

*Casting a wider net:
New applications for wireless sensing*

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Casting a wider net: New applications for wireless sensing

Presentation overview

- Background of Sensors and Devices group
- What *are* wireless sensor networks?
- Prototyping sensor network applications

Sensors and Devices at MSR Cambridge

- Applied research into embedded hardware
 - Sensors, actuators, displays & wireless comms
 - Ubiquitous, mobile & peripheral devices
- Unusual perspective and context
 - Technological expertise
 - Sensitivities to and insights into usage
- Develop technology and applications together
 - Consider the complete *system*
 - Particularly relevant to wireless sensor networking

The importance of hardware

“People who are really serious about software should make their own hardware.”

– Alan Kay

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- 'Hardware' is becoming increasingly diverse
 - Communications, power consumption, form factor
 - Input and output modalities
- Especially true for wireless sensor networking

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- Example applications

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Understanding wildlife

Great Duck Island
ZebraNet

Disaster detection/recovery

Flood detection
Avalanche
Forest fire
Evacuation

Smart environment

Building management
Cold chain

Health

Physiological conditions
Patient and doctor location

Learning about the environment

Pollution
Glaciers
Vineyards

What *are* wireless sensor networks?

- Properties that characterise WSN technology

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Radio communications

Low power

Redundant

Ad-hoc topology

Peer to peer

Multi-hop

Autonomous

Spatially distributed

Small

Embedded

Example #1

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Example #2

Whereabouts clock





Whereabouts clock – trial outcome

- Coordination
 - ‘Put the kettle on’ moments
 - Messaging
- Connectedness
 - Those inside the home and those outside
 - Across different homes
- Reassurance
 - Telling family members what they already know
 - Chimes communicating routine
- Identity
 - Labelling activities
- Social touch
 - Explicit messaging

What *are* wireless sensor networks?

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MANET

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Social connectivity

Example #3

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Prototyping sensor networking applications

- Exploring applications through deployment is valuable...
 - ... but building prototypes is hard
- Especially true for wireless sensor networks
 - Small
 - Low-power
 - Multiple instances

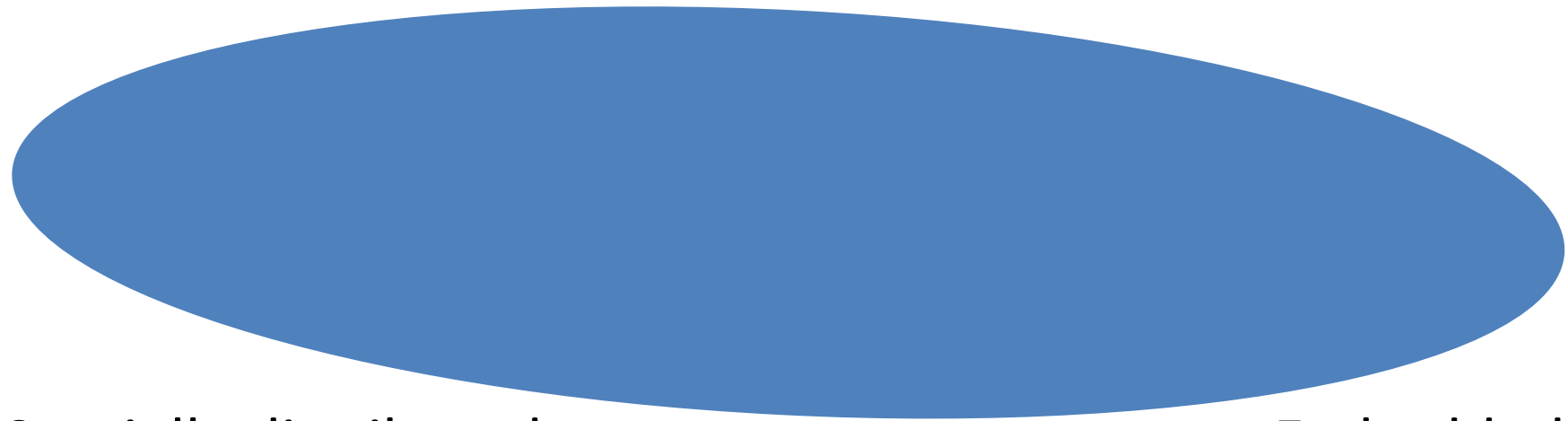
Prototyping sensor networking applications

- Hardware platforms
 - Motes (x n), scatterweb, Smart-its, Particles, BTnodes, Sun SPOT, Fleck, ...
- Software
 - TinyOS, AwareCon, embOS, Salvo, Contiki, Tiny PLUS, uC/OS-II...
- Each provides different pros and cons
 - *Largely* target mobile ad-hoc (MANET) WSNs

Prototyping sensor networking applications

Radio communications

Low power



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a wider range of
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Prototyping sensor networking applications

Work in progress...

- A new wireless actuator and sensor platform
 - Maintain flexibility, size, power consumption, robustness
 - Proof-of-concept and beyond, multiple instances
- Modular approach to hardware
 - Modules small, but different sizes
 - Flexibility of physical arrangement – tile, stack etc.
 - Electrical and physical interconnect

a wider range of

Prototyping sensor networking applications

Work in progress...

- Modular approach (contd)
 - SPI-based bus (10MHz), few wires
 - In line with modular nature of peripherals
- Large range of modules possible
 - Base, processor module – ARM7, USB, power mgmt
 - Wireless – BT, GSM/GPRS, Zigbee, other...
 - Sensors – tilt, touch, light, temp, e-compass, etc
 - I/O – displays, LEDs, buttons, touch, vibrate, sounder

a wider range of

Prototyping λ sensor networking applications

Work in progress...

- Plug together hardware, then develop firmware
- New possibilities for development
 - Initial coding on PC only
 - Communicate with real hardware via USB proxy
 - Transition to embedded tools late in development
 - Simplified monitoring of I/O communications

Summary

- Reflect on what we mean by 'wireless sensor networking'
- Think about applications and technology hand-in-hand
- Make it easier to prototype ideas

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Shameless plug – opportunities at MSR Cambridge

- 3 month internships
 - http://research.microsoft.com/aboutmsr/jobs/internships/about_uk.aspx
- 2 year post-doc positions
 - http://research.microsoft.com/aboutmsr/jobs/fulltime/about_postdocs_UK.aspx



A	X	90	40	100
W.11115	Y	10	90	