Whitehouse Research Group

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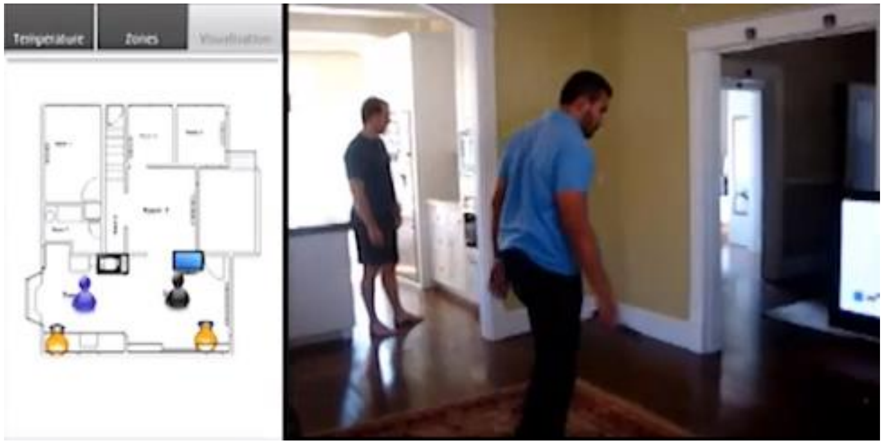

Our research lab develops new technologies at the frontier of Cyber-Physical Systems (CPS), including RF sensing, safety-critical wireless communication, wearable sensors, occupancy sensing, smart buildings, and coordinated control of distributed systems and autonomous drones. Our team develops techniques at the intersection of signal processing, control theory, and machine learning. The technologies created by these projects have been downloaded 50,000+ times, have been used by over half a dozen companies to create new products, and are currently running in millions of embedded devices around the world. We have patents granted and pending in a range of CPS techniques. Prof. Whitehouse is currently leading the creation of the Link Lab as its inaugural director, with the mission to enhance excellence in CPS at U. Virginia. He is a past TPC chair for ACM BuildSys, ACM SenSys, ACM/IEEE IPSN, and EWSN and serves as associate editor of ACM Transactions on Sensor Networks (TOSN) and The PACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT). He earned a B.A. in Philosophy and a B.S. in Electrical Engineering and Cognitive Science from Rutgers University. He earned a M.S. and Ph.D. in Computer Science from UC Berkeley.

"Designing equipment and buildings to more quickly respond to occupant behavior."

University of Virginia
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Energy-efficient Smart Buildings

Buildings account for 40% of the total US energy budget, the largest energy consuming sector in the country, and many government and public organizations agree that a national grand challenge is to achieve a 70% reduction in building energy by 2030. However, energy retrofits are extremely costly. We are developing computational alternatives to conventional retrofits that use a combination of embedded sensing, intelligence, and control to save energy at 10x to 100x lower cost than conventional approaches. A cornerstone of this work is new technology to identify and track individual people, recognize common activity patterns, and detect object usage. These sensing technologies allow buildings to provide heating and cooling, lighting, and water heating services that respond to the dynamics of occupant presence, activities, and goals. Our current data predicts that, if they were deployed in every home, these techniques would reduce total US energy consumption by almost 3%, more than the energy used by the entire commercial airline industry.

Network Tasking

Many forecast that the Internet of Things will grow to over 1 trillion objects in the next two decades. However, people cannot practically coordinate the 1000's of connected objects they will encounter every day to help with their daily tasks. Networks of coordinating devices are too complex to operate with conventional human controls such as dials, switches and knobs. We are creating new tools and techniques to dynamically compose objects in a goal-driven fashion, adapting in real-time to changes in either network resources or high-level objectives. We have demonstrated these techniques in both static networks and networks that include aerial drones. In addition to goal-oriented tasking, we have shown that these tools enable system-level analysis, run-time visibility and debugging, and testing and verification, even in the face of severe limitations on energy, memory, and bandwidth.

RECENT RESEARCH DEVELOPMENTS

- The Smart Water Heater
- The Smart Thermostat
- The Doorjamb Tracking System
- The Smart Blueprints auto-commissioning system
- The SunCast daylight prediction system

RECENT GRANTS

- NSF – Collaborative Sensing: An Approach for Immediately Scalable Sensing in Buildings
- NSF – HomeSHARE - Home-based Smart Health Applications across Research Environments
- NSF – The BetaHome Network: A Multi-Home Testbed for Smart Building Technology
- NSF – Occupant Oriented Heating and Cooling

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