INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

GeoMCU: Wireless Interface for Structural Vibration Sensing with Geophones

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Hardware
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OVERVIEW

PCB and software enabling wireless geophone-based vibration sensing for health and activity monitoring

- Offers wireless, remotely configurable, battery-powered sensing with flexible data acquisition
- Human/animal activity monitoring, footstep detection, gait analysis, remote health sensing

BACKGROUND

Vibration sensing is crucial for structural monitoring, health assessment, and security applications. Historically, approaches have relied on wired seismometers or piezoelectric sensors hard-wired to data acquisition systems, limiting deployment flexibility and increasing installation complexity. Such setups often lack remote configurability and robust wireless capability, which restricts their usefulness in distributed or long-term monitoring scenarios. Traditional geophone interfaces are not designed for easy tuning or adaptability in the field, making long-term maintenance and deployment costly and labor-intensive. Additionally, integration with modern wireless communication protocols and data logging frameworks is often absent or cumbersome to implement. These shortcomings emphasize the need for more flexible, wireless, and remotely configurable solutions that allow simple deployment, continuous field operation, and scalable data acquisition for real-world applications.

INNOVATION

This invention introduces a novel PCB design and software suite for high-sensitivity interfacing with geophones, focusing on wireless structural vibration data acquisition. The system integrates remotely adjustable gain and onboard filtering for precision sensing, supporting both internal (built-in ADC) and external data collection hardware. Configuration is efficient, achieved over serial or WiFi connections, and the ESP8266 microcontroller enables full wireless capability (battery or wired power). Data can be logged wirelessly and remotely using MQTT protocols, with accompanying Python software for real-time data streaming and analysis. The result is a deployable, adaptable, and failure-tolerant sensing platform suitable for continuous activity monitoring, footstep detection, gait analysis, or vital signs tracking in humans and animals, outperforming legacy analog and wired solutions. This flexibility unlocks applications in healthcare, livestock monitoring, security, and smart buildings, enabling scalable and non-intrusive long-term deployments.

ADDITIONAL INFORMATION

PROJECT LINKS:

DEPARTMENT/LAB:

- Pei Zhang, Electrical Engineering and Computer Science (EECS)

LICENSE: