

Pet Health Wearable - PetPulse



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Abstract:

PetPulse is an AI-powered IoT collar that continuously monitors six pet health metrics [heart rate, breathing rate, temperature, humidity, step count, and activity] streaming live data via BLE to a React Native mobile app. Historical readings are stored in Supabase and analyzed using AI/ML to detect behavioral patterns and flag early warning signs, giving pet owners a proactive window into their pet's health.

Problem Statment:

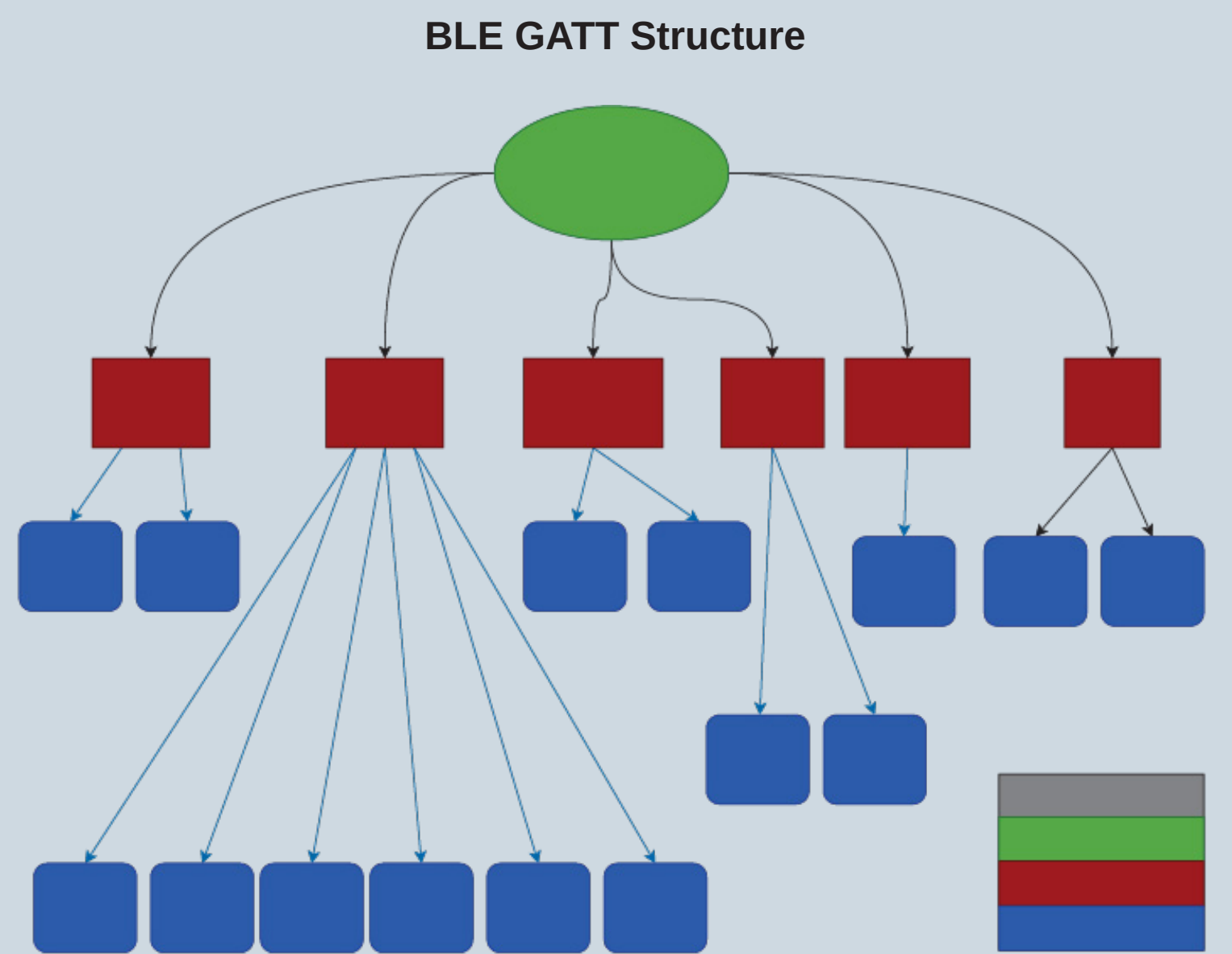
Pet ownership is rising, but continuous health monitoring for pets remains limited. Illness is often detected too late, making early monitoring a critical unmet need. Most existing wearables focus on GPS and basic activity, while health features are often unreliable in real-world use. Although research shows IMU and radar can monitor animal health effectively, these technologies haven't been combined into a practical wearable. PetPulse fills this gap by integrating advanced sensors with real-time mobile intelligence.

