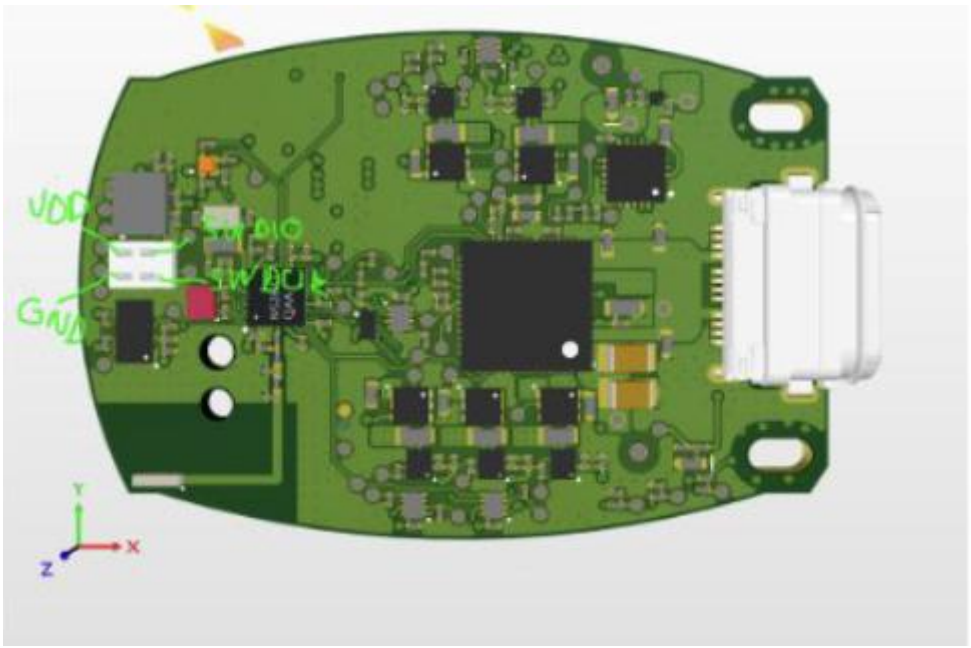
Oxeltech

Smart Heated Undergarments – Menstrual Relief Wearable

This wearable device was developed to provide targeted thermal relief to women during the menstrual cycle. Integrated into undergarments, the system delivers controlled heat at three levels (Low, Medium, High) to reduce cramps and discomfort. The design focuses on safe, efficient, and user-customizable heating using embedded electronics and softPWM-based control.



Key Features:

- Multi-level heating control (Low / Medium / High)
- SoftPWM-based smooth thermal transitions
- Battery-powered with USB-C PD (PowerBank support)
- Real-time temperature feedback and logging
- Seamless integration into garments for comfort and safety

Applications:

- Women's Health & Wellness Tech
- Smart Wearables for Pain Relief

Technologies Used:

- **MCU:** Nordic nRF52833 (BLE + ARM Cortex-M4F)
- **RTOS:** FreeRTOS-based firmware architecture
- **Power Management IC:** Texas Instruments TPS65987
- **ADC:** ADS1440 for temperature sensing
- **Heating Control:** Custom softPWM for multi-level thermal output
- **Power Source:** External Power Bank (USB-C)
- **Data Logging:** Onboard event and temperature logs for analysis

Firmware Development Overview:

- Real-time task management using FreeRTOS (heating control, BLE communication, logging)
- BLE service for user interaction (app-controlled temperature levels)
- SoftPWM implementation for efficient and safe heating control
- Temperature feedback loop using ADS1440 ADC
- USB-C PD negotiation and power handling via TPS65987
- Persistent logging of usage patterns and temperature history
- Safety features: overheat protection, timeout-based auto shutoff
- Low-power modes and optimized runtime for power bank usage
- Firmware modularization for easy scalability and future feature addition