SCEMS – Smart Community Environment Monitoring System

A Software-Only IoT Simulation Project

UFTB Robotics Club – Monthly IoT & Robotics Contest 2025

(Senior Category)

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GitHub: *https://github.com/Esatjahan/SCEMS-Environment-Monitoring*

Wokwi Simulation:
https://wokwi.com/projects/448685686274316289

Submission Date:11/28/2025

Contents

1. Introduction

The Hi-Tech industrial area in Gazipur is facing several environmental and public safety issues:

- Poor air quality
- Rapid temperature rise & heat stress
- Unstable soil moisture
- Crowd congestion at public points
- Night-time security problems
- Wasted electricity due to non-adaptive street lights

To solve these challenges, I built **SCEMS – Smart Community Environment Monitoring System**, a **fully software-based simulation system** that replicates:

- Soil moisture monitoring
- Temperature & humidity tracking
- AQI monitoring
- Crowd density detection
- Security event detection
- Adaptive lighting system

All sensors are implemented using **Wokwi simulation**, while analytics, alerts, and logs are generated using a **Python backend** and **Streamlit dashboard**.

2. System Architecture

SCEMS consists of three major layers:

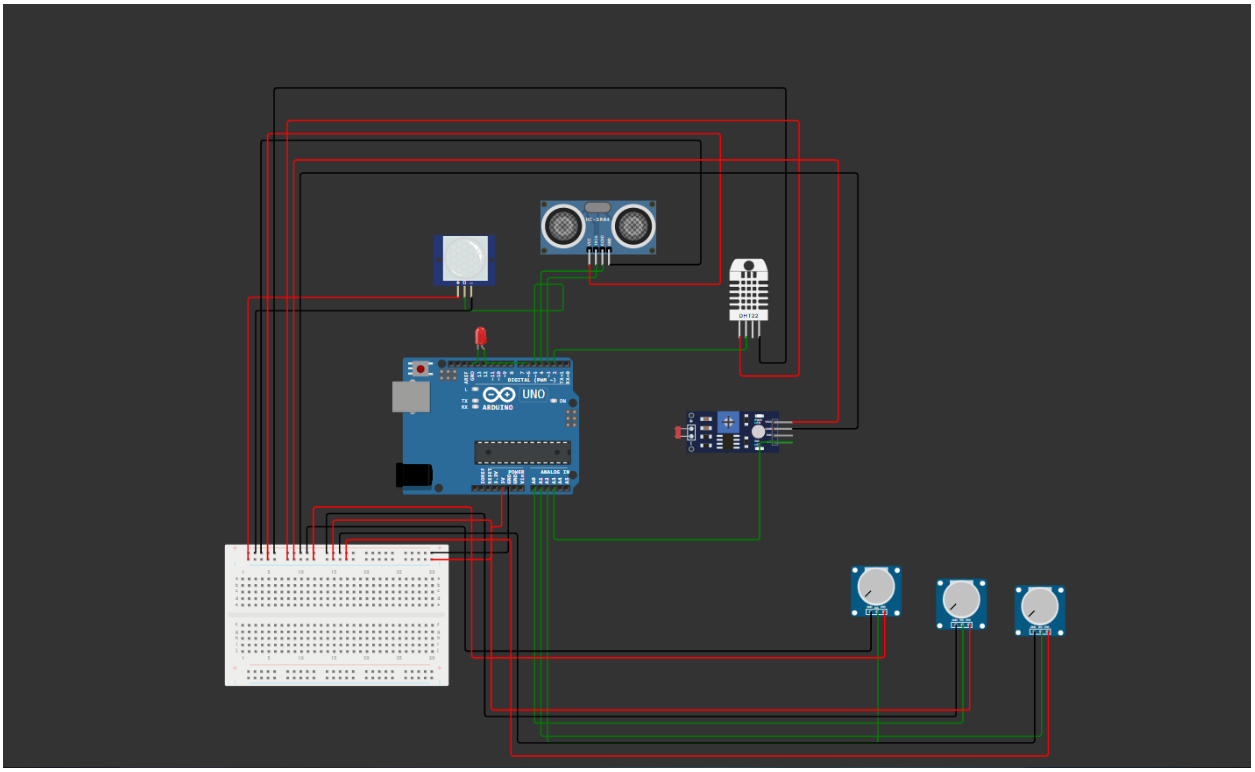
2.1 Sensor Simulation Layer (Arduino/Wokwi)

Simulated Components:

