Proposed Title for IEEE Sensors Distinguished Lecture Program

Self-Powered Wearable Sensors for Health and Environmental Monitoring

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Abstract

Health care spending continues to rise globally and the costs in U.S. now exceed any other industrialized country. Since chronic diseases makeup majority of the health care costs, a disruptive solution to address the health care challenge is to empower users and providers with technologies that provide personal health status and inform patients and doctors with better choices while also enabling rapid and effective treatment. The hassle-free and battery-free features of wearable sensors devices can not only increase adoption and compliance but also enable long-term and continuous monitoring of many key health and environmental parameters. As an example, continuous monitoring of data can provide doctors with trends in physiological data leading up to a traumatic event, making treatment and medication regimes significantly more rapid and effective, and providing feedback to doctors on efficacy of prescribed medications and long-term physical response. Recent advances in nanomaterials, nanostructures, and nanodevices have increased efficiency of energy harvesters, lowered energy per computational bit, increased capacitor storage density, and enhanced nanosensor efficiency making autonomous operation realizable. In this talk, I will how these advances are being combined together to build self-powered wearable sensor systems, which can enable long-term sensing and effective management of chronic conditions, sensing of personal exposure to air pollutants and toxins and provide longitudinal studies that can provide new insight into correlation of various health and environmental parameters. Such sensor systems can empower patients and providers to manage wellness instead of managing illness, assist in effective treatment of at-risk elderly, reinforce healthy lifestyles, and provide new tools for long-term environmental exposure health studies. In order to achieve self-powered operation, it is essential to maximize the power generated from the body and minimize the power consumed by sensors, computation, communication and power management to achieve the self-powered operation. Recent advances in nanomaterials, nanostructures, and nanodevices have increased efficiency of energy harvesters, lowered energy per computational bit, increased capacitor storage density, and enhanced nanosensor efficiency making a self-powered system finally realizable. To address these needs effectively, the ASSIST Center has focused on engineered systems-level approach where the system levels needs drive all the research. I will discuss the challenges in technology development, including energy harvesting, ultra low power radios and durability, needed to realize these sensor systems and explore the role that data will play in making these systems effective for both the patient and the provider.