Mobile Phone Sensing

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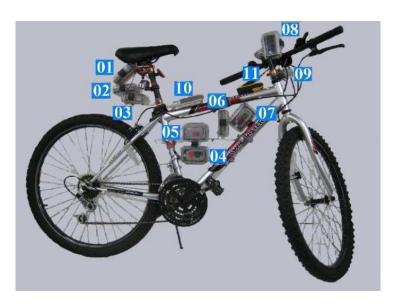
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- Motes are not ubiquitous
- There's only so much a mote can do
- Motes are still costly (no economies of scale)
- Untethered operation comes with lots of cons
- Motes and humans don't relate to each other

- Mobile Phones as high-end gateways
- Motes report their data to the sink...
- ...and the sink passes it on to a phone

01 = mike
02 = magnetometer
03 = pedal speed
04 = inclinometer (tilt)
05 = sink with 802.15.4-to-Bluetooth interface
06 = lateral tilt
07 = Galvanic Skin Resistance Stress Monitor
08 = Mobile Phone
09 = Speedometer and odometer
10 = CO_2 meter
11 = GPS

S. Eisenman et al., **BikeNet: A mobile sensing system for cyclist experience mapping**, ACM Transactions on Sensor Networks, 2009

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- The phone is not as resource- and energy-constrained
- Computationally intensive tasks may be performed on the phone
- If only the phone could also *sense*...

- Proximity sensor (is the phone close to your face?)
- Accelerometer
- Gyroscope (measures orientation)
- Digital compass
- GPS
- Camera
- Microphone
- Ambient light sensor (regulates brightness)
- Back-illuminated sensor (low-light camera performance booster)
- Moisture sensors (warranty-related legal quagmire)

- Today's smartphones can indeed sense!
- Lots of sensors on board
- Smartphones are becoming ubiquitous
- There's a lot a smartphone can do
- Cost is no issue – people buy them anyhow
- No need to worry about untethered operation
- Smartphones and humans do relate to each other

N. Lane et al., **A Survey of Mobile Phone Sensing**, IEEE Communications Magazine, 2010

- **Energy** no longer drives every aspect of the design
- **Communication** is infrastructure-based
- The **scale** is potentially huge
- The focus is on the **application**
- Only partial overlap with WSN **app spectrum**
- **Humans** can be leveraged
- **Deployment** comes for free

- WSN: every Joule matters
- MPS: people recharge their phones

Energy is still a constraint
- The footprint of your application should be negligible with respect to the footprint of communication
- Your end users will be very upset if that is not the case

- WSN: many stationary nodes covering a limited area
- MPS: many mobile nodes covering (potentially) the whole world

- WSN: *many* means *hundreds* or *thousands*
- MPS: *many* means *millions* or *billions*

Relatively little overlap between the app spectra of WSN and MPS

• WSN: anything that is best done without humans
Non-invasive monitoring in remote or unsafe locations

• MPS: anything that is best done with humans
Leverage people to gather people-centric data

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Participatory Sensing
The user actively inputs information

Opportunistic Sensing
Get the data in the background, don't get the user involved

Application Examples

Transportation Monitoring

Collect data from mobile phones to map the traffic in real time
(http://traffic.berkeley.edu)

Social Networking

CenceMe: use MPS to classify what you're doing and share it with your
friends (www.cenceme.org)

Health and Fitness

Classify your daily activities to self-monitor how much exercise you get
(http://ils.intel-research.net/projects/ubifit)

People-centric environmental monitoring

Monitor exposure to and generation of pollution
(http://urban.cens.ucla.edu/projects/peir)

Your Smartphone May Not Be Enough