Objectives / Goals:

- Develop a multi-sensor embedded module integrating PCR Radar, nine-axis Inertial Measurement Unit (IMU), and a temperature sensor for monitoring vital signs and activity
- Develop software that can process and wirelessly transmit sensor data using a combination of synthetic and publicly available datasets
- Create a mobile application for real-time visualization and health-trend tracking
- Integrate machine learning algorithms and artificial intelligence to analyze long-term patterns and detect abnormal vitals or behavioral trends for early health warnings
- Design a lightweight, modular harness enclosure that keeps the embedded system safely attached

Methods:

- Designed an ESP32-S3-based multi-sensor wearable integrating BNO085 9-axis IMU, A121 PCR radar, and temperature sensor for real-time pet activity and vital-signs monitoring
- Developed firmware for sensor data processing, SD-card storage, and wireless transmission via custom BLE GATT services (diagram below)
- Built a React Native mobile application for live visualization, cloud syncing, and health-trend tracking
- Integrated rule-based AI analytics and Trends Engine to detect abnormal patterns and generate early health warning



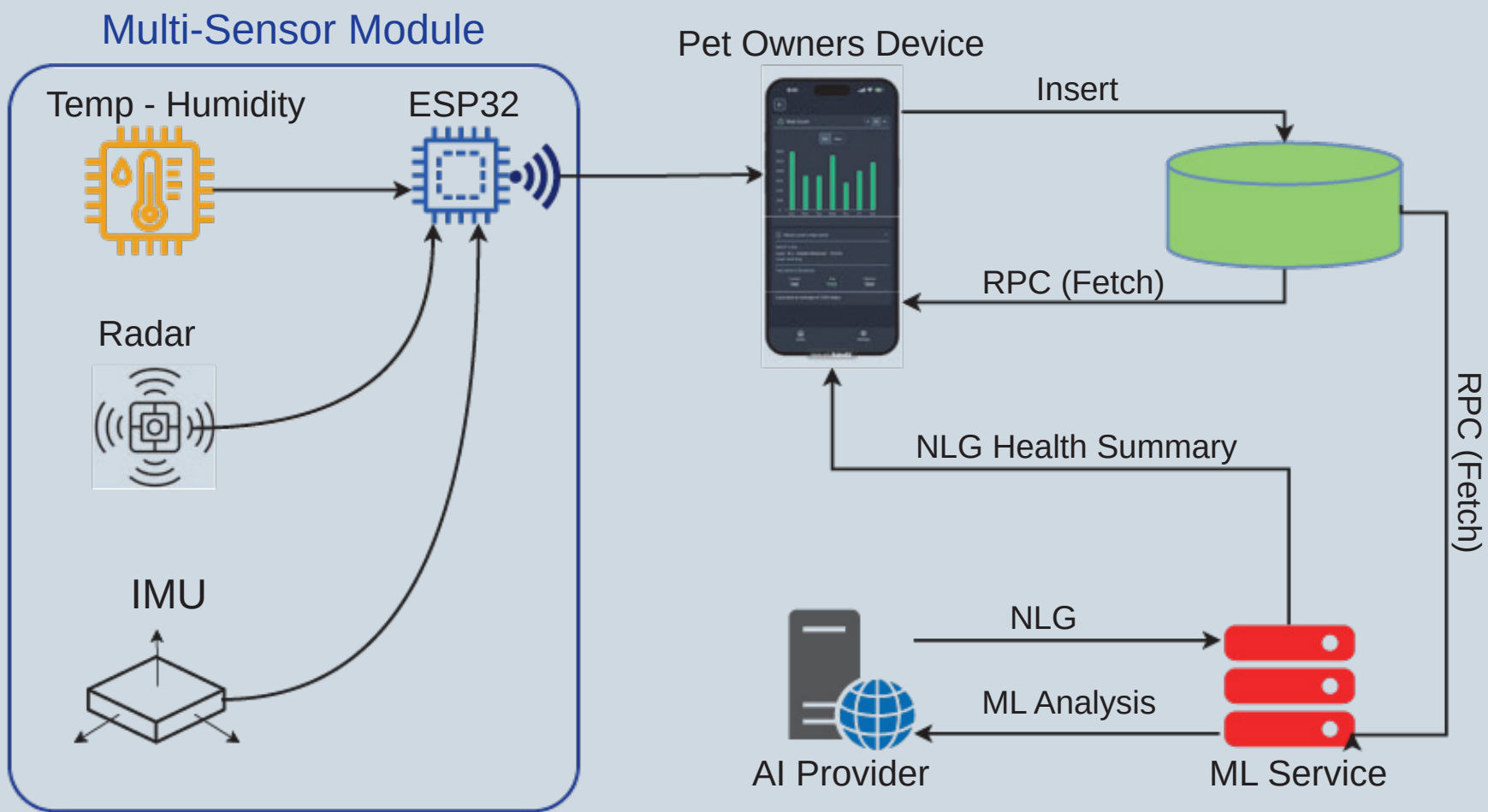
System Architecture:

