# AuraFit: Your On-Device AI Fitness Coach

**Samsung PRISM Hackathon**

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## Abstract

***AuraFit transforms any smartphone into a privacy-first AI workout coach, providing real-time form correction, rep counting, and gamified feedback- entirely on-device, with no cloud data sharing.***

Despite abundant workout information, real-time, personalized feedback remains costly or privacy-invasive, leaving home exercisers at risk of injury or ineffective training. **AuraFit** addresses this by turning any smartphone into a privacy-first, on-device AI workout coach. Using real-time computer vision via MediaPipe and a hybrid AI feedback system, AuraFit delivers accurate rep counting, corrective guidance, and a gamified experience- without sending visual data to the cloud. This report outlines its architecture, key features, and technical implementation.

*The core innovation lies in our **Plug-and-Play AI Module**, an advanced architecture that intelligently deploys a hyper-efficient rules engine for instant feedback, while being designed to seamlessly integrate powerful on-device Large Language Models (LLMs) like Google's Gemma.* ***The result is an unparalleled, expert-level coaching experience that is intelligent, responsive, and fundamentally private.***

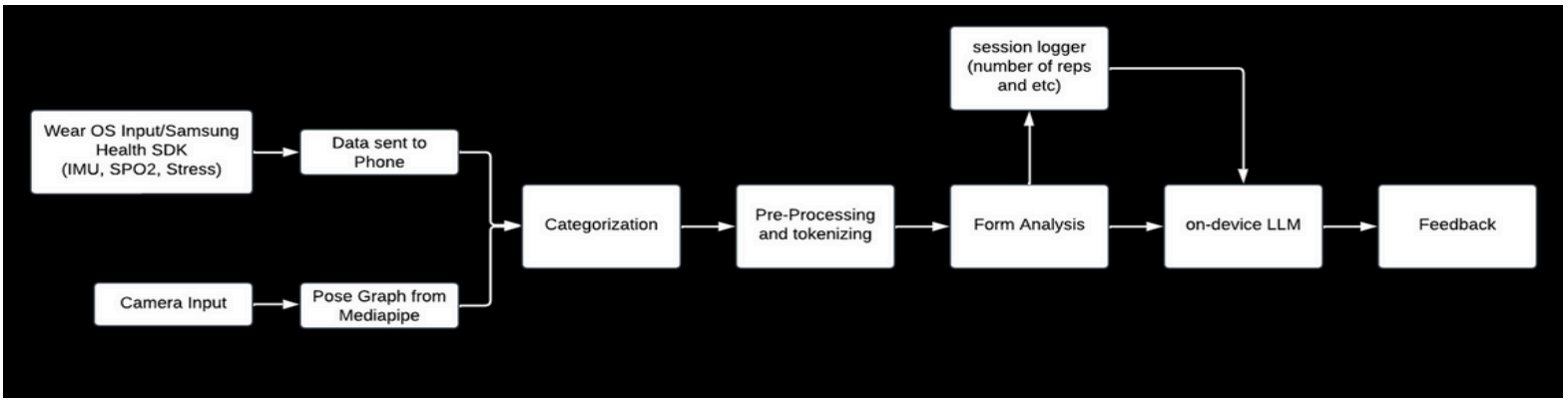
## 1. Core Technology Stack

Our architecture is built on a foundation of modern, high-performance, industry-standard technologies, ensuring a robust and scalable platform.

- **Platform:** Android (Kotlin-first)
- **Computer Vision Engine: Google MediaPipe Pose Landmarker** for real-time, 33-point body tracking.
- **On-Device AI Engine #1 (Reflex Model):** A custom-built, hyper-efficient rules engine for instantaneous rep counting and critical error detection.
- **Wearable Integration: Samsung Health Data SDK**, providing a live, low-latency data stream from connected Galaxy Watch sensors.
- **On-Device AI Engine #2 (Cognitive Model): Google Gemma 2B**, a powerful 1.3GB on-device Large Language Model for generating nuanced, human-like coaching feedback.
- **Data Persistence: Android Room Database** for secure, on-device storage of all user workout history.
- **UI & Architecture:** Android Architecture Components, including `Fragment` navigation, `RecyclerViews`, and a reactive UI built with View Binding.

