ROBOMO 2.0

Real-Time IoT Monitoring & Privacy-Preserving Occupancy

25-2-D-11

By:

Mohammed Jaber & Amal Kandeel

Advisor:

Dr. Naomi Unkelos Shpigel

BRAUDE College of Engineering, karmiel

Problem

Indoor labs require continuous air quality monitoring

Camera based occupancy violates privacy

Static sensors create blind spots

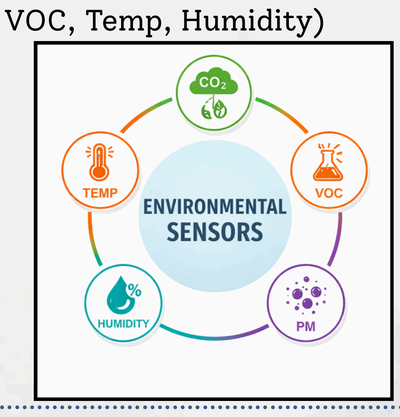
Poor IAQ affects health & concentration

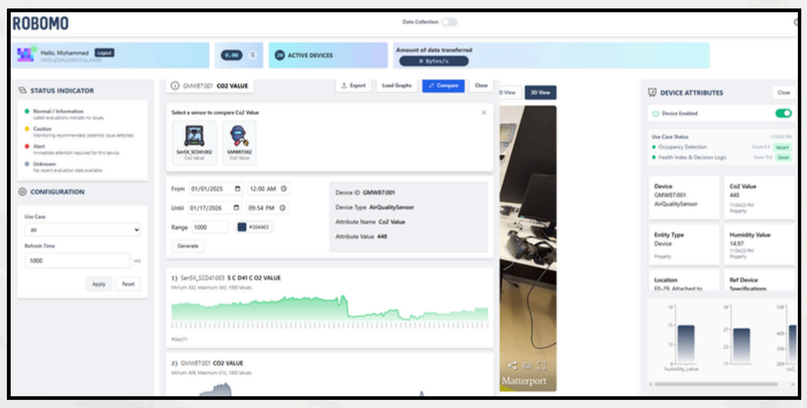
Need:

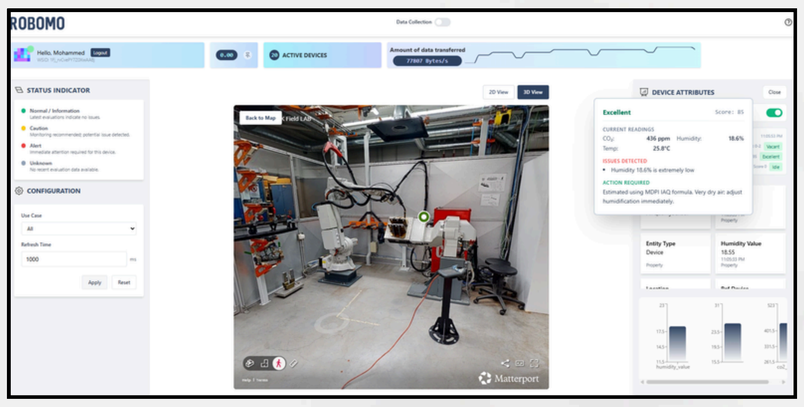
Privacy preserving, real time monitoring system for indoor spaces

