Qube Network: A Low-Cost, High-Sensitivity Consumer Seismic Network for Earthquake Early Warning

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Earthquakes are a major global risk, causing the most fatalities among all natural disasters and billions of dollars in damages. Current earthquake early warning (EEW) systems face significant challenges concerning high cost, low station density, high latency, and large blind zones. First, a low-cost Internet-of-Things (IoT) device, called the Qube, was developed for EEW. It costs less than $100, is the size of a Rubik's cube, and has WiFi access. It detects ground motion and provides on-site warning by sounding the built-in alarm, and regional warning through text messages. The Qube detected all earthquakes over magnitude M3.0 around Los Angeles, small nearby earthquakes down to M1.1, and large distant ones in Peru and Alaska. An empirical formula is developed to estimate local earthquake magnitudes. Then, eight Qubes were built and installed at consumers' homes across Los Angeles, forming a Qube Network for even better EEW. Through a secure AWS cloud platform, they are time synced and remotely monitored and accessible. Live communication among the devices has been established, which can be used to provide longer warning time and reduce false alarms. The Qube Network now provides earthquake detection and early warning across Los Angeles. It has detected multiple earthquakes and issued alerts. The data from the Qubes have been used to estimate earthquake magnitude, calculate epicenter location through trilateration and origin time. A smaller-scale Qube Network, with devices separated by only 3 meters, has been tested to distinguish seismic wave propagation, demonstrating the high sensitivity and low latency of a Qube Network.

Awards Won:
Air Force Research Laboratory on behalf of the United States Air Force: Glass trophy and USAF medal for each recipient
Air Force Research Laboratory on behalf of the United States Air Force: First Award of $750 in each Regeneron ISEF Category