Introduction to Pervasive Computing

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Talk Overview

• Sensors: History and Evolution
• Promising Applications of Sensor Networks
• Grand Challenges
• Programming the Sensor Network
• The Atlas Sensor Platform
  – Service-Oriented Architecture
  – Sensor Plug and Play
• Case Studies in the Gator Tech Smart House
• Standards for Sensor Networks
• Concluding Remarks
The Computer Evolution

Mainframe Computer, 1960

The PC, 1980

Mobile Computer 1990

Sensor Platforms 2000

Smart Dust …
Sensor Network Forecast

• “The Quest for the Next Big Thing”
  – Business Week, August 2003
    • Utility Computing
    • The Sensor Revolution
    • Plastic Electronics
    • Bionic Bodies

• “10 Emerging Technologies That Will Change The World”
  – MIT ENTERPRISE TECHNOLOGY REVIEW, Feb. 2003
    • Brain-Wireless Sensor Networks
    • Grid computing
    • Software Assurance
    • and more
Trend – Faster, Smaller, Numerous

- **Moore’s Law**
  - “Stuff” (transistors, etc) doubling every 1-2 years

- **Bell’s Law**
  - New computing class every 10 years

We will soon be able to know almost everything about everyone.
Promising Applications

Sensor Network Applications

- Environment
- Daily Life
- Public Service
- Industrial Business
- Civil Engineering
- National Defense
- Transportation
- Buildings
- Roads
- Bridges
- Homes
- Cities

Sensor Deployment

Sensor Networks for Pervasive Service

Excerpted and modified from ‘Ubiquitous City Plan’, NCA, Korea, 2005.
Promising Applications

**Daily Life**
- Home Automation
- Home Security
- Sports & Fitness
- Weather Forecasting
- Childcare / Baby monitoring
- Elderly remote monitoring
- Local Community Activities

**Public Service**
- Energy Saving
- Water Resource Saving
- Smart Schools
- Smart Learning
- Medical Service
- Rehabilitation
- Medical Surgery/Treatment
- Healthcare & Immunization
- Postal Service
- Governmental Service

**Transportation**
- Traffic Monitoring
- Traffic Accident Avoidance
- Transportation Traceability
- Connectivity Optimization
- Shortest Routing Service
- Logistic & Delivery
- Vehicle Sensors
- Tire Pressure Real-time Monitoring sensors
- Roadside sensor deploying

**Environment**
- Monitoring Ocean Pollutant
- Monitoring Terrestrial Habitants
- Natural Disaster Avoidance
- Foods Traceability
- Agriculture Automation
- Poultry & Meat Traceability
- Man Disaster Avoidance
- Integrated Biology
- Habitant Monitoring

**National Defense**
- Military Operation Assist
- Military Resource Management
- Personnel Management
- Tactics & Battlefield Assist
- Logistic Traceability
- Frontier Guard Assist
- Open public space Surveillance (airports...)
- Mobile C4I Services

**Industrial Business**
- Sales Market Monitoring
- Logistics and Delivery
- Office Automation
- Manufacturing Automation
- Factory Automation
- Building Automation
- Legacy SCM, CRM and ASP Interface
- Resources Sensing (underground resources)

**Civil Engineering**
- Logistic
- Bridge Health Monitoring
- Architecture Monitoring
- Structural Monitoring
- Engineering Measurement
- Tension & Cracks Monitoring
- Road Monitoring
- Corrosion Monitoring
Daily Life Applications
- Home Automation

- MOODS: eHome can create your entertainment atmosphere.
- CURTAINS: eHome can open your curtains.
- eCAM: eHome gives you access to cameras over the internet.
- SECURITY: eHome can connect to your security system.
- SPRINKLERS: eHome can water your garden.
- LIGHTING: eHome can create lighting effects.
- HVAC: eHome can turn on/off your heating, ventilation and air conditioning.
- GARAGE: eHome can open your garage.
- APPLIANCES: eHome can time clock your appliances.
- SHUTTERS: eHome can close your shutters.
Smart Homes are coming ....
Smart Grocery Shopping

The Dollar Stretcher
Living Better...for Less
Public Service Applications
- Medical Service

• Healthcare: Embedded Sensor networking for patient monitoring

Transportation Applications
- Vehicle Sensors

• Smart Cars?
  – Safety
  – Power/energy saving
  – Navigation & Tracking

Transportation Applications

Environment and Civil Engineering Applications

- Environmental Monitoring
  - Habitat Monitoring
  - Structural Monitoring
National Defense Applications

- Surveillance Platform

Industrial Business Applications
- Supply Chain Management

- Logistic or Transportation Provider
- Goods Tracing Server (GTS)
- Logistic or Transportation Server (MLS)
- Mobile Logistic Server (MLS)
- Goods Information Server (GIS)
- Terminals
- Internet
- GPS
- WLAN/Bluetooth
- GSM/GPRS
- RFID Reader
- Passive RFID Tag
- Thinking Tag
- Mobile Logistic Server (MLS)
- Tag Reader
- short range radio

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Grand Challenges

- Large Scale Distributed processing requiring decentralization
- Long life-time requirement
- Reliability (no-repair failure model)
- Deployment
- Configuration and Network Management
- Programming the Sensor Network
- Others.
The Computer Evolution

- Cobol
- ANSI Standard
- Client/Server
- TCP/IP
- Synchronization
- SyncML
- ?
- ?