Wearable Hardware Unit: ESP32 microcontroller for processing and streaming sensor data over Bluetooth Low Energy (BLE) from temperature/humidity sensor, inertial measurement unit (IMU) for activity tracking, and a pulse coherent radar for physiological signs

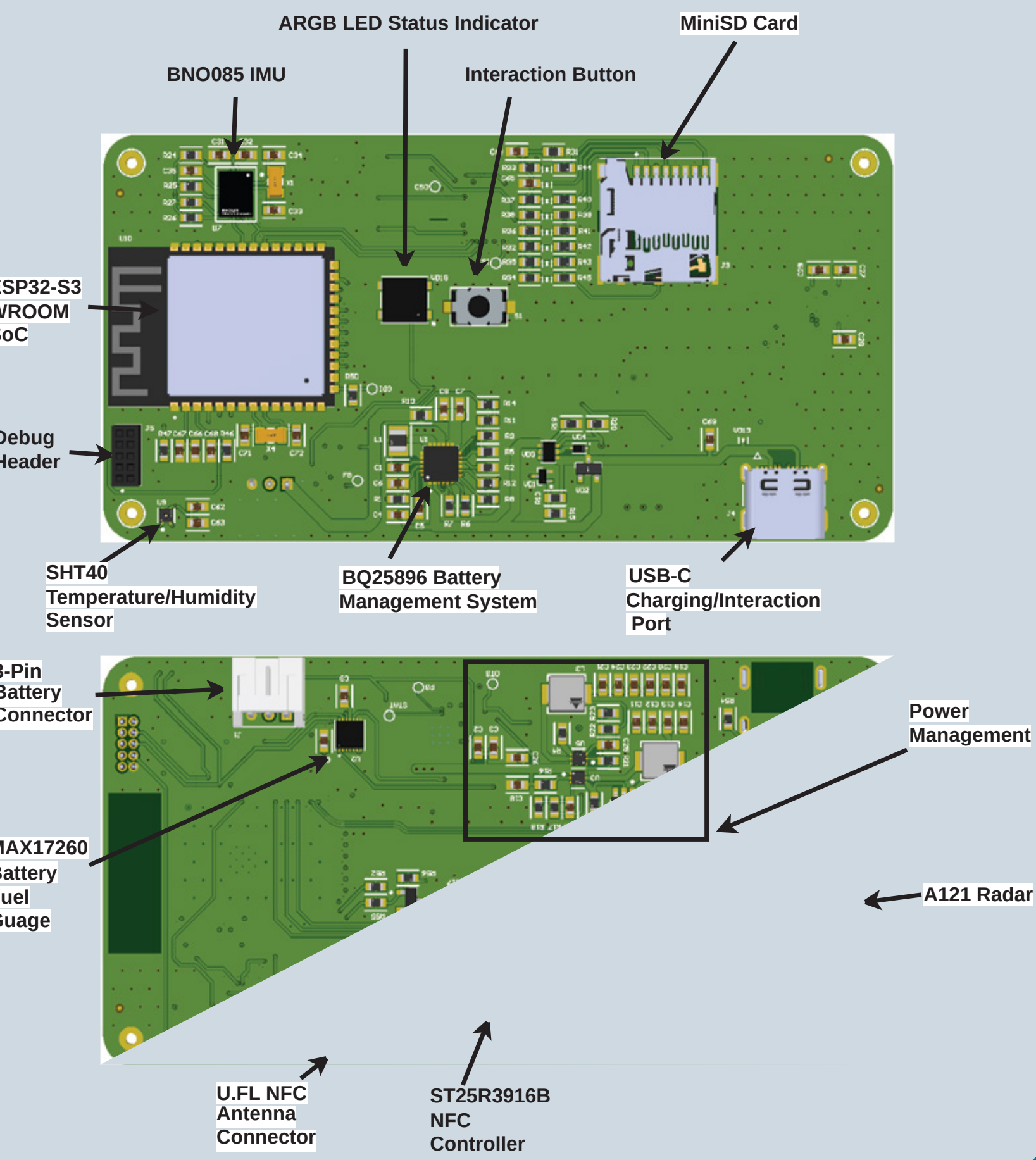
Mobile Application: React Native app tailored to iOS, running on the users smartphone for data collection, visualization, and analysis

Cloud Backend: Supabase backend to handle user authentication, data storage and data aggregation.

