RUBES: Resonators Used in Building Emergency Sensors - Developing a Device (Year 4)

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In the aftermath of tragedies like the Surfside Condo Collapse of 2021, the necessity for long-term monitoring methods to detect structural deterioration has significantly increased. Mechanical resonance is one potential method through which structural deterioration can be tracked and understood, particularly by measuring changes in resonators. Previously, a bar-based resonator was tested under compression to examine the relationship between output frequency and applied load. After several years of examining this resonator type, little to no change was observed in the output frequency under load, even at high loads. This development suggested that a different, more sensitive resonator type may be more insightful for early-warning detection of structural changes or failures long before collapse is imminent. In this study, an alternative method for measuring structural disturbances, however minor, was proposed and examined through the medium of string resonance. To replicate previous experimental conditions, the string resonator was exposed to various loads, and the string's resonant frequency was measured at each applied load. As predicted, the string resonator experienced much greater changes in frequency than the previously tested bar-based resonator under comparable applied loads. It is highly possible that a benign structural deterioration could develop into a critical failure, as seen with the Surfside Condo Collapse, so it is necessary to consider early warning capabilities when designing a sensor. In the future, the goal will be to implement string-based resonance in a self-driving mechanism that has the ability to monitor residences and other critical infrastructure for long periods of time.

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