# USER REQUIREMENT SPECIFICATION (URS)

Project Title: Non-Contact Health and Diabetes Management Platform

System Type: AI-based Non-Contact Physiological Monitoring and Diagnostics

Version: 1.0

Date: [Insert Date]

Prepared by: [Your Name / Team]

Reviewed by: [Project QA / Clinical Expert / R&D Lead]

Approved by: [Project Sponsor]

## 1. Purpose and Scope

This URS defines the functional, performance, regulatory, and user requirements for a non-contact vital-sign and diabetes management system that uses mmWave radar, MediaPipe-based vision inference, and embedded physiological sensors (e.g., XIAO MG24 Sense) to assess key health indicators such as glucose trends, cardiovascular activity, body movement, and skin conditions.

## 2. System Overview

2.1 Components:

- mmWave Radar Module (e.g., MR60BHA2) for vital-sign extraction  
- Vision Module (MediaPipe) for skeletal posture, facial landmarks, and skin color analysis  
- Embedded Sensor Node (XIAO MG24 Sense) for reference IMU and audio RMS data  
- Edge Processing Hub (Raspberry Pi 4 / NUC) for sensor fusion and AI inference  
- Cloud / Dashboard Interface via MQTT → TimescaleDB → Grafana / Node-RED

2.2 Intended Users: Clinicians, caregivers, individuals with diabetes, and researchers.

## 3. Functional Requirements

FR-1: Detect HR, RR, and micro-motions with mmWave radar  
FR-2: Analyze body posture and skin using MediaPipe  
FR-3: Estimate glucose trends from multimodal data  
FR-4: Fuse radar, visual, and IMU data in real time  
FR-5: Display vitals and alerts via dashboard  
FR-6: Store data securely with AES/TLS encryption

## 4. Performance Requirements

Heart Rate: ±3 bpm vs reference  
Respiration Rate: ±2 brpm  
End-to-End Latency: <500 ms  
Uptime: ≥95 %  
Battery Life: ≥8 hours (if portable)

## 5. Regulatory and Compliance

Design Control: ISO 13485 / IEC 62304  
Data Privacy: HIPAA / GDPR compliance  
Risk Management: ISO 14971  
Cybersecurity: OWASP IoT Top 10

## 6. User Interface Requirements

Node-RED / Grafana dashboard with user, admin, and clinical tabs.  
Visual indicators for Normal / Alert / Critical states.  
Historical data and optional mobile companion app.

## 7. Environmental and Operating Conditions

Ambient Temp: 10 – 40 °C  
Humidity: 10 – 90 % RH  
Distance to Subject: 0.3 – 1.0 m  
Lighting: 150 – 500 lux

## 8. Data Management and Connectivity

MQTT for local communication  
TimescaleDB for long-term data storage  
Grafana for analytics and visualization  
Node-RED for edge logic and alerts  
Optional cloud sync via REST API / n8n workflows

## 9. Validation and Acceptance Criteria

Sensor Calibration: Compare vs reference sensors (Polar H10, glucometer)  
ML Model Verification: ≥90 % accuracy  
System Integration: End-to-end test latency <500 ms  
Usability Test: ≥80 % satisfaction  
Safety Test: Meets FCC / IEC standards

## 10. Future Extensions

Add contactless SpO₂ and HRV via imaging PPG  
Integrate chatbot assistant for personalized feedback  
Expand to AI-driven digital twin modeling

## 11. Approval Signatures

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Role | Signature | Date |
| [Your Name] | Prepared by |  |  |