African Geotechnical Engineering

Development of Sensors and IoT Systems for Environmental Monitoring in Ugandan Mining Sites

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Abstract

Mining activities in Uganda have led to significant environmental degradation due to dust emissions, water contamination, and noise pollution. The existing monitoring systems are often inadequate or non-existent, leading to poor management of these issues. The methodology involves selecting appropriate sensor technologies based on their accuracy and cost-effectiveness. A pilot site was chosen for initial deployment, where data from multiple sensors were collected over a period to assess the reliability and effectiveness of the system in real-world conditions. Statistical analysis using linear regression models was employed to evaluate the precision and variability of sensor readings. The preliminary results indicate that the developed sensor network can accurately measure air quality parameters with an error margin of ±5% and noise levels within a range of ±3 dB, demonstrating its reliability in real-time monitoring scenarios. Water contamination data showed consistent measurements with a coefficient of variation (CV) below 10%, indicating minimal variability. The study successfully demonstrated the feasibility of using IoT-based sensor systems for comprehensive environmental monitoring in Ugandan mining sites. The findings provide valuable insights into improving environmental management practices and reducing negative impacts on local communities and ecosystems. Recommendation is made to integrate these advanced monitoring systems into existing infrastructure, facilitate regular maintenance and calibration of sensors, and implement data-driven decision-making processes for effective environmental management in Ugandan mining operations. Environmental Monitoring, IoT Systems, Mining Sites, Sensor Networks, Precision Measurement The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Uganda, Geospatial, Sensor Networks, Internet of Things, Geographic Information Systems, Data Analytics, Remote Sensing*