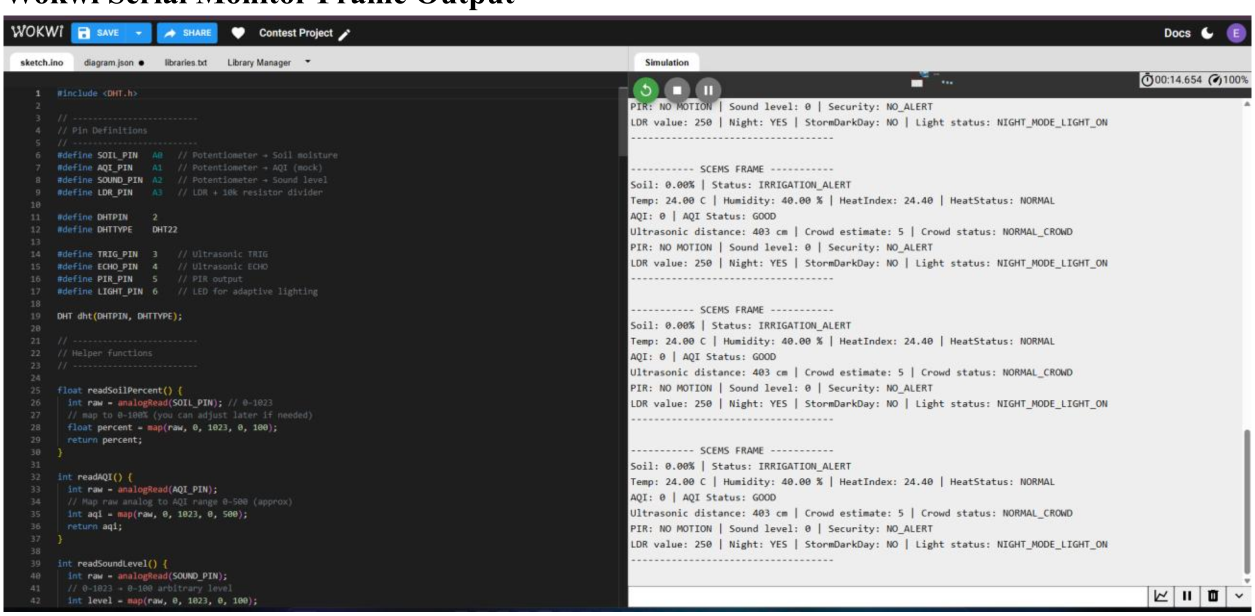
- Soil moisture (Potentiometer → A0)
- AQI mock sensor (Potentiometer → A1)
- Sound sensor (Potentiometer → A2)
- LDR light sensor (LDR + 10k → A3)
- DHT22 (D2)
- Ultrasonic Sensor HC-SR04 (D3 / D4)
- PIR Motion Sensor (D5)

- Street Light LED (D6)

Wokwi Circuit Overview



Wokwi Serial Monitor Frame Output



2.2 Backend Processing Layer (Python)

Files implemented:

- threshold_engine.py – All threshold rules
- sensors_simulation.py – Synthetic sensor data generator
- log_to_csv.py – Historical log generator
- dashboard_app.py – Streamlit real-time dashboard

Key features:

- ✓ Heat index & emergency detection
- ✓ AQI classification
- ✓ Security escalation (night + sound + PIR)
- ✓ Lighting control (night/storm logic)
- ✓ Global priority generation (CRITICAL → LOW)
- ✓ Historical CSV logs saved in logs/system_logs.csv

