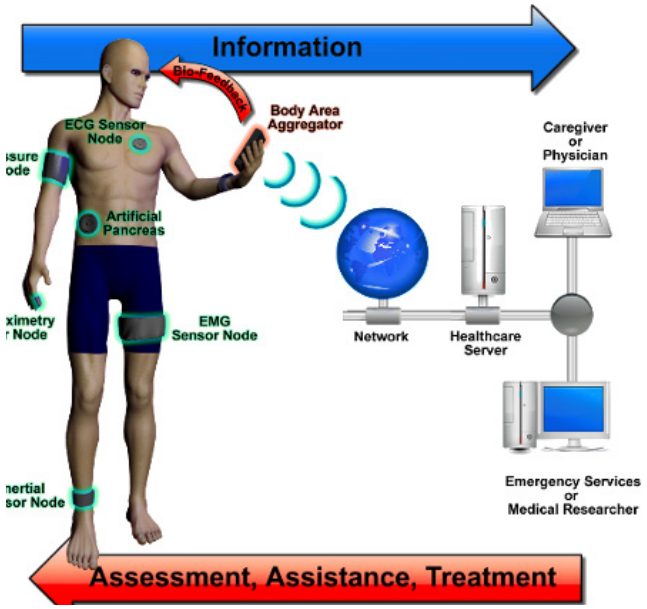
Center for Wireless Health



Our group is primarily interested in body sensor networks for biomedical and healthcare applications, integrated circuit design techniques, and dynamically adaptable and real-time embedded systems. The UVa Center for Wireless Health is an interdisciplinary team of researchers focusing on technology to improve healthcare and healthcare to improve technology. We seek to infuse wireless technologies in healthcare and medical research with the goals of improving patient care and quality of life while reducing healthcare costs. Below are example projects demonstrating the breadth of the work in our lab.

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"Working with doctors and patients to inform our optimization of wearable body sensors to meet medical needs in the most efficient way possible."

UNIVERSITY of VIRGINIA
ENGINEERING

Medical Applications

- We have developed techniques using body sensor networks (BSNs) for fall risk assessment that can be used to identify at-risk individuals and intervene with physical therapy and assistive technologies *before* a fall even occurs.
- We have developed a solution for assessing the efficacy of ankle foot orthoses (AFO) for children with cerebral palsy. By embedding sensors in the AFOs, we can provide continuous, remote, and non-invasive assessments, allowing doctors to longitudinally monitor – and ultimately improve – AFO performance.
- We have developed a method for assessing physical agitation in dementia patients using BSNs. Given that the challenge of dealing with agitation is a primary cause of family members transitioning a loved one with dementia to a care facility, there is a need to study the causes of agitation and to assess various behavioral and pharmaceutical interventions for agitation reduction.
- We are developing and validating methods for high-precision gait analysis using BSNs. These methods are currently being used in the diagnosis of multiple sclerosis and normal pressure hydrocephalus and in the improvement of smart prosthetics for above-knee amputees.

Engineering Research

- BSNs provide long-term, continuous, remote monitoring of physiologic and bio-kinematic information. Because of varying computational, storage and communication capabilities at different layers of the BSN, system designers must make design choices that trade-off information quality with resource consumption and battery lifetime. We are developing objective metrics for information distortion and its effect on decision making to help designers to make more informed trade-offs, and to help practitioners understand the kinds of information provided by the BSN.
- We are participating in a large cyber physical systems approach to the holistic design of BANs. Specifically, we are interested in developing new principles and techniques for reliable adaptive operation in highly dynamic physical environments, using miniaturized, energy-constrained devices.
- We are using embedded hardware and software techniques to dynamically manage the energy-fidelity relationship that exists in many BSN applications, thereby enabling smaller, more wearable devices with longer runtimes.

Platforms and Technologies

TEMPO is an inertial sensing device that incorporates full six degrees of freedom motion capture in a device about the size of a watch. The device uses accelerometers to measure linear acceleration in all three axis, as well as gyroscopes to measure rotational rate in all three planes at sampling rates as high as 128 Hz. The data is then wirelessly transmitted via Bluetooth to an aggregator such as smartphone, laptop, or other mobile device.

RECENT RESEARCH DEVELOPMENTS

- A recent study on normal pressure hydrocephalus patients demonstrated the ability of BSNs to provide higher-precision assessments of motor skills, leading to improved capabilities for differential diagnosis.
- We have embedded sensors in orthoses for children with cerebral palsy and have validated the system's capability for remote, continuous monitoring of activity and gait.

RECENT GRANTS

- NSF – NERC for Advanced Self-Powered Systems for Integrated Sensor Technologies (ASSIST)
- NIH – Correlates Among Nocturnal Agitation, Sleep, and Urinary Incontinence in Dementia
- NSF – Multi-scale QoS for Body Sensor Networks

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