

Autonomous Bridge Inspection

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Motivation

Bridge Structural Health

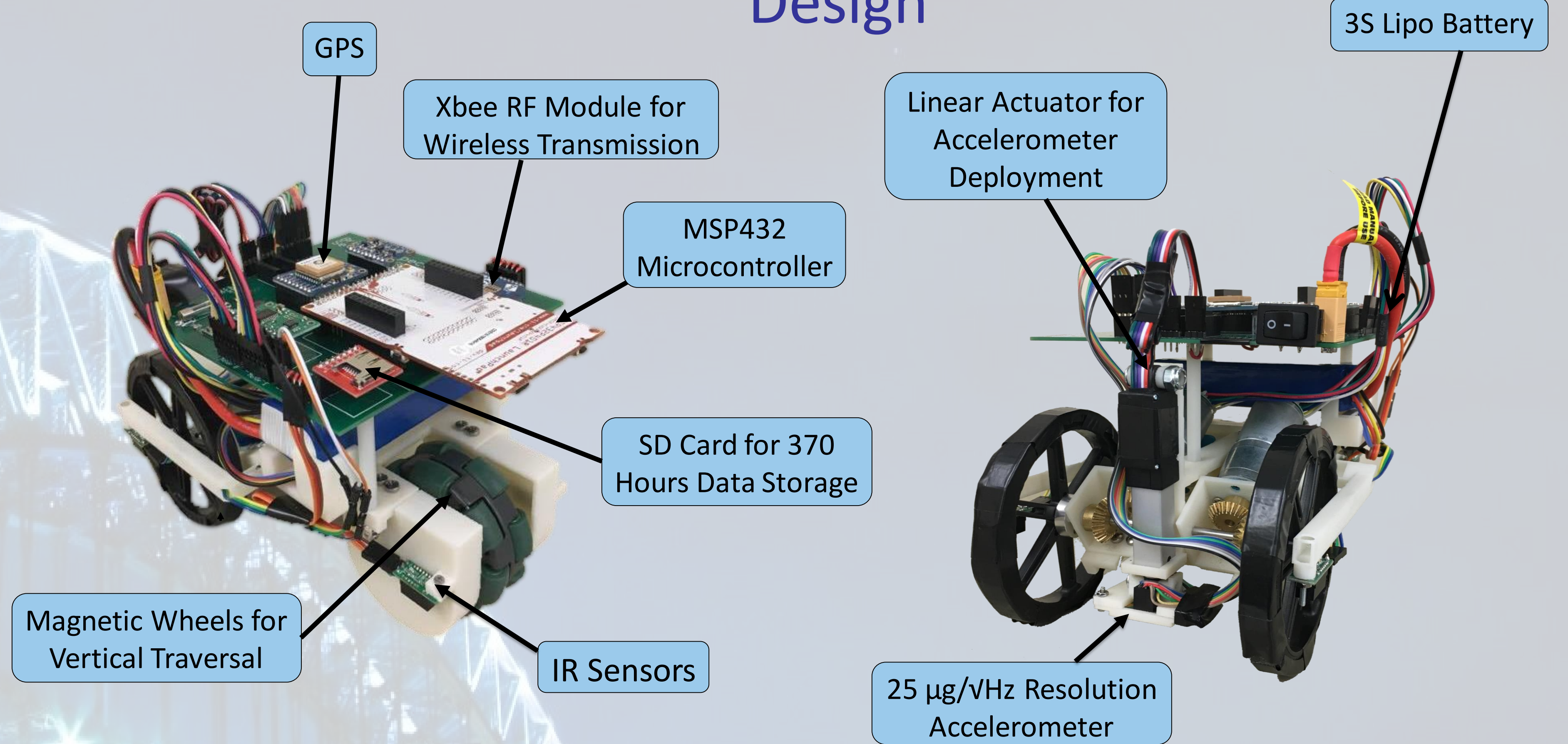
- 50+% of U.S. bridges built before 1940's
- 1 in 9 structurally deficient
- Maintenance costs ~\$20.5 billion annually; only \$12.8 billion available

Structural Health Monitoring (SHM) Systems use sensor data to monitor structural behavior

- **Currently:** Cable connections between sensors expensive and time-consuming
- **Solution:** Create a **wireless network** of multiple **mobile sensing robots**