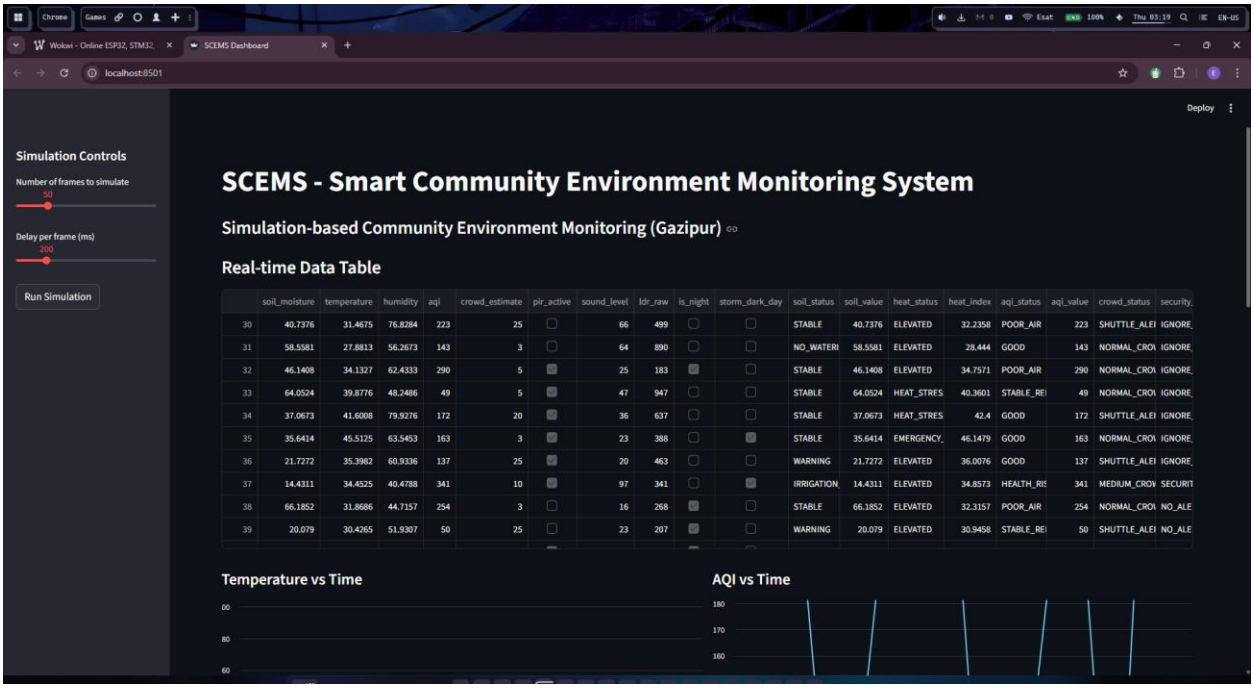
2.3 Dashboard & Visualization Layer (Streamlit)

The dashboard provides:

- Real-time data table
- Temperature, Soil, AQI & Crowd graphs
- Alert priority chart

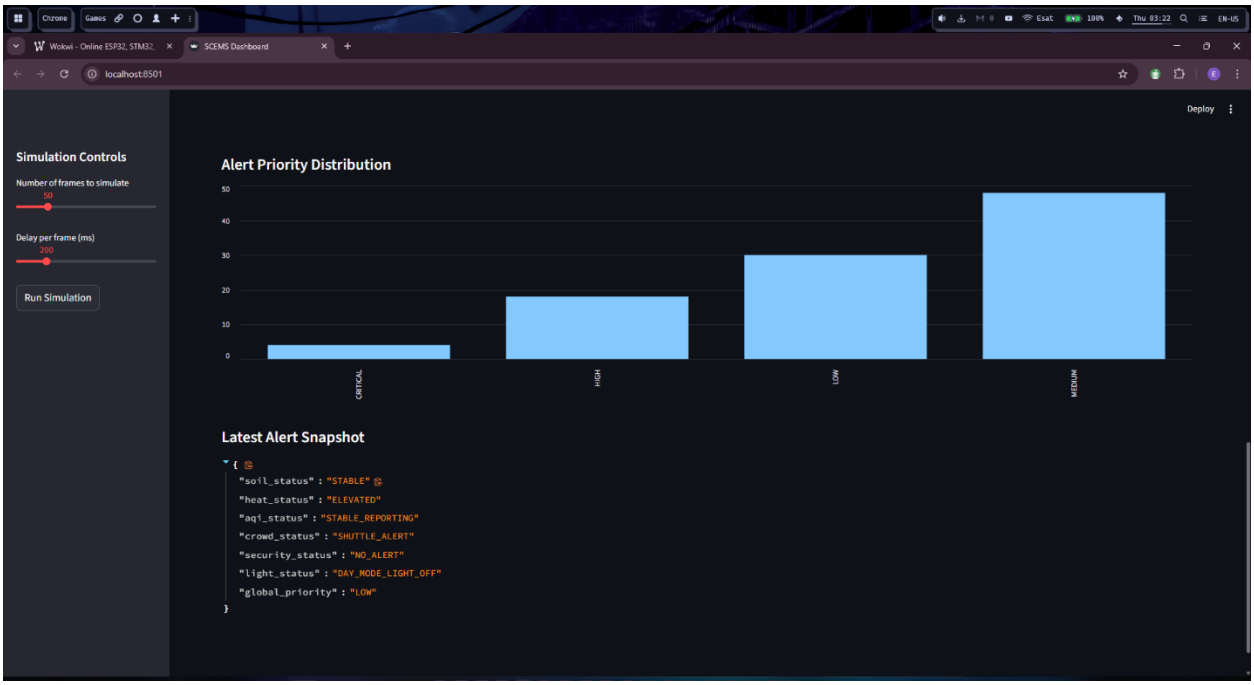
- Latest alert snapshot

Dashboard – Main View



Dashboard – Graphs (Temperature, Soil, AQI, Crowd)

