Hive Monitor - Power Management Concept Overview

1. Overview

This document outlines the power management subsystem of the hive monitor project.

It details how the system will use solar charging, battery management, and deep sleep cycles to operate for extended periods in remote, off-grid environments.

2. Power Sources and Configuration

- Battery: 2S LiFePO4 battery pack (nominal 6.4-7.2V)
- Charging: BQ24650 MPPT solar charge controller
- Solar Panel: 12V, 10W
- Regulator: DC-DC converter (e.g., 5V Pololu step-down) to power Feather
- Power routed to Feather VBAT or USB input, depending on regulator

3. Power Management Strategy

- All sensors and peripherals powered down or disabled when not in use
- nRF52840 enters deep sleep mode between readings
- Adjustable wake/sensor interval: 1 min, 5 min, 10 min, 30 min, or 1 hour
- Optional power gating via MOSFETs for SD card, amplifier, or HX711
- Battery voltage and solar current can be monitored (if desired) via ADC or INA219

4. Low Power Sleep/Wake Behavior

- Deep sleep current target: <10 uA between readings
- Wake from RTC, onboard timer, or external ESP32 RTC pulse
- Runtime duration per cycle: ~1-2 seconds total for all sampling and logging
- Configurable wake intervals allow fine-tuning power vs data frequency
- Optionally enter extended sleep if low battery detected

5. Optional Features and Alerts

- Low battery warning via log file or BLE packet

- Suspend logging during rain (if rain sensor added)

- Runtime voltage monitoring for diagnostics

- Add status LED blink (disable in field mode to conserve power)

6. Wiring and Safety

- All power lines fused (battery, solar, and logic)

- Use Schottky diodes or OR-ing logic to prevent backfeed from solar

- Mount MPPT and battery in weather-resistant compartment

- Ensure clean ground between modules to avoid noise and brownouts