AI / ML Analysis: Python based ML service for anomaly detection and statistical analysis. Analyzed data is then passed to an AI provider for a natural language generated health summaries sent back to the mobile app



Hardware:



Software:

Mobile App: React Native (Expo Go) with TypeScript, cross-platform iOS & Android, styling with NativeWind(Tailwind CSS), charts with react-native-gifted-charts

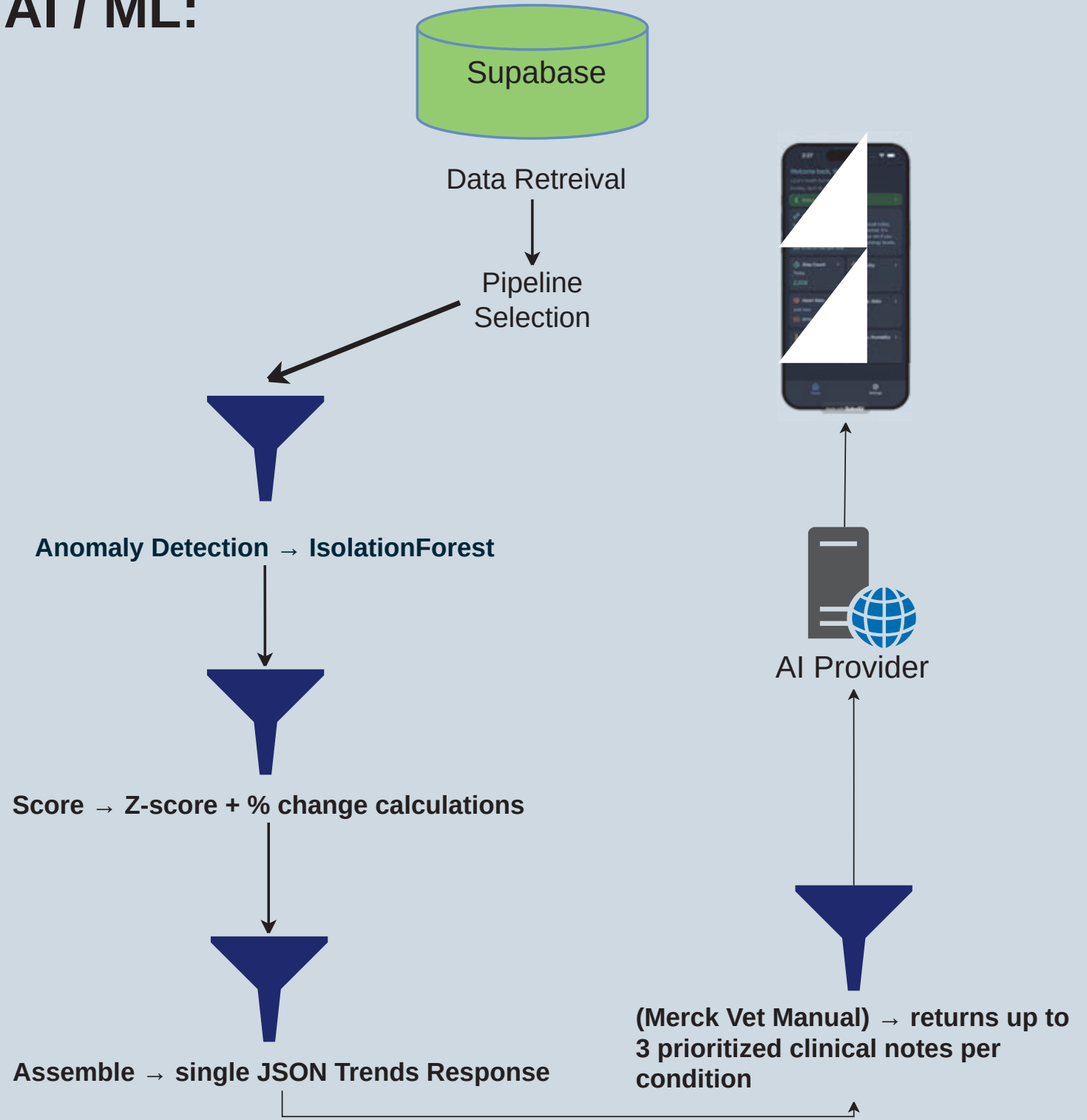
Connectivity: Bluetooth Low Energy (BLE) powered byreact-native-ble-managerbbfor live collar data streaming

Backend: Supabase (real-time database, authentication, and cloud storage)

AI/ML: Behavioral pattern detection and anomaly flagging on historical metrics



AI / ML:



Results:

Successfully delivered a functional PetPulse wearable prototype and mobile app delivering real-time activity tracking, AI health summaries, and cloud-based trends.



Conclusion:

PetPulse demonstrates that continuous, multi-metric pet health monitoring is achievable through the integration of embedded sensing, wireless connectivity, and AI-driven analytics. The system successfully streams real-time vital data from a wearable IoT collar to a mobile application, providing pet owners with meaningful health visibility without specialized equipment or vet visits.

Future Additions:

- Expand AI/ML training data with real-world animal subjects
- Refine radar-based vital sign detection under motion and varying fur conditions