



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

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Abstract

Urban slums in Eritrea face significant environmental challenges due to poor waste management and inadequate water supply systems. The need for cost-effective solutions that can monitor these conditions has emerged as a critical issue. A comparative approach was employed using a mixed-methods design involving literature review, expert consultations, and pilot testing of selected IoT devices in urban slums. Data were collected through questionnaires, interviews, and sensor readings to evaluate the performance of each solution. Preliminary data analysis indicates that a combination of low-cost sensors for waste management (costing 10–20 per unit) and water supply monitoring (5–15 per unit) showed a 70% reduction in contamination levels when deployed. The most effective communication protocol was found to be LoRaWAN, with a median response time of 30 seconds. The study concludes that the development of low-cost IoT solutions can significantly improve environmental monitoring in urban slums by reducing costs and increasing efficiency. Recommendation is made for further research into scalability and sustainability of these solutions, with a focus on integrating user feedback to enhance device functionality and reliability.

Keywords: *African Geography, IoT, Sensor Networks, Wireless Communications, Data Analytics, Energy Harvesting, Microcontrollers*

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