Low-Cost IoT Solutions for Environmental Monitoring in Urban Slums of Senegal: A Scoping Review

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Abstract

Urban slums in Senegal face significant environmental challenges due to rapid urbanization and inadequate infrastructure. Traditional monitoring methods are often expensive and inaccessible. A systematic search strategy was employed across multiple databases including Web of Science, Scopus, Google Scholar, and relevant journals. Studies were selected based on predefined inclusion criteria focusing on IoT-based solutions targeting environmental parameters such as air quality, water contamination, and waste management in urban slums. The review identified a total of 25 studies, with a majority (76%) focusing on air quality monitoring using low-cost sensors. The proportion of projects that reported successful deployment was notably high at approximately 80%, indicating the feasibility and practicality of these solutions in resource-limited settings. Low-cost IoT technologies offer promising alternatives for environmental monitoring in urban slums, particularly for air quality, but further robust evaluation is needed to validate their efficacy across diverse contexts. Future research should focus on integrating low-cost IoT systems with existing municipal waste management and water treatment infrastructures to enhance overall sustainability and efficiency. Policy makers are encouraged to develop supportive frameworks that facilitate the adoption of these technologies in urban planning and development strategies. Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} \, sumi \, ell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2$, with performance evaluated using out-of-sample error.

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