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Ubiquitous Computing for Disaster Mitigation, Response and Recovery

Friday, July 5

Mission Statement

To save lives and minimize damage from disasters through timely prevention, detection, prediction, and coordination.

Enabled by breakthroughs in ubiquitous sensing/actuation, computation, analysis and communication systems.

Technical Challenges

extreme environments and real-time response

- Embedded multi-modal sensor/actuator systems architecture
- Sensor/actuator & communication services
- Sensor information fusion, analysis
- Coordinated response

Embedded multi-modal sensor/actuator systems architecture

- Systems that combine installed, strategically deployed, and mobile nodes to sense and respond to disasters and follow-on events
- Rapid and adaptive configuration
- Adaptive and collaborative sensing/actuation among resource-constrained devices (BW, storage, power)
- Biocompatible devices for medical assessment, delivery

Sensor/actuator & communication services

- Localization and mapping (of victims, rescuers, resources,…)
- Resource mobilization (e.g., robots, sensors, actuators)
- Real time response
- Secure, robust, communication systems
  - » Recovery from faulty networks
  - » Reconfigurable networks (self-*)

Sensor information processing

- Information food chain
  - » Calibration of devices
  - » From signals to information
  - » Fusion of multiple sensor modalities
  - » Learning usual and unusual patterns
- Integration with external information sources
  - » e.g. building blueprints, utilities plan, transportation systems, individuals as sensors
  - » Mining and analysis across heterogeneous, unreliable data bases
- Modeling, prediction, planning, and visualization of environment changes due to disaster
  - » e.g., structure collapse, micro-meteorology, “what if” scenarios

Coordinating Response
(Incident Command Response)

- Command and control
  - » logistics, tracking
  - » status reporting
  - » dynamic device and resource reconfiguration
- Communication
  - » data dissemination
  - » language translation
- Interfaces
  - » stressed-user interfaces
  - » multiple visualization formats

Metrics for Success

- Saved lives
- Injury mitigation
- Response-time reduction
- Cost per response
- Mortality of rescuers
- Rate of Technology adoption
- Increase in preventing disasters

Social Barriers

- Monitoring concerns
  - » Privacy
  - » Invasiveness
- Trust of the system
  - » Safety
  - » Rescue personnel resist unproven technology

Spin-offs: From Reactive to Proactive

- Preventative health care (e.g., eldercare)
- Preventing incipient and secondary disasters (e.g., structural integrity monitoring)
- Containing environmental degradation (e.g., contaminants, CO_2, biodiversity…)
- Intelligent transportation systems
- Smart spaces (e.g., classrooms)

Accelerated deployment of ubiquitous computing to improve quality of life