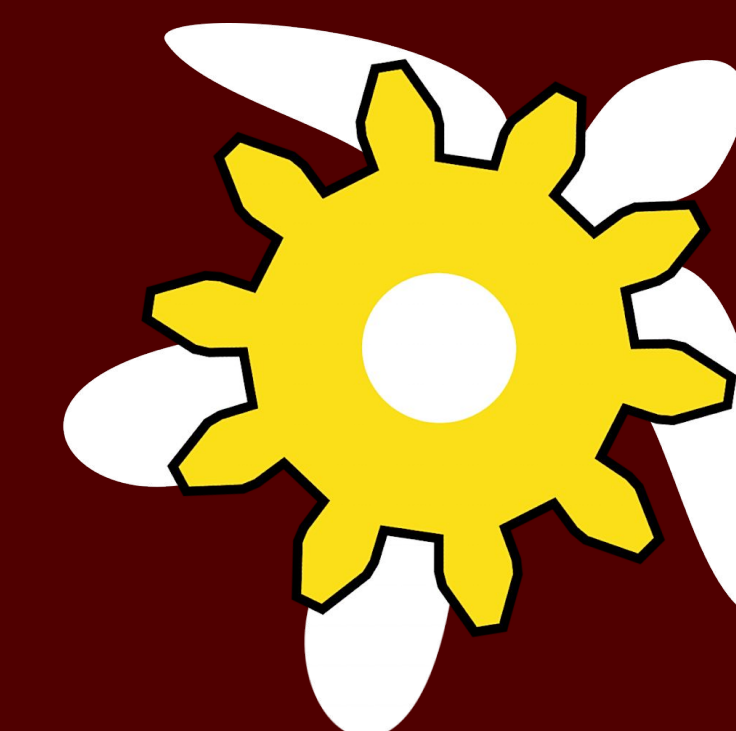**TEXAS A&M UNIVERSITY**
Engineering

Canine Vital Signs Wearable (VEST)

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ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Problem Definition

Many Dogs experience preventable health issues or death because owners do not always recognize early signs of illness or distress in their pets. Additionally pet owners lack effective tools to measure their dogs health.

Proposed Solution

Design a non-invasive wearable vest with automatic tightening that measures a canine's vital signs including heart rate, breathing rate, and temperature while allowing pet answer to monitor trends and statistics through a mobile app.
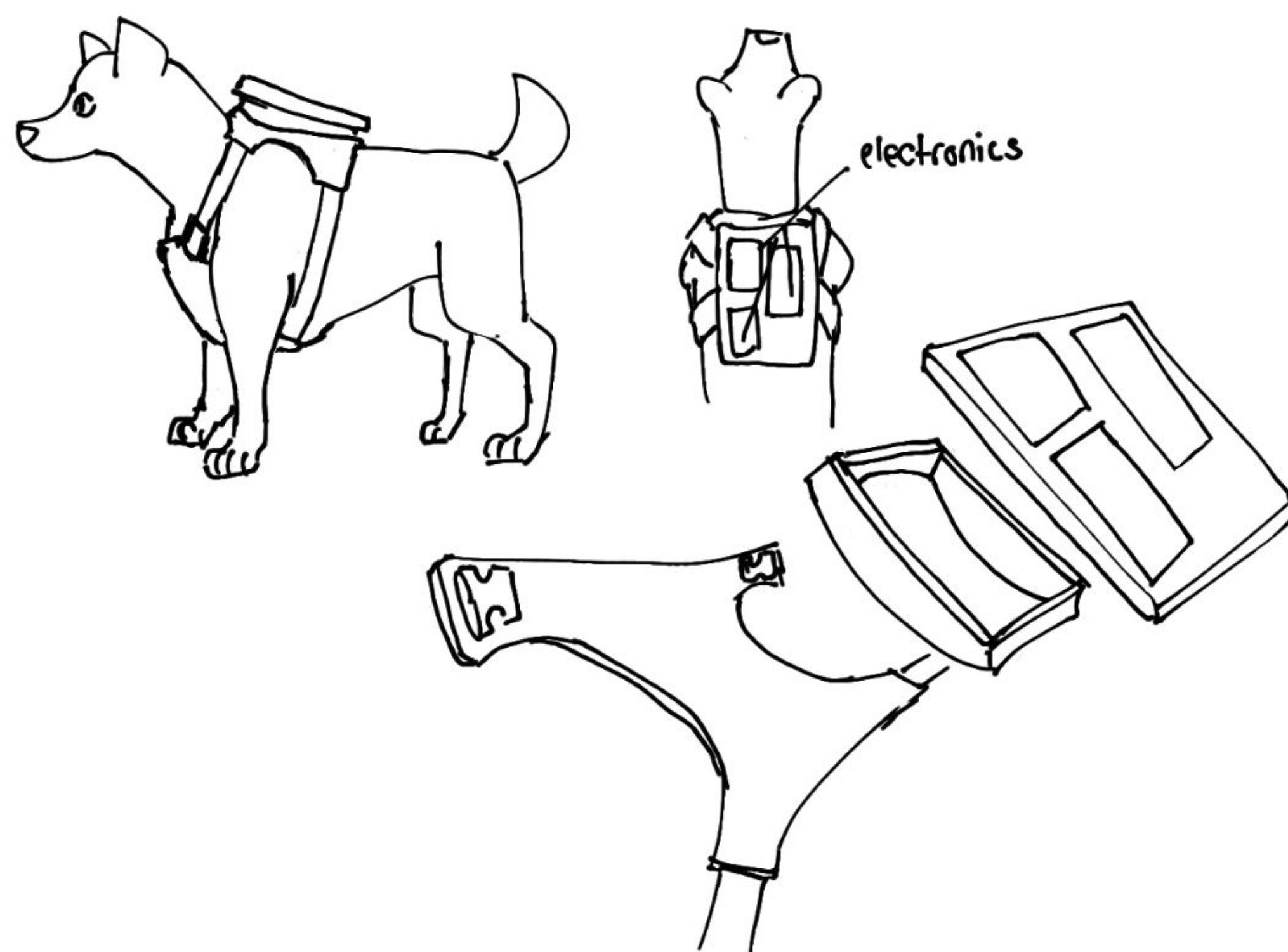

