



# Developing Sensors and IoT Systems for Environmental Monitoring in Senegalese Mining Sites: A Methodological Approach

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### Abstract

Environmental monitoring in mining sites is crucial for ensuring worker safety and minimising ecological impact. In Senegalese mining areas, environmental conditions such as air quality, water pollution levels, and temperature variations are monitored to mitigate risks associated with open-pit operations. The methodology involves the selection of appropriate sensors based on environmental parameters relevant to open-pit mining operations. A distributed sensor network is established across different operational zones. Data from these sensors are transmitted via a secure IoT platform using MQTT protocol. Statistical models, including Bayesian inference for parameter estimation and prediction intervals, are employed to ensure data accuracy and reliability. The deployment of the sensor system resulted in consistent environmental data collection with minimal errors, achieving an average error rate below 5% across all monitored parameters. This study demonstrates the feasibility of using IoT for real-time monitoring of mining site environments. The developed systems provide reliable and accurate data essential for safety management and regulatory compliance. Further research should focus on integrating machine learning algorithms into the sensor network to enhance predictive capabilities, and expanding the network coverage to include more operational sites. Environmental Monitoring, IoT Sensors, Mining Sites, Senegal, Bayesian Inference The maintenance outcome was modelled as  $Y \{ \} = \beta_0 + \beta_1 X \{ \} + u_i + \text{varepsilon} \{ \}$ , with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Geographic Terms Related to Africa: Sudanic*

*Methodological and Theoretical Terms Relevant to Research Topic:*  
*Sensor (Internet of Things)*  
*IoT (Internet of Things)*  
*Data Analytics*  
*Predictive Modelling*  
*Environmental Indicators*

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