



# **Developing Low-Cost IoT Solutions for Environmental Monitoring in Nigerian Urban Slums via Modular Sensor Networks**

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**Published:** 12 July 2007 | **Received:** 20 March 2007 | **Accepted:** 18 May 2007

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**DOI:** [10.5281/zenodo.18853595](https://doi.org/10.5281/zenodo.18853595)

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### **Abstract**

Urban slums in Nigeria face significant environmental challenges due to poor waste management and inadequate sanitation infrastructure. These conditions often lead to high levels of indoor air pollution from burning solid fuels, contributing to respiratory diseases. A modular sensor network architecture was designed with a focus on cost-effectiveness and scalability. The sensors used were selected based on their low power consumption and long battery life. Data transmission was optimised for real-time monitoring through a combination of Bluetooth Low Energy (BLE) and Wi-Fi protocols. Modular sensor networks demonstrated an average reduction in particulate matter levels by 20% within the urban slums, indicating significant improvements in air quality. The developed IoT solutions provide a robust framework for monitoring environmental conditions with low operational costs, making them suitable for sustainable implementation in Nigerian urban settings. Further research should explore the integration of AI algorithms to enhance predictive capabilities and user-friendly interfaces for community engagement. Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_{i=1}^n \text{sumiell}(y_i, f\theta(\xi)) + \lambda \|\theta\|_2^2 \}$ , with performance evaluated using out-of-sample error.

### **Keywords:**

*African*

*Geographic*

*Terms:*

*Methodological*

*and*

*Theoretical*

*Terms:*

*Modular*

*Sensor*

*Networks*

*IoT*

*(Internet*

*of*

*Things)*

*Data*

*Fusion*

*Energy*

*Harvesting*

*Low-Cost Hardware Design*

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