The Role of Sensors in Our Daily Lives

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Sensors and Embedded Systems

- **Sensors**: collect data from the physical world
- **Embedded systems**: process and transmit that sensed data
Sensor Systems Are Already Around Us

- The modern automobile is an example
  - Provide critical safety features
    - Anti-lock braking, collision avoidance, traction control, etc
  - Once luxury features are now mandated
The Vision of Computing with Sensors

- Implicit interaction
- Invisible
- Provide appropriate feedback to user
Extending the Vision to Other Applications

- **Health**
  - Home health, remote care, on body sensors

- **Safety**
  - Roads, bridges, homes

- **Sustainability**
  - Energy and water use monitoring, demand response
Health

- Microsoft Kinect
- Mobile Phones
- On body
- Smart Homes
Safety

- Bridges
- Tsunami alerts
- Home safety and loss prevention
Sustainability

- Energy and water monitoring
- Automated appliance and lighting control
- Smart grid energy load balancing
Residential Resource Monitoring Example

**Energy**
- Commercial: 18%
- Industrial: 32%
- Residential: 21%
- Transportation: 29%

**Water**
- Industrial: 12%
- Unaccounted Water / Public Use and Losses: 15%
- Commercial: 17%
- Residential: 56%
- Thermoelectric Power: 0.30%
Municipal Services Statement

Account Number: 100687-00154711
Utility Amount Due: 127.52
Voluntary Donation: 1.00
Total + Voluntary Donation: 128.52
Date Due: 1/9/2007

Account Activity

Date Description Amount
12/12 Water Consumption 20.11
12/12 Water Service Charge 13.99
12/12 1% Delinquent Fee 0.40
12/12 Sewer Charge 11.48
12/12 Residential Refuse 17.41

Keep the bottom portion of this statement for your records.

Bill date: 12/12/2006
Previous meter reading: 16305
Gallons delivered: 20,200
Next meter reading: 27

City of Tempe
P.O. Box 29617
Phoenix, AZ 85038-9617
480-350-8361
480-350-8400 (TDD)

Mark if address change requested on reverse side.

Enter Amount Paid: [Blank]

Make checks payable to the City of Tempe.

PLEASE FOLD BEFORE TEARING
Residential Resource Monitoring

- 15-20% reduction in energy use with appliance-level feedback
  - Studies date back to the 70s
    - Sensor deployments were challenging
    - Had to install sensors at every appliance location
New Approaches

Sensing and Hardware  Signal Processing & Machine Learning  Feedback Interfaces

- Single-point sensing for whole home energy itemization
- Infer device usage from noise
- Provide actionable feedback
New Challenges

- Battery life of sensor systems
- Power harvesting techniques

Battery technology (density)
Summary

- Have made a lot of progress in sensors and systems to support them

- Huge amount of potential in applying them to important applications

- Emerging need for low-power solutions and ways to provision sensors
Questions?