Dashboard – Alert Priority Distribution



3. Algorithm Overview (Simplified)

Soil Moisture Logic

- ≤15% → IRRIGATION_ALERT
- ≤30% → WARNING
- 50–60% → NO_WATERING_NEEDED

Heat Stress Logic

- ≥45°C → EMERGENCY
- ≥36°C → HEAT_STRESS_ALERT
- Heat Index Warning if Temp ≥32°C & Humidity ≥70%

AQI Logic

- 40–80 → STABLE
- ≥180 → POOR AIR
- ≥300 → HEALTH_RISK_ALERT

Crowd Logic

- ≥20 → SHUTTLE_ALERT
- ≤5 → NORMAL

Security Logic

- PIR + Sound>60 → SECURITY_ALERT
- Night escalation → SECURITY_ALERT_ESCALATED

Lighting Logic

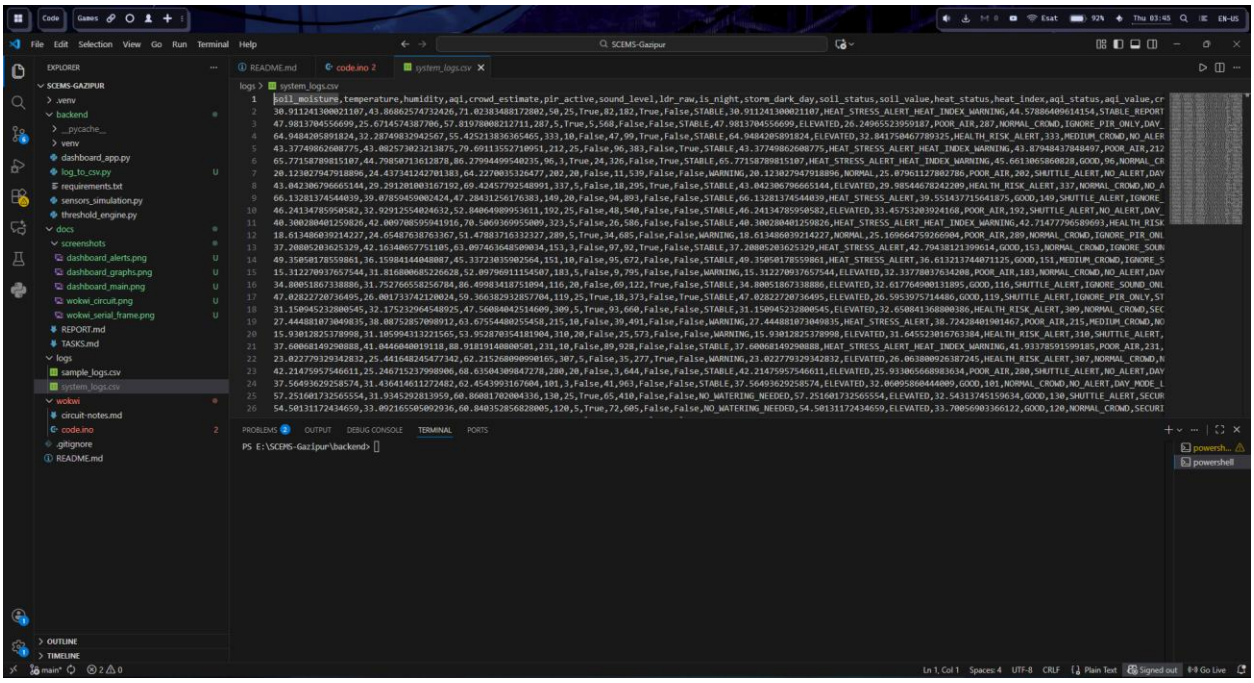
- Night → LED ON
- Storm Dark Day → LED ON
- Day → LED OFF

4. Test Results

The system was tested under all 6 required Section A test scenarios:

- Soil dry/wet ranges
- Temperature + humidity + heat index
- AQI thresholds
- Crowd density cases
- Motion + sound based security
- Dark/light environmental transitions

CSV Log Preview



All test cases matched the expected outputs.

5. Conclusion

SCEMS successfully demonstrates:

- Accurate multi-sensor simulation
- Real-time monitoring dashboard
- Automated thresholds & priority alerts
- Historical logging for analytics
- Fully software-based approach
- Practical relevance for industrial & community monitoring

This project satisfies all requirements of **Section A, B, C, D**, and demonstrates potential for **Section E (future enhancement)**.

6. Important Links

🔗 **GitHub Repository:**
https://github.com/Esatjahan/SCEMS-Environment-Monitoring

🔗 **Wokwi Simulation:**
https://wokwi.com/projects/448685686274316289

🔗 **Demo Video (Google Drive):**
https://drive.google.com/drive/folders/1hMPlVeWZghY3mUDQZwAU2zho7XbX1x9D

📄 END OF REPORT

Thank You!