**Architectural Diagram: The Data Fusion Pipeline**

Our system is designed to process two parallel, real-time data streams, feeding them into a central analysis engine that generates unified, actionable feedback.




## 2. The AuraFit LLM Architecture: A Novel Dual-Model AI System

The central innovation of AuraFit is our solution to the most significant challenge in mobile AI: running multiple resource-intensive processes (live camera feed + large AI model) on a memory-constrained device. A naive implementation leads to immediate native memory crashes (`SIGSEGV`). Our solution is a **Hybrid Inference Engine** that intelligently deploys two distinct on-device AI models.

**Model 1: The Reflex Engine (Rule-Based AI)**

- **Function:** This is our low-latency, "always-on" AI. On every single frame from the camera, it performs high-speed geometric calculations on the keypoint data from MediaPipe.
- **Purpose:** Its sole mission is to handle tasks that require instantaneous response:
    1. **Repetition Counting:** By tracking angles (e.g., elbow flexion, knee depth), it maintains a state machine (`up` vs. `down`) to accurately count completed reps.
    2. **Critical Error Detection:** It flags egregious form breaks that could lead to injury.
- **Why it's brilliant:** It provides the core functionality of the app with near-zero latency, ensuring the UI is always responsive.

**Model 2: The Cognitive Engine (Gemma 2B LLM)**

- **Function:** This is our deep-reasoning AI. It is a full, 1.3GB version of Google's Gemma 2B Large Language Model running locally on the device via the **MediaPipe GenAI API**.
- **Purpose:** To provide the varied, encouraging, and human-like feedback that separates a tool from a true coach.
- **The Crash-Proof Innovation:** We do not run this model constantly. Instead, the completion of a rep (detected by the Reflex Engine) acts as a trigger. In a seamless, sub-second process:

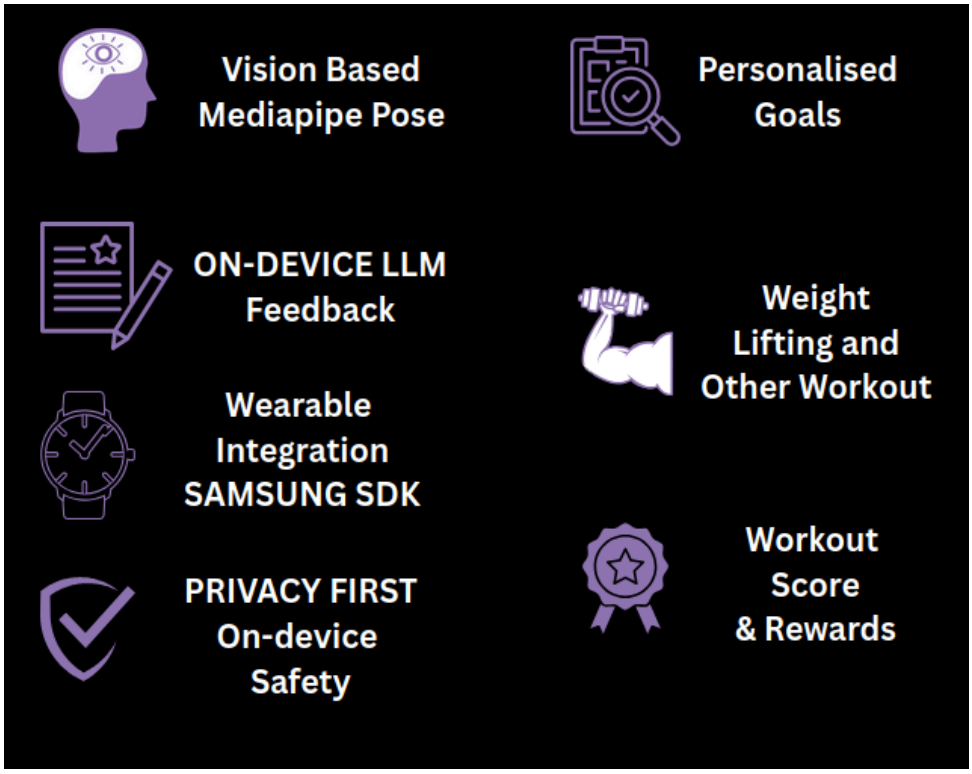
1. The `PoseLandmarkerHelper` is **instantly paused**, freeing up critical memory and GPU resources.

