Hive Monitor - Motion Sensing Concept Overview

1. Overview

This document outlines the motion sensing subsystem of the hive monitor project.

The onboard 9-DoF motion sensors (accelerometer, gyroscope, and magnetometer) will be used to detect hive disturbances, monitor orientation, and log subtle changes in movement.

These readings can provide valuable insights into behavioral patterns, environmental events, or unauthorized tampering.

2. Sensors and Hardware

- Sensor: LSM6DS33 (accelerometer + gyroscope)
- Sensor: LIS3MDL (magnetometer)
- Interface: I2C
- Sensor Type: 9-DoF motion tracking
- Device: Integrated into Adafruit Feather nRF52840 Sense

3. Use Cases

- Detect sudden motion or impact (e.g., hive knock or tampering)
- Monitor hive orientation over time (tilting or shifting due to weather or handling)
- Record subtle motion trends (activity levels)
- Correlate with acoustic and environmental data for behavioral analysis

4. Sampling Strategy

- Motion data will be captured every 10 minutes, synchronized with audio and environmental logs
- Only minimal averaging or RMS will be computed to conserve power
- Optional: Wake from sleep on motion/tilt interrupt for future versions

5. Output Format

Each motion capture session logs:

- Timestamp

- Acceleration vector (X, Y, Z)

- Gyro rates (optional)

- Orientation or tilt

- Motion status classification (e.g., Nominal, Movement Alert)

Example:

2025-04-10T21:45:00Z | X: 0.03g Y: -0.02g Z: 0.98g | Orientation: Stable | Motion Status: Nominal

6. Future Applications

- Behavioral analysis and anomaly detection

- Feature fusion with acoustic and environmental data

- Dataset for AI training or collaboration with researchers

- Swarm prediction using multivariate motion patterns