QStat

Modular Wearable Hub Platform

Challenges with Today's Wearables

Existing consumer-grade wearables present several limitations:

- **Lack of Raw Data:** These wearables typically do not provide access to raw data, limiting the depth of analysis and customization possibilities.
- **Limited Medical Utility**: Due to susceptibility to motion and other noise artifacts, consumer-grade wearables are not suitable for medical applications, hindering their reliability and accuracy. Also, consumer wearables prioritize situational awareness and are optimized for energy efficiency on downstream mobile devices, sacrificing in-depth data collection capabilities.
- **Vendor Lock-In**: Data generated by these wearables often become locked into proprietary cloud backend systems, posing challenges for integration with other sensors, such as gas and environmental sensors, and hindering interoperability.
- **Lack of Customization**: These wearables typically lack hardware customization options, limiting their adaptability and versatility to different use cases.
- **Connectivity Issues**: Consumer wearables are not robust to intermittent connectivity, potentially affecting data transmission and collection reliability and sustainability in harsh RF environments which is especially prevalent in hospitals, airports, construction sites, mines, etc.

How is QStat different? … Solutions to the Current Challenges

The QStat wearable hub platform systematically addresses the limitations of consumer-grade wearables through its advanced features:

- **Continuous Raw Data Streaming**: QStat enables continuous streaming of raw data, facilitating early health diagnostics through downstream AI applications. This feature overcomes the limitation of consumer wearables that typically do not provide access to raw data.
- **Sensor Fusion and Signal Processing**: Sophisticated sensor fusion and digital signal processing algorithms are employed to correct motion-induced errors and noise, enhancing the accuracy and reliability of the collected data making them medically relevant and useable.
- **Seamless Integration with commercial off-the-shelf (COTS) Sensors**: The wearable hub platform seamlessly integrates with COTS sensors, allowing for a wide range of sensor compatibility and enhancing flexibility in data collection providing a wholistic view on one's health and environment.

- **Open Data APIs**: QStat provides open data APIs, empowering customers to own and control their data. This addresses the vendor lock-in issue commonly associated with consumer wearables.
- **Modular Hardware Design**: With a modular hardware design, QStat offers high customizability and facilitates quick productization of new hardware features.
- **On-board Storage and Customizable Data Pipelines**: The platform includes on-board storage and data ingestion pipelines to ensure lossless data transfer and preserve data integrity ensuring reliable data transmission.

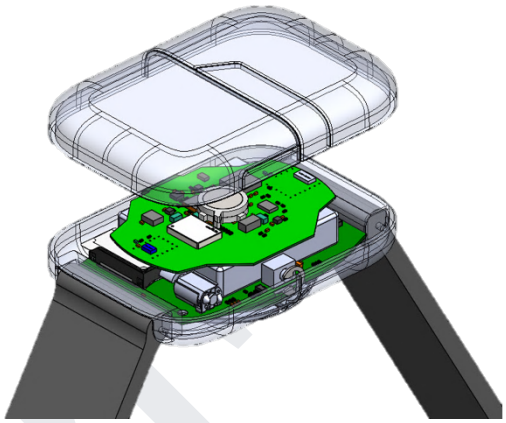

Figure 1 Modular Design based on 3 boards (communications, processing, and sensors)

- **Communication Options**: Standard Wi-Fi and Bluetooth LE communication in the QStat offers high data throughput and direct integration into mobile and web apps as well as the Rajant Kinetic Mesh network. Additionally, the QStat offers LTE as a communications backup for high availability. Optionally, the QStat can provide long-range communication with LoRa, enhancing connectivity options and flexibility in data transmission.
- **Multi-objective Power Optimization:** Intelligent communication modality switching and smart operation modes for optimized utilization while also extending battery life.

And more…

Features and Benefits

Continuous Health and Wellness Monitoring

- Continuous cardiac monitoring helps derive biometrics (Heart Rate, SpO2) of personnel, promoting health-conscious work practices.
- Can be used in high-risk environments to monitor physical exertion, under varying stress and fatigue levels, enhancing safety.
- Useful in detecting early signs of health issues related to poor air quality or physical exertion.
- Raw data (including PPG waveforms) can be made available for downstream AI applications.

Precise Location Tracking (Indoor and Outdoor)

- High-precision GPS essential for real-time personnel location tracking, enhancing safety with quick incident response and management.
- Enables proximity-based alerts to hazardous conditions and/or equipment.
- Enables geo-fencing for zoning and access management.
- Enables Wi-Fi and Bluetooth-enabled RSSI-based RTLS solutions for indoor tracking.

Comprehensive Motion Detection

- Enables accurate activity tracking and detect falls or lack of responsiveness, minimizing work-related injuries and enhancing safety.
- Can be used to enhance the accuracy of GPS (outdoor) and RSSI-based (indoor) location tracking systems.

Open Data and Commands API

- Full access to all data (including raw and processed data) via QStat Data API
- High-fidelity configurability with QStat Commands API

Ergonomic Physical Design

- Withstands high variability in operating environments.
- Ergonomically designed for comfort for extended use.
- Suitable for all weather conditions, enhancing device longevity.

Peripheral Hub

- Can be configured to connect with COTS BLE peripheral devices like weighing scales, and other wearable sensors including environmental and gas sensors, etc.

Electrocardiogram (EKG) Monitoring

- Provides real-time heart rhythm tracking, crucial for detecting cardiac anomalies like Atrial Fibrillation.
- Enhances worker health monitoring, especially in high-stress or physically demanding jobs.

Modular Enclosure Design

- Unlocking unparalleled flexibility, the modular multi-board design empowers customization for different use cases while also streamlining production lifecycles for optimal cost efficiency and accelerated iterations.

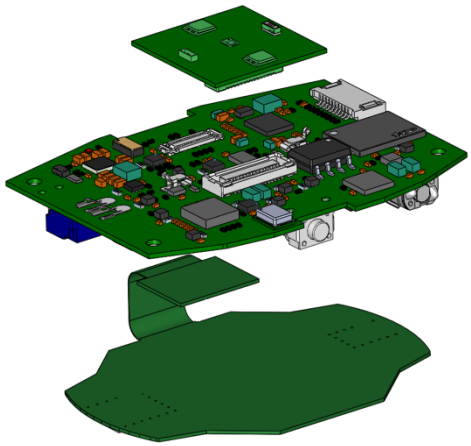

Figure 2 Standard PPG Configuration Module

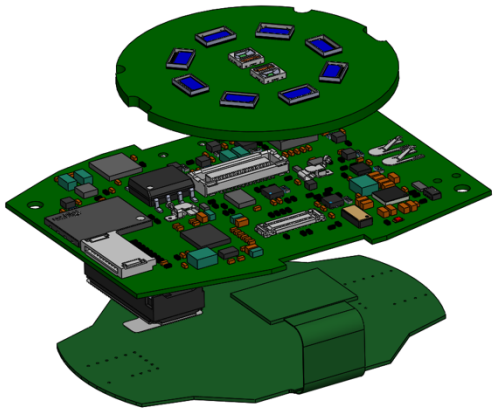

Figure 3 Advanced PPG Configuration Module

Optimized Power Management System

- Improved energy utilization and extended battery life leading to reduced disruptions and prolonged uninterrupted use.
- Reliable for long shifts, ensuring workers are always connected and monitored.

Robust Communications with Persistent Storage

- Intelligent communication modality switching for optimized use (high-throughput data transfer, FOTA, etc.) and prolonged battery life.
- Automatic store-and-forward mechanism with data integrity guarantees even during intermittent network connectivity.
- Enables low-latency situational awareness with optimized data streaming pipelines.

Tactile Haptic Feedback

- Provides non-intrusive alerts in noisy environments, maintaining worker focus and safety.
- Customizable alerts and notifications for specific work-related events, enhancing task responsiveness.

Two-Way Audio

- Facilitates prompt and clear communication between team members, crucial in collaborative tasks, and enhancing safety.
- Enhances remote assistance and instruction, leading to improved task accuracy and efficiency.

Key Technical Specifications

- **Communications:** BLE, Wi-Fi (2.4 GHz), LTE
- **GNSS:** GPS, GLONASS, Galileo, BeiDou
- **Storage:** 512MB Flash Storage (Up to 4 weeks data backup)
- **Vitals**:
    - **Photoplethysmography (PPG):** raw data (waveforms) up to 2kHz sampling rate
    - **HR and SpO2 Monitoring:** derived data from PPG, with motion-artifact removal
    - **EKG/ECG**: 1-lead (spot measurement)
    - Galvanic skin response
    - Skin temperature
- **Audio:** Microphone, Speaker
- **Display:** High resolution screen with touch
- **Haptic**: For alerts and notifications
- **Motion:** 9-Axis Inertial Measurement Unit with Accelerometer, Gyroscope, and Magnetometer
- **Battery:** Up to 48 hours of continuous use, and Fast Charging
- **Physical:**
    - Compact dimensions (50mm x 35mm x 13mm)
    - Water-resistant
- **Updates**: Firmware-Over-The-Air (FOTA) updates using Wi-Fi and Bluetooth
- **Warranty:** Standard 1-year warranty

Integrations and Add-ons

- Core Body Temperature
- Active bands to enable tamper-proofing and modular extensions.
- LoRa Communications
- Extended Capacity Battery
- Ruggedized Enclosure
- And more…

Markets Served

- Healthcare
- Power: Oil & Gas, Renewables
- Mining
- Warehousing
- Construction
- Manufacturing
- And more…

Compatible Software applications

- Cowbell (Edge or Cloud) OTA and AI Server
- And more…