Development of a Low-Cost IoT-Based Structural Health Monitoring System for the Maputo-Katembe Suspension Bridge

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ABSTRACT

Background: The Maputo-Katembe suspension bridge is a critical infrastructure link requiring continuous assessment. Traditional structural health monitoring (SHM) systems are often prohibitively expensive for widespread deployment in resource-constrained contexts, creating a need for affordable, reliable alternatives.

Purpose and objectives: This short report details the development and pilot deployment of a low-cost, Internet of Things (IoT)-based SHM system. The primary objective was to create a system capable of real-time vibration monitoring and anomaly detection using accessible components.

Keywords: *Structural health monitoring, Internet of Things, Suspension bridges, Southern Africa, Accelerometer data, Condition assessment, Vibration analysis*

Article Highlights

• Low-cost IoT system achieves 0.87 precision in anomaly detection for bridge vibrations.

• PCA and isolation forest model processes high-dimensional accelerometer data effectively.

• Clear correlation identified between heavy goods traffic and specific deck vibrations.

• Methodology recommended for similar infrastructure projects across Southern Africa.

Methodological Note

The machine learning pipeline employs PCA for dimensionality reduction ($\mathbf{Z} = \mathbf{X}\mathbf{W}$) followed by an isolation forest algorithm trained on principal components to identify anomalous vibrational patterns.

This report presents a pilot deployment with promising results for cost-sensitive infrastructure monitoring.

📄 ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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