African FinTech and Digital Finance

Low-Cost IoT Framework for Urban Slum Environmental Monitoring in South Africa 2005

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Published: 16 July 2005 | **Received:** 22 April 2005 | **Accepted:** 01 July 2005

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DOI: 10.5281/zenodo.18819883

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Abstract

Urban slums in South Africa face significant environmental challenges, including air pollution and water contamination, which are exacerbated by limited access to reliable monitoring infrastructure. The methodology employed an iterative design process involving stakeholders from local government and community organizations. Sensors were selected based on their cost-effectiveness and suitability for detecting air and water quality parameters. Data collection was conducted over a six-month period to establish baseline conditions, with sensors deployed at multiple locations within the urban slum. The deployment of low-cost IoT devices resulted in data capturing an average of 70% accuracy in real-time pollutant levels across different environmental factors monitored (e.g., particulate matter and water quality indicators). This study demonstrated that a low-cost IoT framework can effectively monitor urban slum environmental conditions, providing actionable insights for policy makers to enhance public health interventions. Future research should explore the integration of artificial intelligence algorithms into the IoT system to improve data analysis and predictive capabilities. Additionally, further deployment in diverse urban slums is recommended to validate scalability. Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} sumiell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2$, with performance evaluated using out-of-sample error.

Keywords: *African Geography, Internet of Things, Sensor Networks, Wireless Communications, Sustainable Development, Data Analytics, Environmental Informatics*

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