Figure 1 - VEST Prototype Sketch

Design Constraints

$500 Budget	Dog Fur	Environmental Factors

Table 1 - Main Constraints

Since this is an animal product, we need to consider factors that we would need to consider for a human, such as comfort, causing no harm, and creating a product that feels natural for a dog.
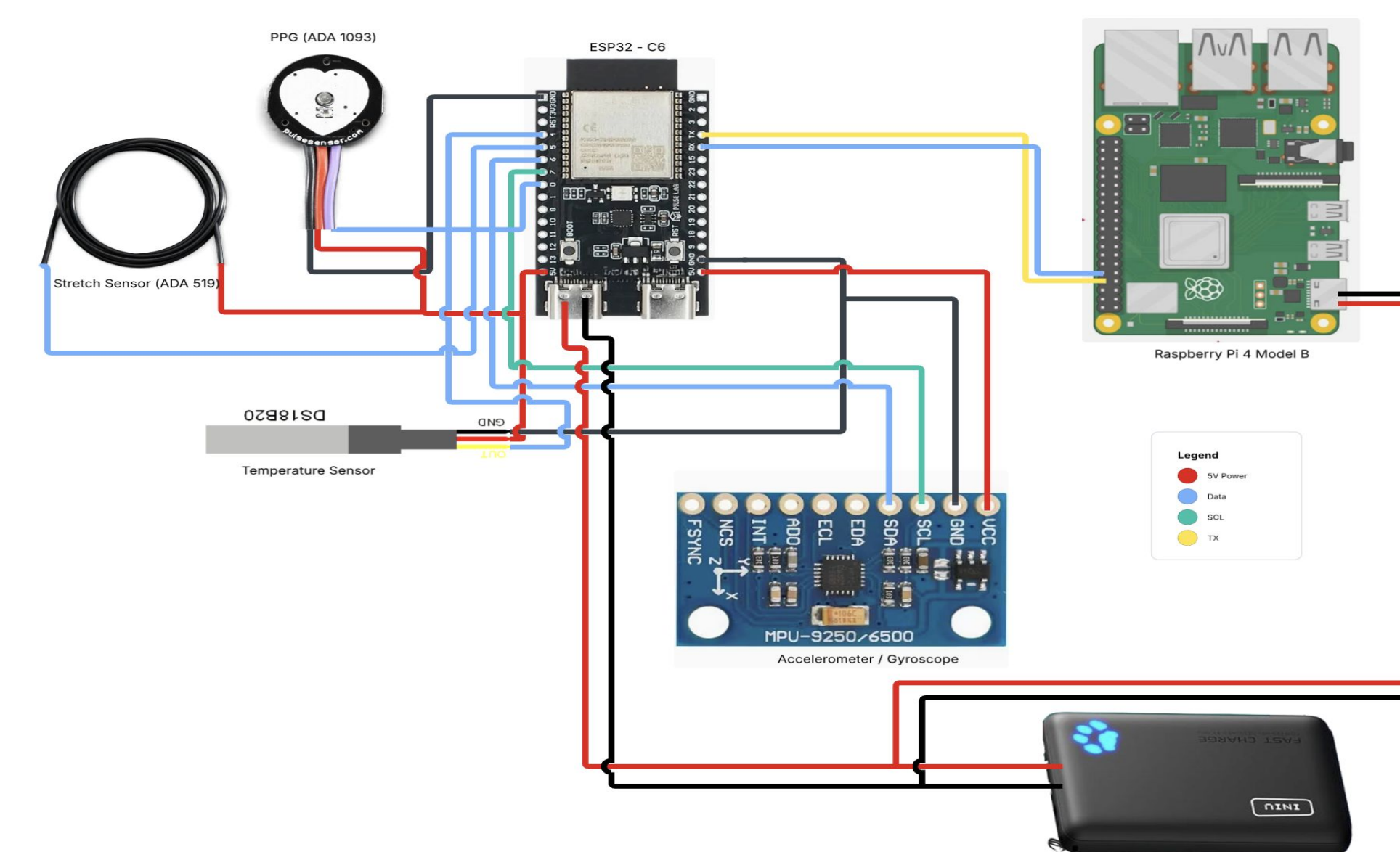
Circuit Layout

