



QUAKELOGIC

AI-POWERED EARTHQUAKE RISK MANAGEMENT SOLUTIONS

STRUCTURAL HEALTH MONITORING
FOR

GALENA BRIDGE | **NEVADA DOT**



www.QuakeLogic.net



+1-916-258-3736



info@quakellogic.net

Cutting-Edge Technology

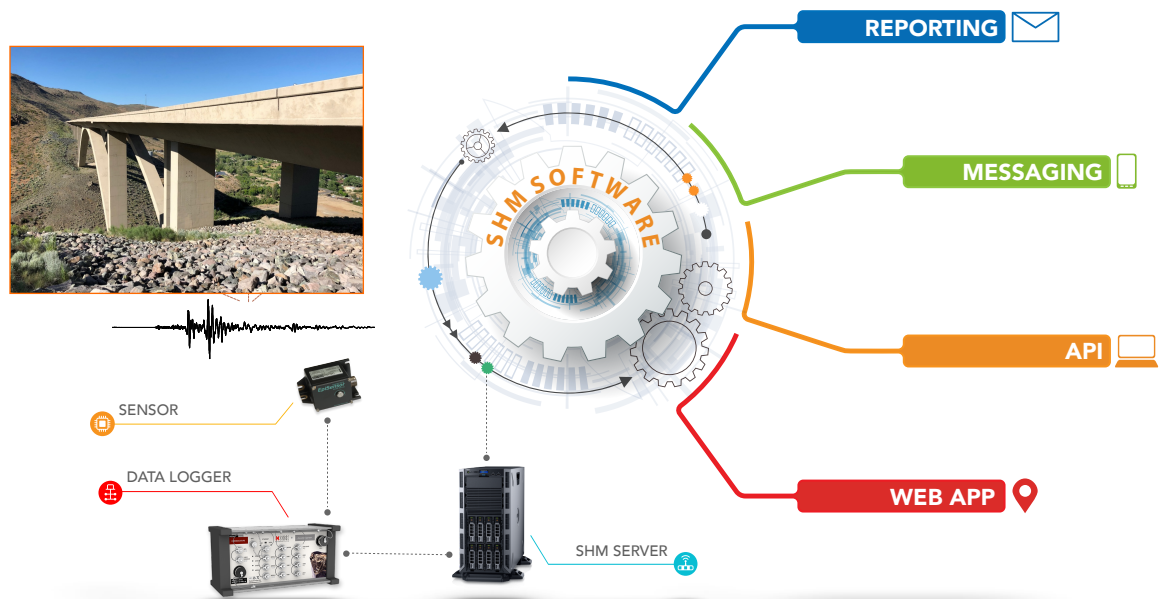
QUAKELOGIC's intelligent technology platform, including Earthquake Early Warning system, is the most sophisticated SHM solution available in its field today. Our platform protects infrastructure, buildings and businesses from the impacts of structural compromise while safeguarding human life, the environment and investor interests.

Cutting-edge technology provides critical real-time information on structural performance. Artificial Intelligence is used to trigger immediate response actions such as road closures and equipment shut-down and send rapid response notifications to decision-makers to prioritize response options based on detailed structural analyses.

Integrated Platform

The QUAKELOGIC integrated SHM platform is a network of hardware and software components that continuously monitors and reports on the health of the structure.

Sensors and data logging devices positioned on the structure are connected to state-of-the-art QUAKELOGIC SHM monitoring software on the on-site SHM servers. This software continuously monitors the integrity of the structure and sends real-time event data to the cloud-based web-application in the form of a customizable management dashboard.



Notifications supported by comprehensive reports are sent within minutes of an event, allowing decision-makers to coordinate emergency responses, prioritize inspections and plan appropriate recovery actions based on accurate, detailed information.

QUAKELOGIC's SHM solution is the only product on the market that uses a cloud-based, AI-powered technology platform to trigger automated intelligent actions, notifications and structural assessments based on real-time sensor data.

QUAKEDASH Intuitive Dashboard

Real-time information about the health of the structure is displayed in the form of a well-designed management dashboard. The mobile-friendly dashboard is intuitive to use and provides drill-down functionality from the initial single-screen overview through increasingly detailed levels of data and information as needed.

The dashboard works seamlessly with QUAKELOGIC's SHM computational platform to organize, store and display current SHM data and reports. Password security is provided to avoid unauthorized access to information.



QUAKELOGIC's dashboard includes advanced features such as sensor display, a map of most recent earthquakes around the globe, fault maps, and much more. The dashboard also provides an asset management layout showing all relevant structural, geotechnical, seismic hazard and other information about the monitored structure.

