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Cloud-Database Integrated Low Power Strain Visualization System for Condition Assessment of Civil Structures

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ABSTRACT

This study presents a cloud-database integrated strain visualization system for long-term condition assessment of civil structures. Strain response was visualized on an electronic-paper display (EPD) as a QR code and data management was performed through MySQL cloud-database. The proposed system uses a half-bridge based strain measuring circuit and a 24-bit analog-to-digital converter for high-fidelity conversions. A low power microcontroller unit in combination with power management circuit (PMC) and EPD makes system power efficient. PMC enables the power-saving mode, and the system actives only when triggered by a push-button or timer. The current consumption of the system was recorded to be 337.9 μA and 18 mA in power-saving and active mode, respectively. The accuracy of the proposed system was validated with a reference strain measuring system (Xnode) in a lab-scale experiment. A cantilever beam mounted with a table was deflected with increasing load, and strain response was measured from both systems. The proposed system was validated successfully, with a root mean square error (RMSE) of 1.15με. Furthermore, another experiment was conducted to estimated displacement from strain. A 5.45m composite beam of was deflected and displacement was estimated through recorded strain using assumed mode method. The measured displacement was validated with reference (LVDT). Strain response encoded QR code was scanned through an android application and uploaded to the MySQL cloud-database during the experiment. In addition, a digital engineering model was designed to illustrate the deflection of the beam.

REFERENCES

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