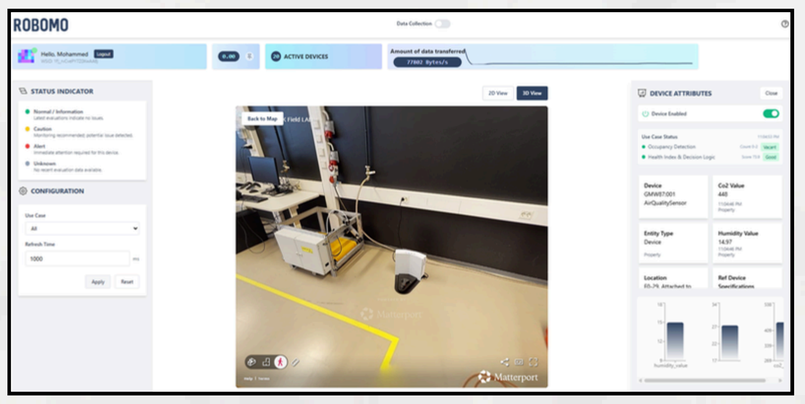
KEY SYSTEM REQUIREMENTS

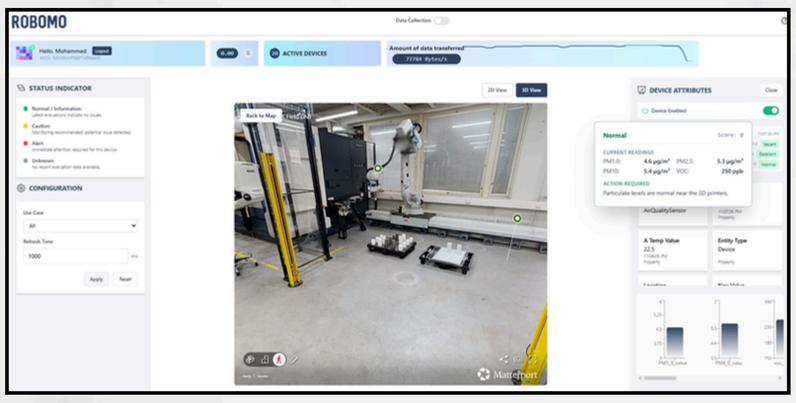
- Realtime sensor monitoring (CO_2, PM, VOC, Temp, Humidity)
- Configurable alerts
- No cameras full privacy
- Scalable deployment
- 2D & 3D visualization
- Occupancy range estimation
- Live dashboard updates

