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

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## Abstract

Environmental monitoring in Egyptian mining sites is crucial for ensuring worker safety and protecting ecosystems. However, current systems are often inadequate due to limited sensor capabilities and poor integration of IoT solutions. A mixed-methods approach was employed, including literature review, design of novel sensor prototypes, field testing, and data analysis using statistical models. Field tests showed that the new sensors could detect pollution levels within ±5% accuracy over a range of 100 meters, indicating high precision. The developed IoT systems demonstrate significant advancements in environmental monitoring capabilities for mining sites in Egypt. Further research should focus on integrating these systems into existing infrastructure and exploring the economic impact of improved environmental management. Environmental Monitoring, Sensors, IoT, Mining Sites, Egypt The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

**Keywords:** *Sensors, Internet-of-Things, Geographic-Mapping, Data-Sensing, Environmental-Technology, Geographic-Informatics, Geospatial-Analytics*

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