MINIATURIZATION OF UW MEDICAL CENTER'S ASSET TRACKING DEVICE

STUDENTS: NITHYA SUBRAMANIAN, JONATHAN LEVINTE, XANDER GEURKINK, MIHIR SHARMA, YINUO FAN

Background and Needs

Clinical Need: Hospital staff spend significant time locating mobile medical equipment, leading to workflow inefficiencies and delayed patient care. Existing tracking systems are often expensive, bulky, or difficult to deploy at scale.

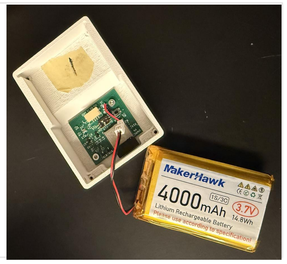
This Year's Goals:
- Improve battery life to near 1 Year
- Reduce tracker size for practical deployment
- Improve reliability during power loss / network outages
- Create two-way communication between device and front-end tool

Optimization Goals

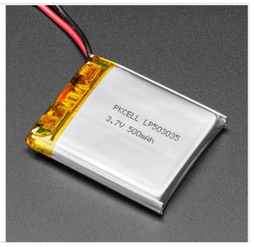
Battery	Reliability	Size
Reduce Wake Up Cycles	Store location before power loss	Smaller battery
Motion-trigged wake	Retain offline data	Smaller enclosure
Deep sleep optimization	Improve reconnect behavior	Improve PCB Design

Battery Options

Old Battery:
- ~4000mAh battery
- Larger than PCB
- Bulky enclosure
- Better capacity but impractical size

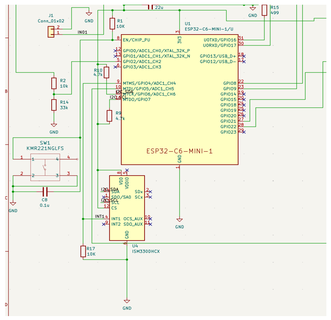


After:
- 500mAh Adafruit LiPo
- ~1/8 the capacity size
- ½ the actual size
- Improved portability
- Supports reduced form factor goals

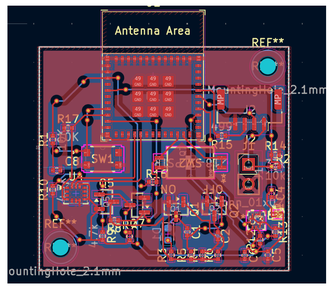


PCB Redesign: Accelerometer Interrupt

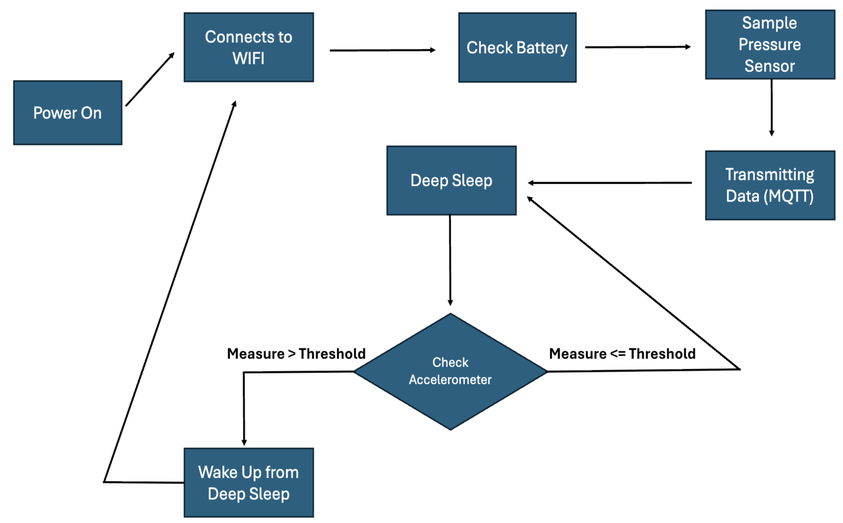
Schematic Design
- Designed and validated system schematic and PCB layout using KiCad
- Accelerometer communicates with ESP32 using low-power I²C interface
- GPIO interrupt enables motion-triggered wake from deep sleep



Design Considerations
- Interrupt-driven architecture minimizes unnecessary processor activity
- Redesigned PCB simplifies routing and reduces system power consumption
- Modular sensor interface supports future hardware expansion



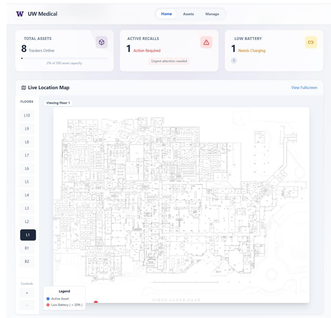
Firmware Flowchart

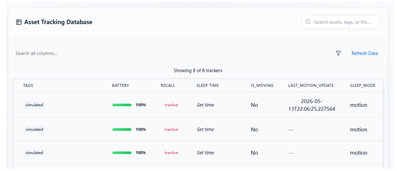


Frontend Redesign

Previous Problems:
- No centralized dashboard
- Limited visualization of tracker locations
- No motion/activity visibility
- Less intuitive navigation

Improvements:
- Added centralized home dashboard
- Added interactive hospital floor maps
- Added motion detection indicators
- Added real-time backend polling
- Added two-way frontend/backend communication
- Updated UI with UW branding and cleaner layouts





Human Centered Design Improvements:
- Designed UI around fast equipment lookup for hospital staff
- Simplified navigation to reduce interaction time
- Added visual status indicators for quick interpretation

Conclusion

- Achieved approximately 40% reduction in overall form factor compared to the previous generation
- Reduced battery size from 4000mAh to 500mAh Improved frontend usability and hospital floor navigation
- Added motion-triggered wake functionality to reduce power consumption
- Improved backend compatibility and testing infrastructure
- Created scalable architecture for future hospital deployment

Future Work

- Redesign MCU architecture for lower power consumption and improved cycle efficiency
- Add BLE functionality for close-range asset localization
- Implement wireless mesh networking for improved reliability and tracking accuracy
- Add lightweight encryption for secure end-to-end communication
- Pursue FDA approval pathways for clinical deployment
- Partner with manufacturing vendors for large-scale production and deployment

Acknowledgments

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