GALENA BRIDGE SHM SYSTEM

The Nevada Department of Transportation (DOT) has funded the QUAKELOGIC, University of Nevada Las Vegas and Georgia Institute of Technology to implement a permanent SHM system for the world's largest concrete cathedral-arch bridge (Galena Bridge) near Reno, Nevada to monitor the bridge's response in real-time to routine traffic, environmental conditions and seismic activity.



The bridge's unique SHM system consists of 45 high-end sensors including accelerometers, potentiometers, tilt meters and weather stations connected to two 24-bit IP-based digitizers. The superstructure's instrumentation system is complimented with an abutment seismic station housing a triaxial accelerometer and a digitizer. These sensor systems work seamlessly with the QUAKELOGIC's real-time SHM platform. This platform sends immediate notifications to Nevada DOT about structural performance after earthquakes.



QUAKEDOG

Host	Service	Status	Last Check	Duration	Attempts	Status Information
GalenaBridge_FF	CPU Performance	OK	04-02-2020 08:20:31	0d 7h 43m 55s	1/3	OK: CPU idle = 35.03%
	CPU Temperature	OK	04-02-2020 08:23:11	0d 7h 47m 15s	1/3	SENSORS OK
	Current Load	CRITICAL	04-02-2020 08:17:06	0d 32m 35m 30s	3/3	CRITICAL - load average per CPU: 0.70, 0.62, 0.59
	Current Users	OK	04-02-2020 08:14:41	0d 7h 39m 45s	1/3	USERS OK - 0 users currently logged in
	Disk Space	OK	04-02-2020 08:19:03	0d 7h 40m 23s	1/3	DISK OK - free space = 1103 MB (25.18% inode(7%); inodefree 933 MB (20.25% inode(100%); inode 174201 MB (34.95% inode(95%); free 1382 MB (27.46% inode(98%); free(ng) 4195 MB (8.18% inode(72%))
	SSH Process	OK	04-02-2020 08:23:48	0d 7h 43m 36s	1/3	PROCS OK: Earthworm process found running: 29
	SSH RCVD Process	OK	04-02-2020 08:18:50	0d 7h 47m 36s	1/3	PROCS OK: Earthworm process found running: 8
	Memory	OK	04-02-2020 08:17:36	0d 7h 46m 57s	1/3	OK: 1421 / 3679 MB (38%) Free Memory, Used: 2627 MB, Shared: 99 MB, Buffers: 32 MB, Cached: 370 MB
	NTP Time	OK	04-02-2020 08:21:08	0d 7h 3m 18s	1/3	NTP OK: Offset: -0.002279190068 secs
	Ping	OK	04-02-2020 08:18:00	0d 7h 3m 28s	1/3	PING OK - Packet loss = 0%, RTT = 175.82 ms
	SSH	OK	04-02-2020 08:23:43	0d 7h 43m 43s	1/3	SSH OK - OpenSSH_8.3 (precompiled 2.0)
	SSHd (bridge)	OK	04-02-2020 08:14:21	0d 7h 39m 58s	1/3	SSHP OK: 80% free (1508 MB out of 2047 MB)
	Total Processes	OK	04-02-2020 08:21:12	0d 7h 43m 14s	1/3	PROCS OK: 234 processes
	Uptime	OK	04-02-2020 08:14:46	0d 7h 39m 43s	1/3	Uptime OK: 43 days(14 hours) 14 minutes(0)

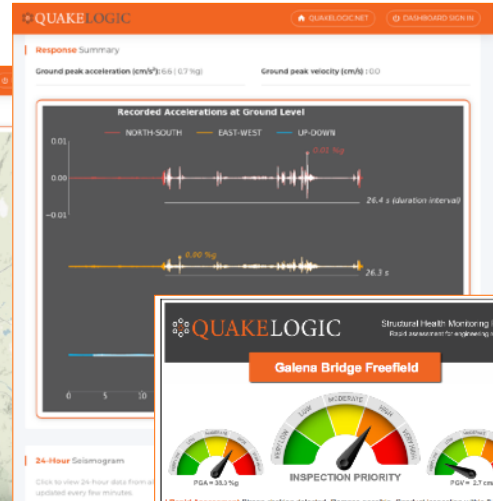
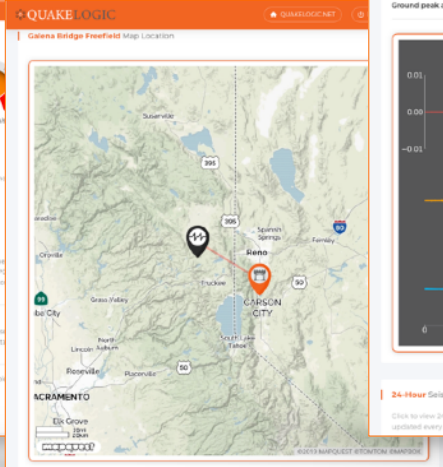
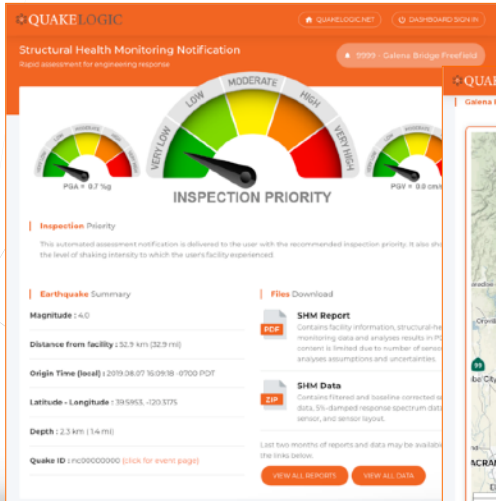
QUAKELOGIC's watchdog system, QUAKEDOG, continuously monitors the entire SHM system platform, including applications, system services, operating systems, network infrastructure and protocols, system metrics and security.



