

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



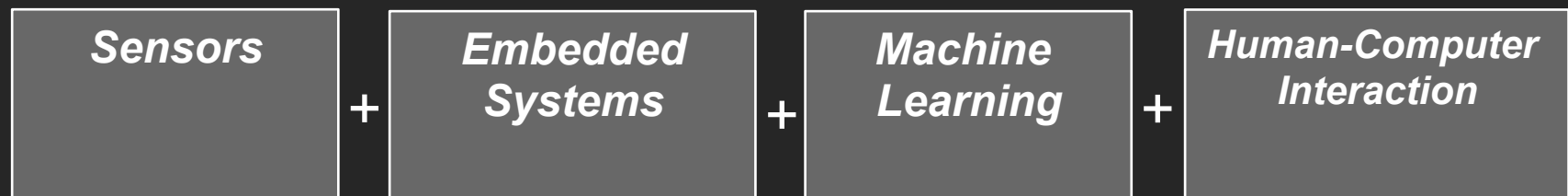
Sensor Systems Are Already Around Us

- 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

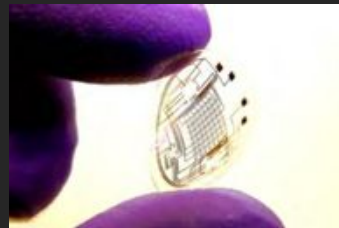
- Microsoft Kinect



- Mobile Phones



- On body



- Smart Homes



Safety

- Bridges



- Tsunami alerts



- Home safety and loss prevention



Sustainability

- Energy and water monitoring



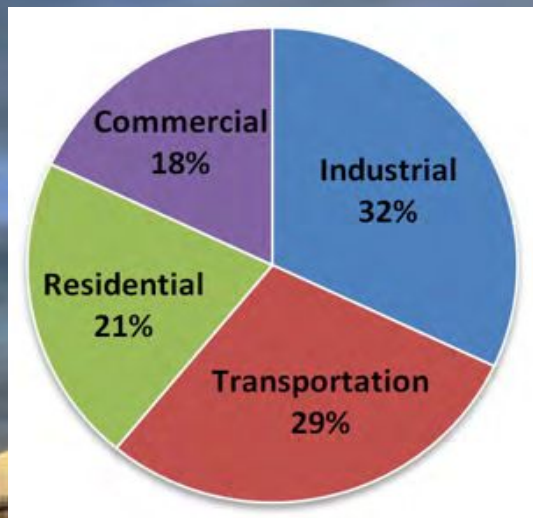
- Automated appliance and lighting control

- Smart grid energy load balancing

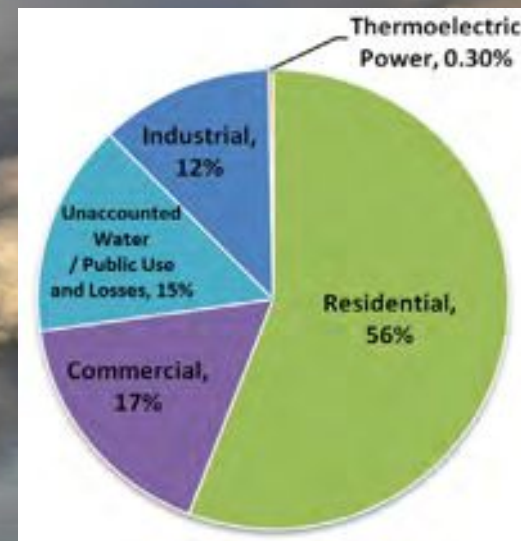


Residential Resource Monitoring Example

Energy



Water





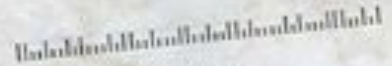
Municipal Services Statement



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

000012752000000000100687001547118

Account Number: 100687-00154711
Utility Amount Due: 127.52
Voluntary Donation: 1.00
Total + Voluntary Donation: 128.52
Date Due: 1/8/2007



LINDER HOLLINQUEST
7450 S KENWOOD DR
TEMPE AZ 85283-4921

Mark if address change requested on reverse side

Enter Amount Paid:

Make checks payable to the City of Tempe.

PLEASE FOLD BEFORE TEARING

Return the top portion of this statement with your payment.
Keep the bottom portion of this statement for your records.

See reverse side for important information.

Account Number: 100687-00154711
Current meter reading: 16007

Billing period: 12/2006
Previous meter reading: 16305

Service Address: 7450 S KENWOOD LN
Gallons delivered: 20,200
Meter read date: 11/20/2006

Days of service: 27

Account Activity

Date Description
Payments Received Thank You
12/12 Water Quality Fee
12/12 Tempe City Tax
12/12 State Tax
12/12 Sewer Service Charge

Amount
100.00
0.13
0.61
2.15
7.28

Date Description
12/12 Water Consumption
12/12 Water Service Charge
12/12 1% Delinquent Fee
12/12 Sewer Charge
12/12 Residential Refuse

Amount
20.11
13.99
0.40
11.48
17.41

Date Due: 1/8/2007
date on bill for regular charges. For Amex & Discover payments accepted, call 480-350-8361

Emergency Fees + New Charges	Other Dues	Utility Amount Due	Voluntary Donation	Total Including Voluntary Donation	
3.45	73.56	0.00	127.52	1.00	128.52

153.96 100.00 0.00

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

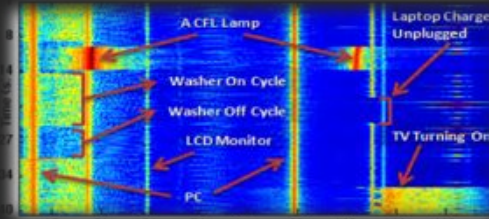
Feedback Interfaces



Electricity



Water



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

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?