Figure 2 - Electrical Wiring of Components with the ESP32

Sensors

Biosensor	Location	Measurement
PPG	Chest	Beat per Minute
Accelerometer	Chest	Steps
Temp Sensor	Axilla	Temp (°F)
Stretch Sensor	Chest	Respiratory Rate (Breath / Minute)

Table 2- Sensor Usage

1. **PPG** - Uses light to measure the displacement of blood vessels to measure heart rate.
2. **Accelerometer** - measures signals from the induced displacement vibration of a tiny proof mass to measure acceleration in X, Y, Z
3. **Stretch Sensor** - A conductive rubber band, when stretched, increases the resistance. Increase in resistance means increase in sensor stress.

Sensors working together

We will take measures from the accelerometer, stretch sensor, temperature sensors, and PPG sensor to measure the activity of the dog. With this, we will send data over to backend for further processing, and the user will be able to monitor vitals in real time through the front end.

Auto Tightening

The webber and the buckles used to hold the dog vest will be repurposed with force sensor and motors to create an auto tightening feedback mechanism.

Software Selection

Table 3 - Frontend language options

Framework / Language	Primary Language	Supported Platforms
Kotlin (Android)	Kotlin	Android, limited multiplatform
Swift (iOS)	Swift	iOS, macOS
React Native	JavaScript / TypeScript	Android, iOS, Web (via extensions)
Flutter	Dart	Android, iOS, Web, Desktop, Embedded

We chose Flutter because of its ease of use and its versatility among supported platforms.
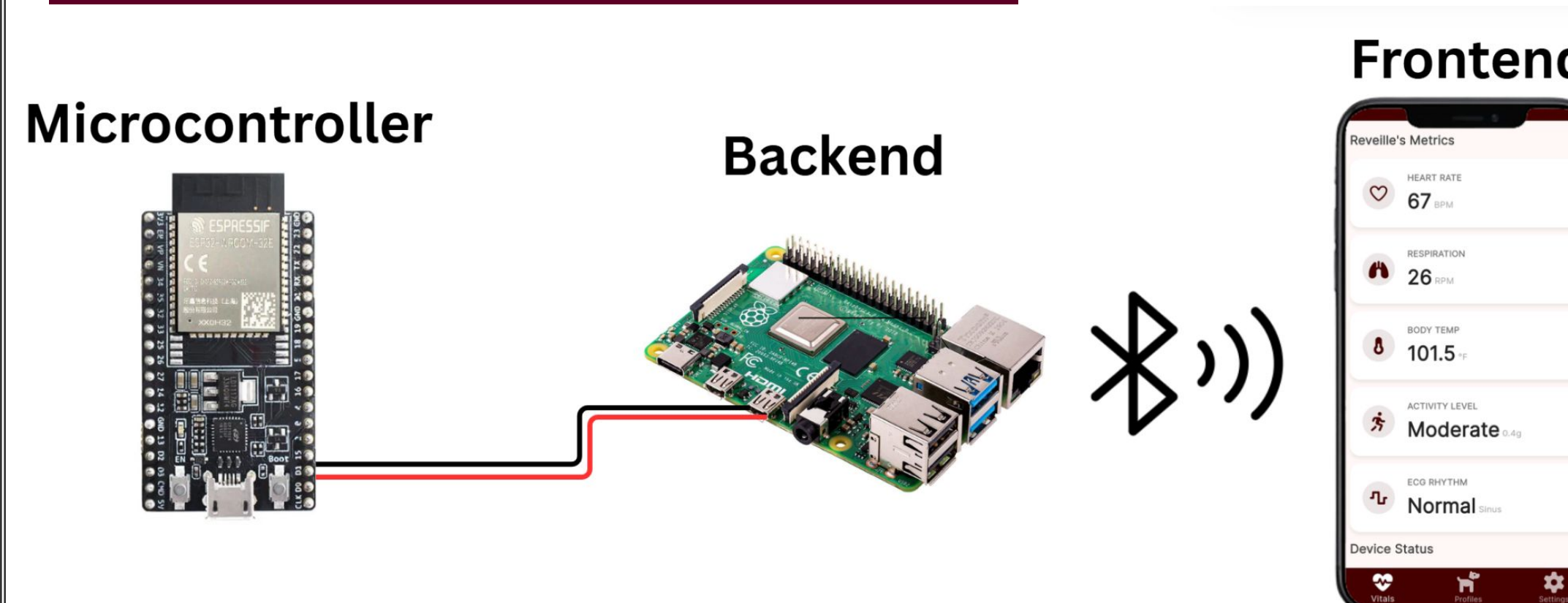
Software Architecture

