

# **Wireless Sensor Networks: Concept, Technologies, Techniques, Opportunities and Research Challenges**

The recent advances and the convergence of micro electro-mechanical systems technology, wireless communications, integrated circuit technologies, microprocessor hardware and nano-technology as well as progress in ad hoc networking routing and protocols, distributed signal and array processing, pervasive computing, and embedded systems have made the concept of Wireless Sensor Networks (WSNs) technologically feasible and economically viable and enabled the development of low-power, low cost, small in size and multifunctional sensor nodes that integrate general-purpose computing with multi-purpose sensing and wireless communications capabilities. WSNs differ in many fundamental ways from Mobile Ad-hoc Networks (MANET). Sensor networks with large and diverse of sensors has the potential to impact on the quality of all areas of life and realizing such potential is significant because of the multidisciplinary nature and complexities involved. A wireless sensor network (also called ad hoc or multi-hop networks) is composed of a large number of sensor nodes or "motes", which are densely deployed either inside the phenomenon or very close to it. Motes form the building blocks of wireless sensor networks. It is expected that these small sensor nodes, will be mass-produced and deployed, making their production cost negligible. These tiny sensor nodes, which consist of sensing, on board processor for data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes. Instead of sending the raw data to the nodes responsible for the fusion, sensor nodes use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data. Large scale, dynamically changing, and robust sensor colonies can be deployed randomly in inhospitable physical environments such as remote geographic regions or toxic urban locations, or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities to enable sensors to communicate with each other and to coordinate and exchange data on a larger sensing task. This will revolutionize information gathering and processing in many situations. Individual sensor nodes have a small, self contained, non-renewable power supply and once deployed it must work unattended. Data from individual nodes moves across the network by wirelessly hopping from node to node (hence the "multi-hop" label), typically flowing towards a super-node, or server, with greater processing power. All of these have made sensor networking a topic of active interest to collaborate sensing tasks.

Potential applications of sensor networking include but not limited: environmental monitoring, health care monitoring, safety and security, law enforcement and fighting terror threats, battlefield surveillance and reconnaissance, intelligent systems and networked robots, modern highway and intelligent transportation systems, construction, modern manufacturing and factory automation, optimize farming and irrigation monitoring and control, condition-based maintenance of complex systems, disasters and relief (earthquake, volcanoes, flood, bush fires, etc.), space and sea exploration, habitat monitoring, agriculture and forestry, and many others. Selecting the optimum sensors and wireless communications link requires knowledge of the application, and problem definition.

The ideal wireless sensor is, networked and scaleable, fault tolerance, consume very little power, smart and software programmable, efficient, transmission media, capable of fast data acquisition, reliable and accurate over long term, cost little to purchase and required no real maintenance. In addition, the main challenges issues facing the expansion of the technology and realizing innovated applications are: the

size of sensor nodes, cost, power consumption, communication protocols and algorithms, dynamic and self-organization capability and changing network topology, scalability, fault tolerance, sensor fusion and tracking, security issues in wireless sensor networks, collaborative processing, scheduling and resources optimization, intelligence, etc.

This workshop will enable the participants to,

- Familiarize with a high level and state of the art presentation on Wireless Sensor Networks, covering key concepts and their various applications,
- Understand the technology associated with Wireless Sensor Network and explore ways that enables process improvement and the development of new products and services,
- Be aware about the potential and limitation, and the challenging issues facing the development of this booming area, and
- Current and future applications

There will be two lectures.

**Speaker:** Prof. Maki K. Habib  
**Organizer:** Prof. Maki K Habib  
**Duration:** Half a day

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