Design

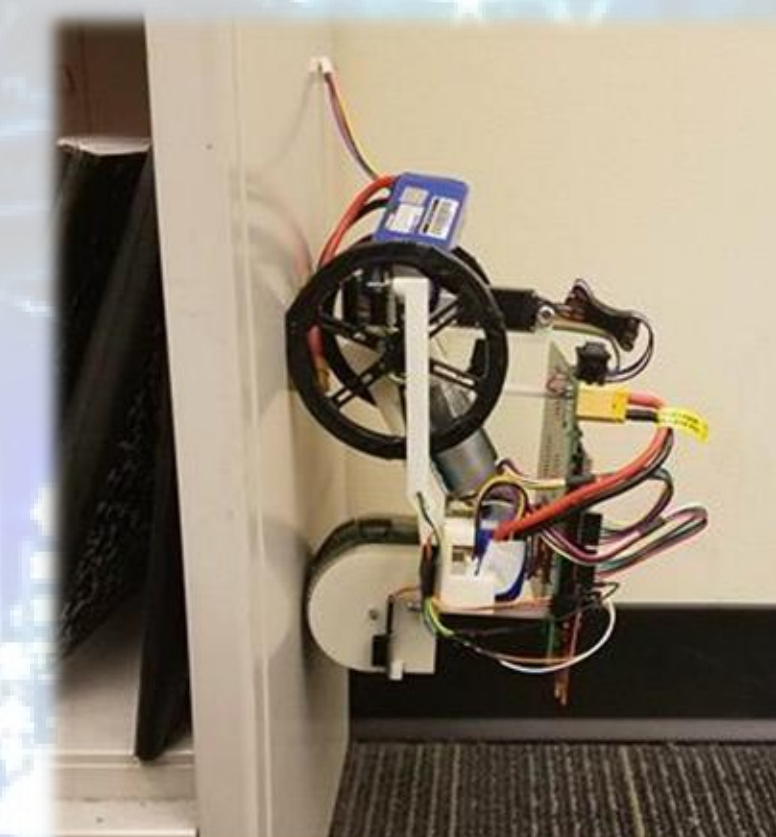


Requirements

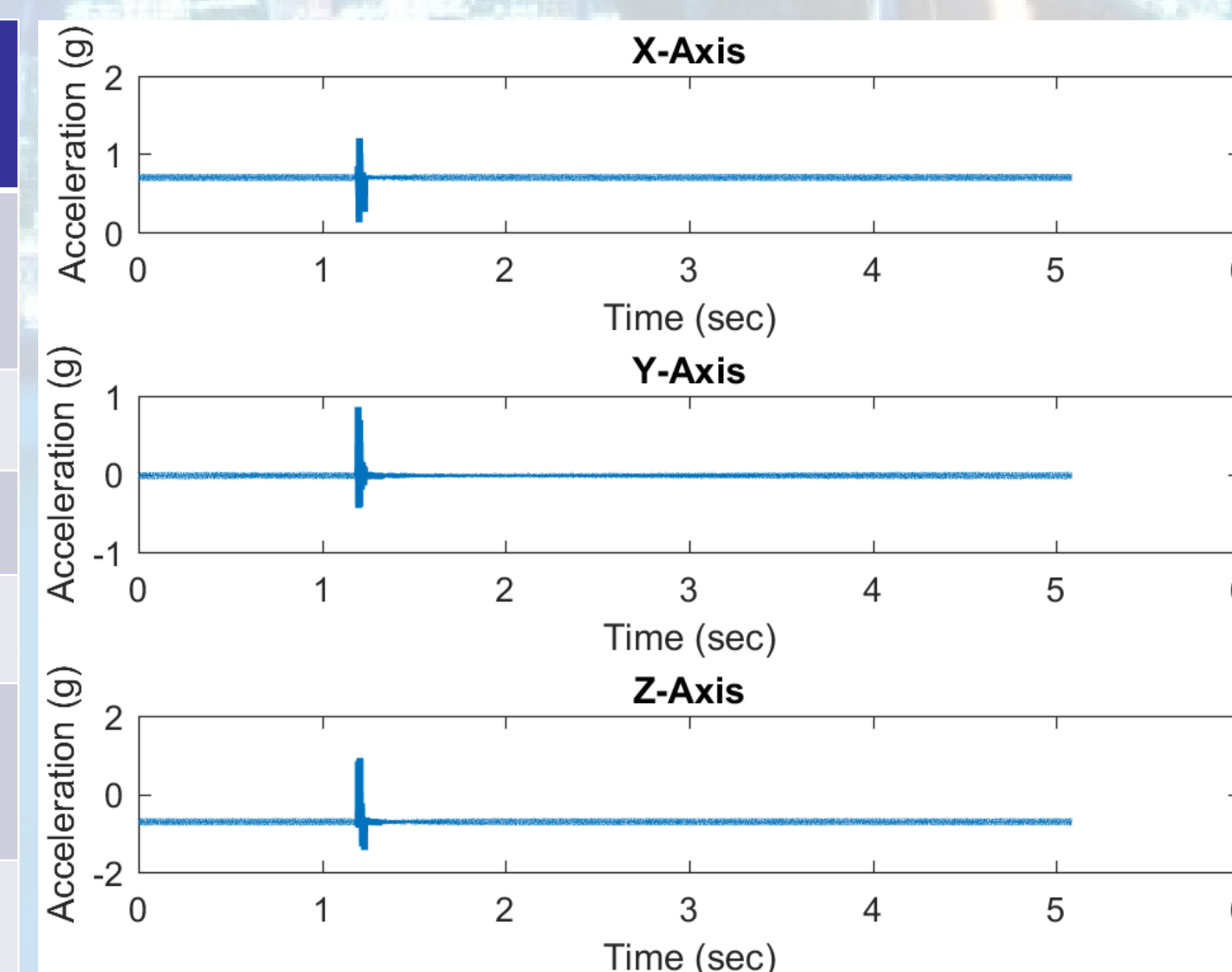
- Horizontally and vertically traverse steel bridges
- Measure bridge vibrations at low frequencies
- Wirelessly transmit vibration data to a PC
- Lightweight for deployment and retrieval by drone

Characteristic	Specification
Magnet Holding Force	Holds robot static indefinitely
Operational Lifetime	Movement Operation ≥ 1 hour Recording Operation ≥ 1 hour
Accelerometer Range and Accuracy	0 – 50 Hz ± 0.5 Hz 50 Hz ± 0.5 Hz
Robot Size	Greatest side length ≤ 0.25 m
Weight	Total mass ≤ 1 kg
Wireless Communication Distance	Able to send/receive data ≥ 800 m
Path Following	Shall not fall off edge in "sunny day" conditions

Results



Verification Test	Result
Magnet Holding Force	Holds position vertically and inverted
Dimensions	24cm x 14cm x 20cm
Mass	1.026kg
Battery Life	0.25V over 1 hour
Communication Range	Sends/Receives at least 800m
Final Demonstration	Collected data of hammer strike on bridge



Accelerometer Data of Hammer Strike on Bridge

Future Work

- Integrate gyroscope for complex path following
- Create network of robots for full mobile sensing network
- Modify robot for drone deployment and retrieval

