

**TECH OFFER**

## Micro-Vibration Enhanced Fiber Optic Sensing for Non-Invasive Vital Signs Monitoring



### KEY INFORMATION

TECHNOLOGY CATEGORY:

Healthcare - Telehealth, Medical Software & Imaging

Infocomm - Healthcare ICT

TECHNOLOGY READINESS LEVEL (TRL): **TRL9**

COUNTRY: **SINGAPORE**

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### OVERVIEW

Sleep-disordered breathing, particularly Obstructive Sleep Apnea Hypopnea Syndrome (OSAHS), affects millions globally and increases mortality risk by 26.2%. Simultaneously, vulnerable populations in nursing homes, assisted living facilities, and hospitals require continuous vital signs monitoring to prevent adverse events. Current solutions demand either expensive hospital-based Polysomnography (PSG) with multiple wearable sensors that disturb sleep quality, or continuous monitoring systems requiring patient cooperation and regular charging.

This technology solves multiple critical healthcare monitoring challenges through an integrated system combining innovative micro-bending loss enhanced optical fiber sensors with intelligent cloud-based data analytics. The hardware component employs specially designed optical fibers placed under standard mattresses where micro-vibrations from respiratory activity, cardiac function, and body movements cause intentional light attenuation. The backend platform processes these signals through deep learning algorithms and big data analytics, automatically identifying apnea/hypopnea events, extracting vital signs, detecting falls, and generating comprehensive health reports accessible via smartphone applications.

The integrated platform addresses urgent clinical needs with clinical validation demonstrating 95% specificity and 93% sensitivity for OSAHS diagnosis compared to PSG, with strong correlation for vital signs measurements.

The technology owner is seeking collaborations with Medical Device Manufacturers, Hospital systems seeking automated patient monitoring with electronic health record integration, Elderly Care Facility Operators, Disability Care Centers, AI/data analytics deep-tech companies, Telehealth platforms and Insurance companies seeking reduction in acute event costs through predictive analytics and early intervention.

## TECHNOLOGY FEATURES & SPECIFICATIONS

The system comprises of the key core technology components including:

**1. Sensing Mechanism:** Special optical fibers with core diameter approximately 1/10th of human hair thickness that detects minute deformations from respiratory motion, heartbeat, body movements, and positional changes. Light propagation changes captured through photodetector arrays transmit to the signal processing unit with two-stage amplification circuitry which digitizes signals and uploads to the cloud platform for analysis.

**2. Backend Platform Architecture:** The cloud infrastructure processes raw sensor data through graphic recognition technology and machine learning models trained on validated clinical datasets. Automated algorithms extract respiratory rate ( $\pm 1$  breath/minute accuracy), heart rate ( $\pm 2$  beats/minute accuracy), sleep states, bed occupancy status, and movement patterns. The platform generates automated reports in multiple formats (PDF, Excel), maintains personalized health profiles, provides medication reminders, and triggers emergency alerts based on configurable thresholds. Smartphone applications deliver real-time monitoring dashboards and historical trend analysis.

### Technical Specifications:

- Sensor dimensions: 61-81cm length, 1.5-1.8cm thickness, 1-2kg weight.
- Optical wavelength: typically 645nm.
- Bandwidth: >10Hz.
- Force sensitivity: 2.2-4.5%/N resolution.
- Compatible with mattress thickness: 5-40cm.
- Data transmission: Wi-Fi/cellular connectivity.
- Platform features: cloud data storage, multi-user access controls, API integration for electronic health records, configurable alert systems.

## POTENTIAL APPLICATIONS

**Primary Industry Deployment:** Healthcare and medical device sectors, specifically sleep medicine, respiratory care, geriatrics, cardiology, preventive medicine, long-term care facilities, and rehabilitation services. The contact-free nature suits pediatric, dementia, and non-compliant patient populations where sensor cooperation poses challenges.

### Applications:

- 1. Nursing Home Monitoring Systems:** Comprehensive vital signs surveillance detecting respiratory distress, cardiac irregularities, fall events, and bed exit attempts without requiring staff intervention or patient cooperation. Automated alerts enable rapid response to emergencies, reducing adverse event rates and liability exposure.

2. **Elderly Care Safety Solutions:** Continuous monitoring in assisted living facilities and private homes, tracking sleep quality deterioration, nocturnal wandering patterns, and physiological decline indicators for early intervention.
3. **Disability Care Facilities:** Non-intrusive monitoring for residents unable to use wearable devices or communicate distress, providing caregivers real-time vital signs data and activity status.
4. **Hospital Patient Monitoring:** Supplemental surveillance in general wards, post-surgical recovery units, and rehabilitation departments, reducing nurse workload while maintaining continuous patient observation. Particularly valuable for fall-risk patients and those requiring respiratory monitoring.
5. **Home Sleep Apnea Testing Devices:** Consumer-grade diagnostic systems enabling clinically-validated sleep studies at home, generating comprehensive reports via smartphone applications.
6. **Chronic Disease Management Platforms:** Long-term monitoring for patients with hypertension, diabetes, cardiovascular disease, COPD, and conditions where respiratory or cardiac status requires surveillance.
7. **Remote Patient Monitoring Services:** Telehealth-integrated systems enabling physicians to track treatment compliance, disease progression, and intervention effectiveness based on real-time home data.

## MARKET TRENDS & OPPORTUNITIES

Globally, 936 million adults have obstructive sleep apnea with 80-90% undiagnosed (Lancet Respiratory Medicine, 2019). The aging population reaches 1.4 billion aged 60+ by 2030 (WHO, 2025), with 80% residing in low- and middle-income countries requiring cost-effective monitoring. Healthcare facilities worldwide face chronic staffing shortages, making automated multi-parameter surveillance essential. Remote patient monitoring reduces hospital admissions by 25% with \$2,000/patient/year savings (U.S. Department of Veterans Affairs, 2023). Rising chronic disease prevalence (diabetes, cardiovascular disease, COPD) drives continuous monitoring demand across all regions.

## UNIQUE VALUE PROPOSITION

### Current State-of-the-Art Limitations:

- Polysomnography (PSG) requires 7+ hours hospital monitoring with 20+ wearable sensors, costing \$1,000-3,000 per study while disrupting sleep quality.
- Results require manual analysis by sleep technicians, creating delays and interpretation variability.
- Continuous vital signs monitoring in hospitals and nursing homes relies on wearable devices requiring patient cooperation, regular charging, and skin contact which can be problematic for elderly, disabled, or cognitively impaired populations.
- Electromagnetic scanning faces environmental interference; pressure sensors require complex amplification with poor accuracy.

### UVP:

1. **Intelligent Automation:** Deep learning algorithms automatically identify clinically significant events, generate diagnostic reports, enables predictive deterioration warnings and trigger alerts—eliminating manual data review and enabling immediate clinical decision-making.
2. **Multi-parameter surveillance from single sensor infrastructure:** Simultaneously monitors respiratory rate, heart rate, sleep quality, bed occupancy, and fall/exit events with cloud-based analytics consolidating data from multiple sensors across facilities.
3. **Healthcare Efficiency:** Reduces staff workload and zero patient contact eliminating compliance barriers across all

vulnerable populations.

4. **Scalability:** Cloud architecture enables facility-wide deployment with centralized monitoring dashboards, multi-site management, and seamless electronic health record integration.
5. **Safety Profile:** Zero electromagnetic radiation, electrical isolation, heat resistance, waterproof operation—essential for 24/7 deployment with intelligent software safeguards preventing data loss.