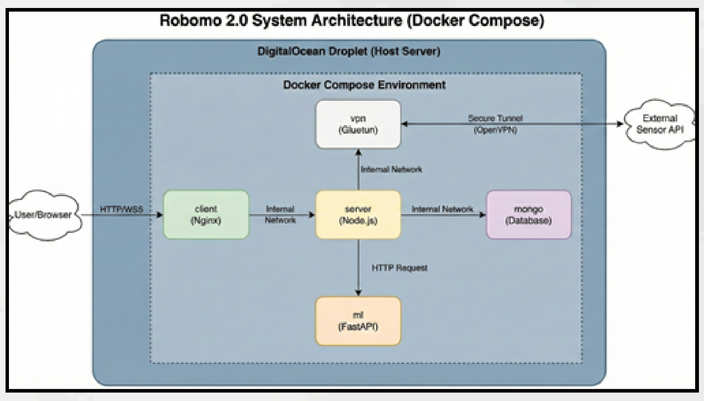


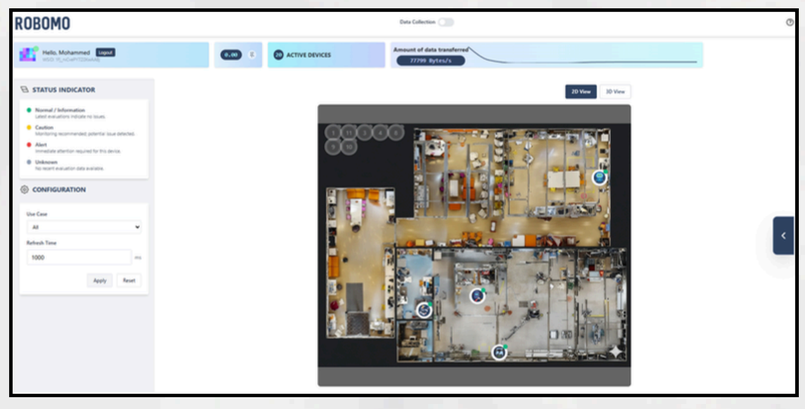








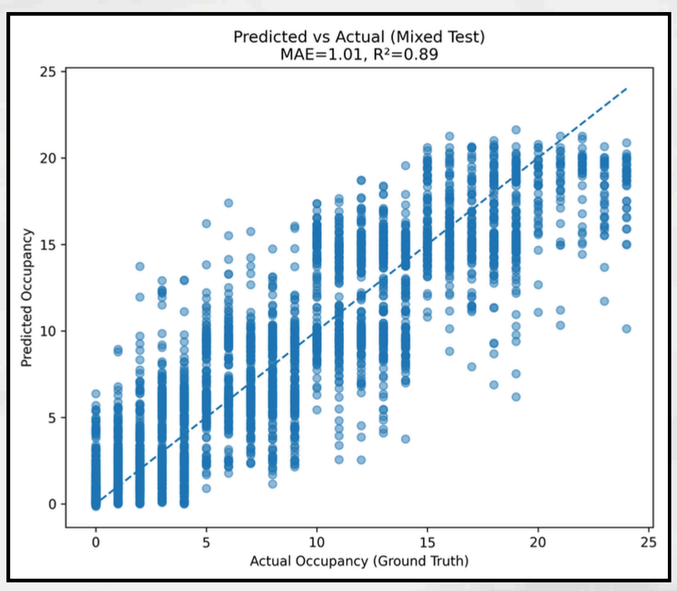


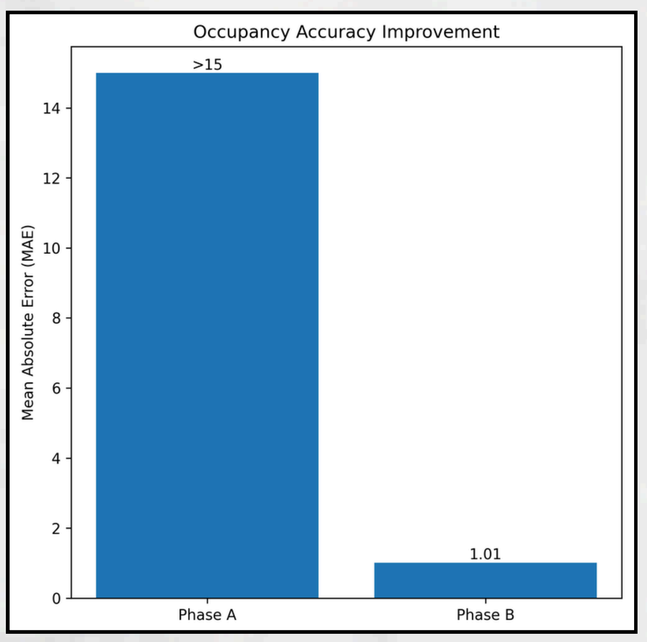


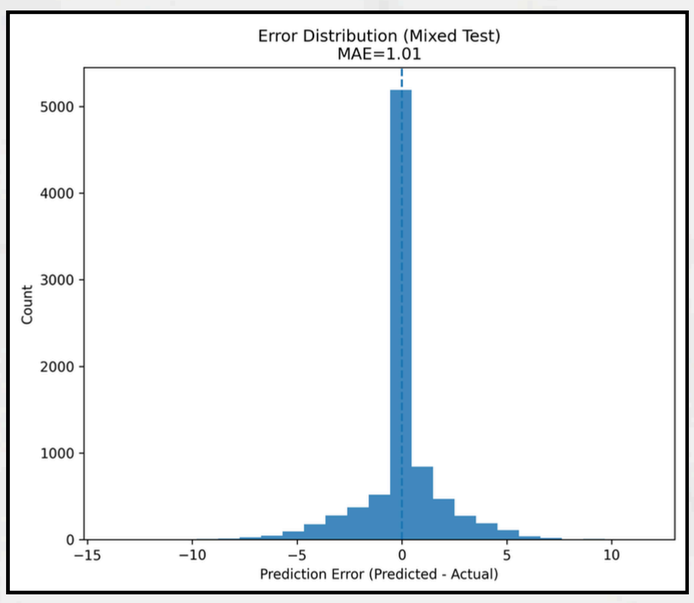
IAQ = 100 – (PenaltyPM2.5 + PenaltyCO2 + PenaltyTVOC + PenaltyComfort)

A hybrid approach uses real and synthetic sensor data with XGBoost for real time occupancy estimation and deterministic IAQ monitoring.

Accuracy was evaluated using prediction and error graphs, showing MAE improvement from >15 (Phase A) to ~±2 (Phase B).

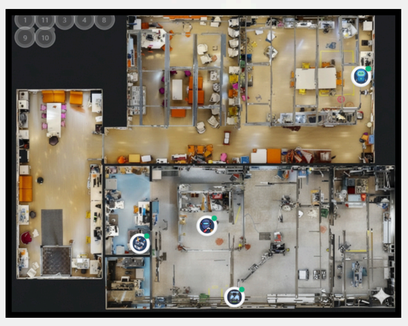






Challenges were addressed using physics based simulation, manual logging, activity detection, standard formulas, and a 3D Digital Twin.

Project metrics show strong performance: ±2 occupancy error, zero false alarms, stable IAQ, real time latency, and reliable uptime.



Website:

Demo: