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Sensors and IoT Systems for Environmental Monitoring in Egyptian Mining Sites: A Comparative Study

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Abstract

In Egypt's mining sector, environmental monitoring is crucial for ensuring safe working conditions and sustainable resource extraction. Current practices often rely on manual inspections, which are time-consuming and prone to human error. A comparative study was conducted using a mixed-method approach, combining laboratory testing with field trials. Sensor configurations were optimised based on performance metrics such as accuracy and reliability. The analysis revealed that the IoT system integrated with advanced sensors achieved an average error rate of ±5% in monitoring air quality parameters compared to manual inspection methods. The study concluded that the IoT-based sensor systems significantly improved environmental monitoring accuracy, reducing human intervention by up to 80% while maintaining or improving data precision. Recommendation for further research includes expanding trials to a wider range of mining sites and incorporating predictive analytics to anticipate potential environmental issues. Egyptian Mining Sites, Environmental Monitoring, Sensors, IoT Systems, Comparative Study 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 (IoT), Geographic Information Systems (GIS), Data Analytics, Remote Sensing, Sustainable Development, Precision Mining*

ABSTRACT-ONLY PUBLICATION

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