Figure 3 - Software architecture

The microcontroller will send raw data to the Raspberry Pi which will clean the data. Machine learning algorithms based on that data will then be run to detect abnormal vitals. The device hosting the frontend will connect to the Pi cleaned data and/or alerts are sent via Bluetooth and displayed.
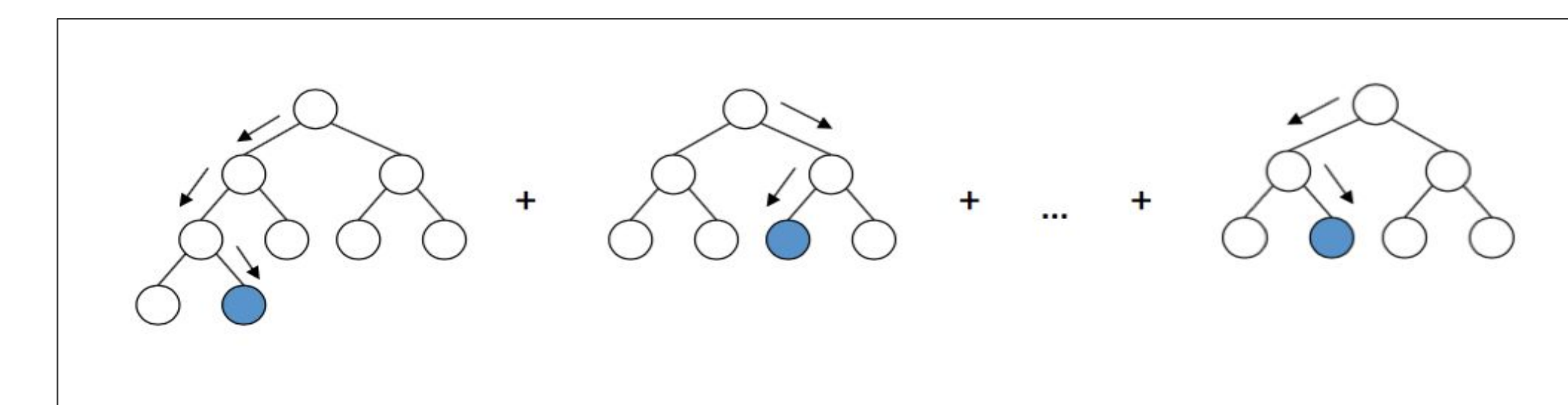
Gradient Boosted Trees

Figure 4 - Gradient Tree Examples

Gradient-boosted decision trees are used on heart rate, respiration, and temperature features with per-dog baselines to flag potential health issues.

Canine Categorization

Due to the changing status of the dog (such as activity, age, weight, fat density, skin color, breed, etc.), we will change our acceptable measurements.

- Different breed = different normal body temperatures and heart rates
- If the Dog is more active, fatter, or heavier = adapt the acceptable range of normal heart rate and temperature readings.
- We will accommodate for the changes in heart rate and temperature as the dog progresses in age

Future Plans

- App Refinement
- Vital Signs Collection
- Compact Vest Design
- Wireless data transfer
- Environmental Design Consideration
- Animal Testing
- Develop printed circuit boards
- Battery life Prediction
- Vest auto-tightening