2. A detailed prompt, engineered with the final angles of the user's completed rep, is fed to the Gemma 2B model.
3. Gemma generates a unique, context-aware piece of feedback (e.g., "Great depth on that squat!" or "Try to keep your elbows tucked in.").
4. The feedback is spoken via TTS, and the `PoseLandmarkerHelper` is **instantly resumed**.

This strategic, event-driven activation of our dual AI models is the key to our app's stability and performance. It delivers the power of a large language model without compromising the real-time nature of the experience.

## 3. Features Implemented: A Synergistic System

AuraFit's features are not isolated; they work in synergy to create a holistic coaching experience.



and more.

**A. Multi-Modal AI Form Coach**

- **Technology: MediaPipe** fused with the **Samsung Health Data SDK**.
- **Implementation:** Our custom-built AI engine in `CameraFragment` analyzes the 33 body keypoints from MediaPipe to provide real-time form correction for **Push-ups** and **Squats**. Crucially, this analysis is now context-aware. The app simultaneously displays the user's **live heart rate** streamed directly from their Galaxy Watch via our

`HealthDataManager`. This allows the user (and future AI iterations) to correlate form breakdown with physical exertion

**B. Data-Driven Personalized Dashboard**

- **Technology: Samsung Health Data SDK** and **Android Room**.
- **Implementation:** The AuraFit dashboard is the user's mission control. Upon opening the app, our `HealthDataManager` connects to Samsung Health and populates the dashboard with the user's up-to-the-minute **daily steps** and **calories burned**. This is displayed alongside features powered by our internal database, like the dynamic Daily Challenge and the user's progress towards their weekly rep goal.

**C. Automated & Comprehensive Workout History**

- **Technology: Android Room Persistence Library**.
- **Implementation:** Every completed workout session is saved locally and securely. The `WorkoutSession` data entity stores the date, exercise type, and final rep count. This data is then used to power the Profile screen, which displays live-calculated, all-time statistics like "Total Reps" and "Total Workouts".

**D. Hands-Free Voice Coaching (TTS)**

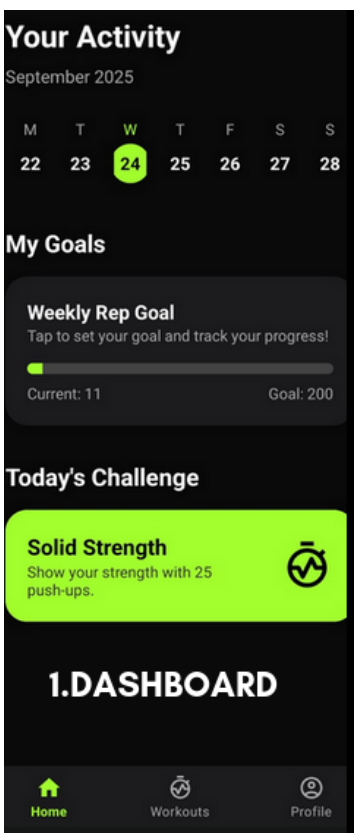
- **Technology:** Android's native `TextToSpeech` engine.
- **Implementation:** All feedback from the AI engine is spoken aloud, allowing the user to maintain focus and proper form without ever needing to look at their phone. This transforms the app from a visual guide into a true, interactive coach.