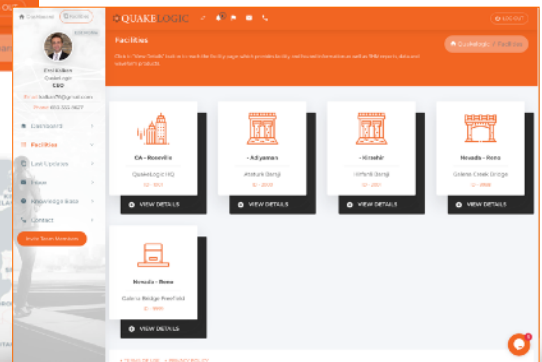
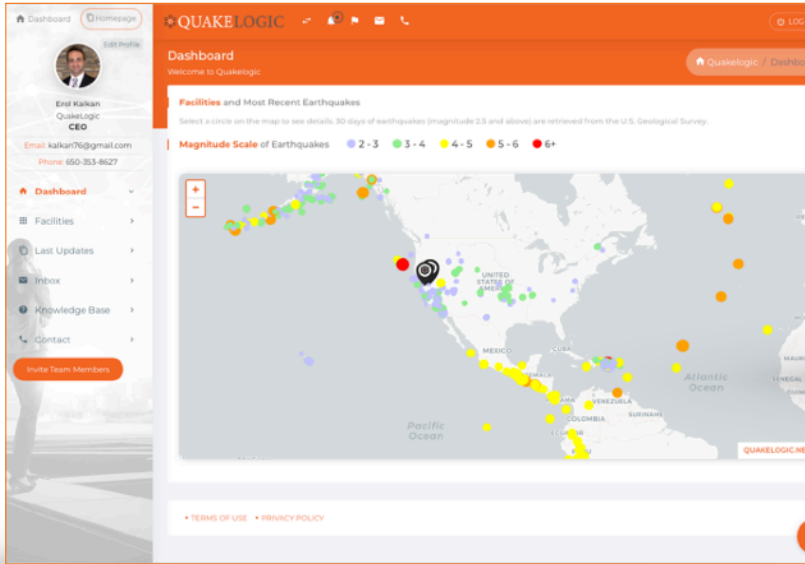
"By working with QuakeLogic, we're finally able to have an accurate realtime earthquake monitoring of our largest bridge for rapid disaster response"

Troy Martin, P.E.

Nevada Department of Transportation



QuakeLogic's SHM system will automatically trigger on predefined events, such as an earthquake, and rapidly send text and email notifications to alert users. It also prepares a detailed assessment report in PDF.



QuakeLogic's mobile-friendly dashboard is a data management framework to support aggregation, storage and reporting of SHM data obtained and analyzed from the users' facilities.



Technical Features

- Earthquake early-warning
- Artificial intelligence and machine learning
- Real-time drift computation
- Torsion and rocking analysis
- Wave propagation analysis
- Modal analysis
- Base-shear capacity vs. demand
- Base-shear, overturning moment and hysteretic response
- Acceleration and displacement response spectra
- Spectrograms
- Frequency response analysis
- Coherence, cross-spectrum phase and cross-correlation
- Fourier amplitude spectra
- Power spectral density
- P-phase picking
- Polarization
- Intensity measures:
 - PGA and PGV, Arias intensity, CAV
 - RMS acceleration, duration interval
 - Cumulative Arias intensity
- Custom fragility function integration
- USGS-PRISM processing (COSMOS)

” Proper monitoring, surveillance and maintenance can provide early detection and intervention — Emergency Response

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