Self-Powered Wireless Sensor Network for Smart Buildings

Gray, Robert

Currently, between single-family residences, multi-family residences, and commercial buildings, buildings consume a significant share of the total energy in the United States, contributing to nearly half the national carbon footprint. Smart building technologies used to reduce energy consumption are expensive and often inaccessible to the public. The authors' objective is to create an accessible self-powered wireless sensor network which will monitor buildings' HVAC systems and improve their efficiency. Their research focused specifically on the use of piezoelectricity to power the devices. Piezoelectric materials generate a potential difference when they undergo a mechanical stress, which can be used as an energy source. The authors tested two commercial cantilevers, the Vulture V21BL (0.66in×2.40in×0.031in) and V22BL (0.24in×2.50in×0.032in), along with cantilevers fabricated in the lab. On a pump vibrating at a frequency of 120 Hz, they generated enough energy to power a temperature sensor using the commercial cantilevers and a commercial power management unit. The authors then successfully powered the temperature sensor using two lab-fabricated 5mm×10mm cantilevers tuned to resonate at 120 Hz connected in series. They used a lab-fabricated ASIC chip operating at 2.2 V for power management. The authors also calculated the energy generated when the cantilevers were set into oscillation from the impact of closing a door. The V21BL device produced 8.53 μJ, the V22BL device generated 3.63 μJ, and a lab-fabricated 0.5mm*7.5mm*10mm cantilever with a rectifier circuit generated 0.638μJ of energy. The authors continue to research the optimized size of cantilever for producing energy from sudden jolts.