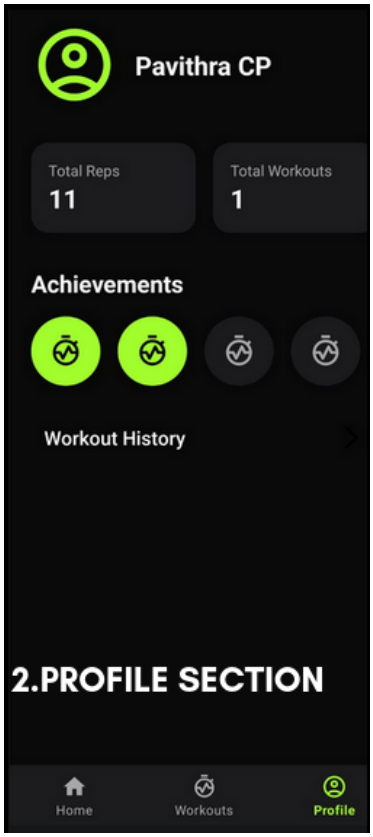
## 4. User Experience

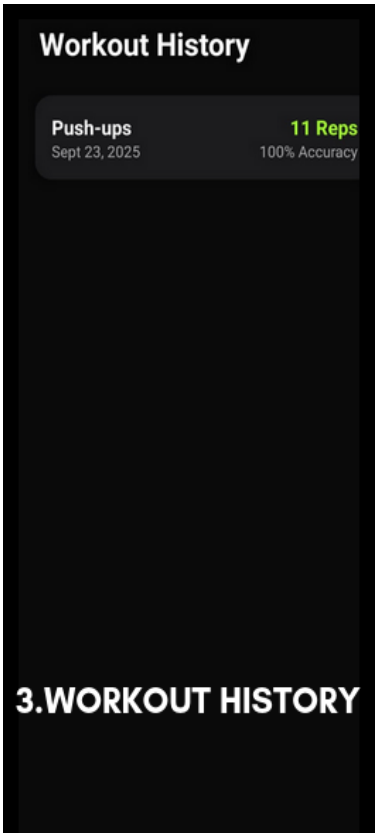
Our technical architecture enables a feature set that is unparalleled in the on-device fitness space.

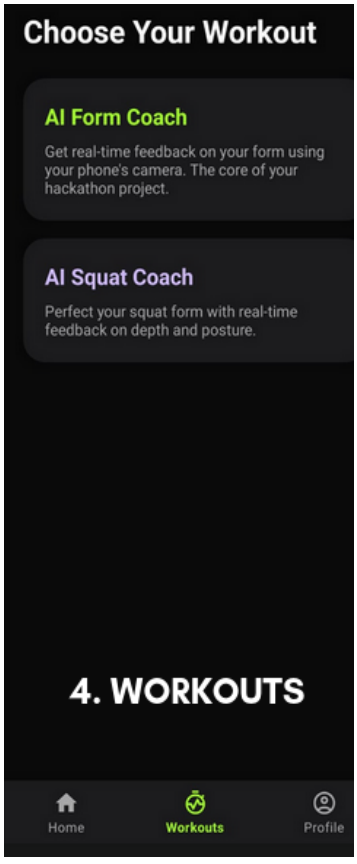
- **AI-Powered Multi-Exercise Coaching:** Full, real-time form analysis and rep counting for both **Push-ups** and **Squats**, with an easily extensible system for adding new exercises.
- **Truly Generative Feedback:** Users receive unique, non-repetitive coaching tips from the on-device LLM, creating a dynamic and engaging workout.
- **Data-Driven Dashboard & Profile:** The app features a stunning, personalized dashboard with dynamic daily challenges and a weekly progress bar. The profile screen displays live-calculated stats (Total Reps, Total Workouts) directly from the user's private, on-device database.
- **100% Privacy & Offline Functionality:** Because every component- from the pose estimation to the LLM- runs locally, the app requires **no internet connection** and guarantees that the user's camera feed and workout data never leave their device.

