

Challenges and Opportunities for Sensor Networks

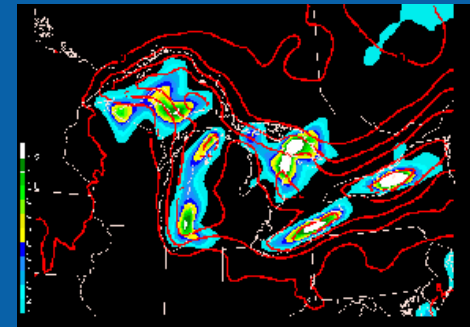
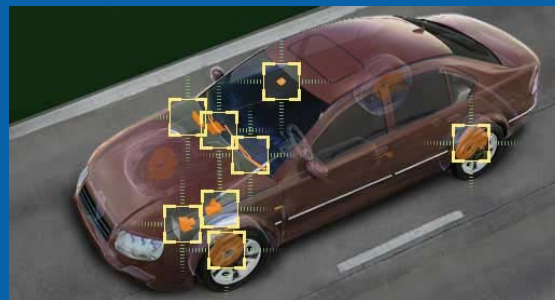
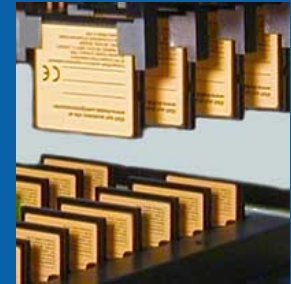
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Sensor networks

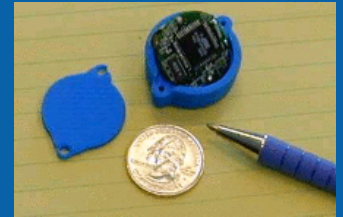
“A computer network of many, spatially distributed devices used to monitor conditions”

- Wide, varied usage
 - Manufacturing automation
 - Surveillance & security
 - Weather & disaster prediction
 - Automotive safety & efficiency



Technology Trends and Effects

- Ad-hoc wireless networking
 - Real time sensor data no longer requires wires
- Dense solid-state storage
 - Data can be stored at the sensor
- Fast, power efficient processors
 - Data analysis can be done at the sensor
- Wealth of small, inexpensive sensors
 - The scale and variety of uses has changed

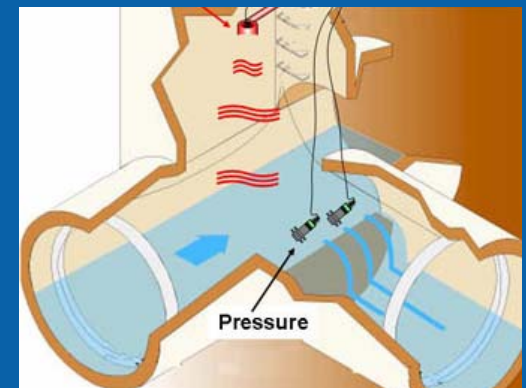


Easily deployed, inexpensive, sensor-agnostic, wireless sensor networks

New usages and applications

Affordances of wireless sensor networks have driven new classes of applications

- Disaster & emergency response
- Precision agriculture
- Proactive home maintenance
- Personal health monitoring
- Wildlife conservation



Key Research Areas

- Sense making & inference
- Privacy & security
- Power management



Sense Making & Inference

Data from large number of heterogeneous sensors requires sophisticated inference techniques

- Typical: Direct observation of the phenomenon of interest
 - *Magnetic switch measures door opening*
- Atypical: Phenomenon is inferred from data from many different sensors
 - *Hurricane service predicts storm based on wind speeds, air and water temps over wide area*
- In the research labs
 - Generic inference tools for applications to learn activities from generic sensor data
 - Shown to recognize everyday activities like walking, cooking, dressing



Privacy & Security

Systems can provide privacy and security both at the sensors and in the infrastructure

- Encrypting stored and transmitted data
 - Existing encryption can be applied
 - Versions have been tuned specifically for sensor platforms
- Reliable Secure Authentication
 - Sensors themselves offer opportunity to strengthen authentication
- Disguising radio transmission
 - Tracking devices can be thwarted via radio and protocol changes



Power Management

Sensor nodes should run months, if not years between battery charges

- State of the art
 - Dense lithium-polymer batteries
 - Solar recharging when possible
 - Ultra-low power sleep modes to prolong life
- Coming soon
 - Ultra Wide Band (UWB) should make short-range wireless networking much more efficient
- In the research labs
 - Power harvesting from alternative sources
 - E.g. vibration, induction, ambient radio signals



Summary

The Wireless Sensor Network

- Was born from recent computing advances
- Will be flexible, powerful, easily deployed and inexpensive
- These affordances give rise to new applications
- They also raise challenges:
 - Power management
 - Maintenance
 - Sense making & inference
 - Privacy & security

