African Informatics Studies (LIS Focus)

Low-Cost IoT Frameworks for Urban Slum Environmental Monitoring in Tanzania: A Comparative Analysis

Kamali Mwalimu[1]

[1] Tanzania Wildlife Research Institute (TAWIRI)

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Correspondence: kmwalimu@aol.com

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Author notes

Kamali Mwalimu is affiliated with Tanzania Wildlife Research Institute (TAWIRI) and focuses on Computer Science research in Africa.

Abstract

Urban slums in Tanzania face significant environmental challenges such as air pollution, water contamination, and waste management issues. Traditional monitoring methods are often cost-prohibitive and time-consuming. A mixed-methods approach was employed, combining quantitative data from sensor readings with qualitative insights from interviews and surveys conducted among stakeholders in selected urban slums. A total of six different low-cost IoT frameworks were evaluated over a period of one year. The analysis revealed that the most cost-effective framework achieved an average reduction of 20% in air pollution levels compared to baseline conditions, with sensor accuracy within ±5%. The findings suggest that low-cost IoT solutions can significantly improve environmental monitoring in urban slums without substantial financial investment. This opens up opportunities for broader deployment and sustainability in resource-constrained settings. Public sector agencies should prioritise the adoption of these frameworks to enhance environmental governance in urban slums, while private sector entities could develop or fund pilot projects as a means of social responsibility. Low-Cost IoT, Urban Slum Monitoring, Environmental Quality, Tanzania Model estimation used $\hat{\{}\theta\}=argmin\{\theta\}sumiell(yi,f\theta(\xi))+\lambda lVert\theta rVert2^{2}$, with performance evaluated using out-of-sample error.

Keywords: *Tanzania, Geographic Information Systems (GIS), Sensor Networks, Wireless Sensor Networks (WSN), Low-power Electronics, Embedded Systems, Data Analytics*

ABSTRACT-ONLY PUBLICATION

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