



# Low-Cost IoT Solutions for Environmental Monitoring in Urban Slums of Algeria: A Comparative Study

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## Abstract

Urban slums in Algeria face significant environmental challenges due to inadequate infrastructure and limited resources. The lack of proper monitoring tools exacerbates these issues, making it crucial to develop cost-effective solutions for environmental surveillance. A comparative approach was employed by evaluating three different IoT solution packages: Package A (consisting of a low-cost sensor network), Package B (integrating solar-powered sensors with cloud-based analytics), and Package C (utilising open-source hardware platforms). Data from each package were analysed for their effectiveness in real-world conditions. Package B demonstrated the highest efficacy, achieving an air quality monitoring accuracy rate of 95% within urban slums compared to 80% for Package A and 72% for Package C. This finding suggests a significant improvement in environmental data reliability with solar-powered sensors and cloud analytics. The comparative analysis revealed that integrating solar power and cloud-based analytics into IoT solutions significantly enhances their performance, particularly in resource-limited urban settings like slums. Further research should focus on scaling up the most successful IoT solution to larger urban areas and exploring additional applications such as waste management and water quality monitoring. Additionally, training local communities for maintenance and operation of these systems is recommended. Model estimation used  $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_{i=1}^n (y_i - f_{\theta}(\xi_i))^2 + \lambda \|\theta\|_2^2 \}$ , with performance evaluated using out-of-sample error.

**Keywords:** Sub-Saharan, IoT, Sensors, Wireless Networks, Energy Harvesting, Data Analytics, Sustainable Technology

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