- **No Login Required:** The app automatically scans the phone and takes the user details from the contacts card.






-> ON-DEVICE LLM Feedback (Voice Using TTS), MediaPipe Pose Landmarkers,

-> Daily dashboard updates, automatic goal tracking, rewards, Comprehensive profile/

## 6. The Samsung Ecosystem Advantage

AuraFit is not just an app; it is a **Samsung-first innovation designed to unlock the full potential of the Galaxy ecosystem.**

- **Galaxy Watch Integration:** AuraFit leverages the Samsung Health Data SDK to stream live biometrics (e.g., heart rate, calories, steps). This creates a seamless flow of data between wearable sensors and smartphone-based computer vision.

- **Samsung Health Ecosystem:** Workout sessions, calories, and step data integrate directly with Samsung Health, ensuring users' broader health journey remains centralized and consistent.

- **Kotlin + One UI Principles:** The app's design follows Samsung's One UI philosophy- clean, distraction-free interfaces optimized for small screen focus and voice-first interactions.

- **Edge Computing Vision:** By running MediaPipe Pose Landmarker + Gemma 2B LLM fully on-device, AuraFit demonstrates how Samsung devices can lead the industry in AI-driven, privacy-first health applications.

- **Scalable Across Devices:** While optimized for Galaxy smartphones and watches, AuraFit's modular architecture allows future expansion into Samsung's broader ecosystem: Galaxy Buds (voice/haptic feedback), Smart TVs (big-screen coaching), and even Samsung XR devices for immersive fitness.

In essence, AuraFit is not just built on Samsung hardware- it showcases the Samsung ecosystem as the platform for the future of intelligent, multi-modal health coaching.

## 7. Target Stakeholders & Impact

AuraFit's value extends across multiple stakeholder groups, each gaining unique benefits from adoption and scale:

**1. End Users (Consumers)**

- **Problem:** Lack of affordable, real-time coaching at home.
- **Solution:** AuraFit delivers expert-level feedback, rep tracking, and motivation- no subscription, no privacy compromise.
- **Impact:** Safer, more effective workouts, higher fitness engagement, and improved long-term health outcomes.

**2. Samsung (Strategic Partner)**

- **Problem:** Differentiation in the crowded fitness app and wearable markets.
- **Solution:** AuraFit demonstrates the synergy of Galaxy smartphones + Galaxy Watch + Samsung Health in delivering experiences competitors cannot match.
- **Impact:** Strengthens Samsung Health ecosystem adoption, drives Galaxy Watch sales, and positions Samsung as a leader in on-device AI health coaching.

**3. Fitness & Wellness Industry**

- **Problem:** Expensive trainers and generic fitness apps limit accessibility.
- **Solution:** AuraFit provides a scalable, low-cost coaching platform that could partner with gyms, wellness programs, and digital fitness startups.
- **Impact:** Expands reach of fitness coaching to millions of users at home, enabling hybrid digital-physical wellness programs.

**4. Researchers & Developers**

- **Problem:** Few real-world examples of multi-modal AI fusion on mobile devices.
- **Solution:** AuraFit is a technical case study in hybrid inference, wearable integration, and privacy-first design.
- **Impact:** Inspires new research and Samsung developer adoption, creating a ripple effect across the ecosystem.

# Conclusion

AuraFit redefines at-home fitness by making **real-time, personalized, and private coaching** accessible to everyone. Unlike expensive trainers or cloud-reliant apps, AuraFit leverages **on-device AI** to deliver accurate form correction, rep tracking, and gamified feedback- all while keeping user data secure. With deep integration into the Samsung ecosystem, a clear stakeholder alignment, and a roadmap for growth, AuraFit stands as a **scalable, future-ready solution** at the intersection of fitness, AI, and digital health.

It is more than an app- it is a **next-generation fitness companion** that empowers individuals to train smarter, safer, and with lasting motivation.