. The **Frontend Layer**, built with Streamlit [4], manages user authentication, dashboard rendering, and user input. The **Computer Vision Layer** captures frames using OpenCV [3] and processes them through MediaPipe's deep learning models [2] to identify skeletal nodes. The **Backend Logic Layer** executes angle computations using numpy.arctan2 [8] and triggers the Pyttsx3 voice engine [11]. The **Database Layer** uses SQLite [5][15] to persistently store user credentials (hashed via SHA-256), exercise logs, and biometric progress.

2. Core Modules and Workflow

Authentication Module: Secure login and sign-up capturing detailed user metrics — height, weight, dietary preferences, and fitness goals.

Dashboard and Biometrics: Dynamically calculates and categorizes BMI (Underweight, Normal, Overweight) per WHO guidelines [10], and renders a personalized workout intensity plan.

Exercise Tracking Zone: Supports Realtime Camera, Image, or Video upload. Continuously evaluates posture — e.g., for a Wall Sit, it validates the knee angle is between 70° and 100° [6][12].

Dietary Advisory Module: Generates personalized nutrition guidelines [9][10], including plant-based protein recommendations for Vegan users and daily protein targets based on body weight.

VI. CONCLUSION

The FitKit application successfully demonstrates the powerful integration of Computer Vision and modern Python web frameworks to modernize personal fitness. By combining Streamlit's rapid UI capabilities [4] with MediaPipe's robust pose estimation [1][2] and an SQLite backend [5], the system automates both workout tracking and posture correction in real-time. The intelligent angle-calculation algorithms [6][7] ensure users maintain safe forms, while integrated voice feedback [11] provides an engaging, hands-free experience. Built entirely with open-source Python libraries [8], the solution is highly efficient, private, and accessible [15]. FitKit establishes a solid foundation for the future of smart, at-home fitness management.

Future Enhancements

1. Dynamic repetition counting for exercises like Push-ups and Bicep Curls using CNN-based action recognition [14].
2. Integration with wearable fitness trackers for real-time heart rate monitoring.
3. Migration to a mobile framework (React Native or Flutter) for iOS and Android deployment.
4. Cloud-database integration for cross-device synchronization and social sharing features.

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