Automatic Activity Recognition on Mobile Phones

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Long-term goal

- Detect PA type, intensity, and duration in real-time using mobile phones and miniature, wireless accelerometers
- Create an open-source and low cost hardware and software system that permits population-scale studies to be deployed and run for months+ on common mobile phones
- Evaluate of validity, usability, and acceptability of the system
Wockets wireless accelerometers

- 3-axis, 90Hz, raw accelerometer data
- Multiple sensors transmit to phone in real-time
- Optimized for size, affordability
- Worn comfortably under clothing or in pockets
Wockets wireless accelerometers

• Robustness
• Bluetooth Support
• Extremely small form factor
• Truly mobile
• Data consistency
• Consistent sampling rate
• Open source community
Real-time activity type recognition

- All software for activity type detection (algorithm training & testing) ported to phone and running in real-time
- Use internal and external accelerometers
Real-time activity type recognition

Non-dominant upper arm

Dominant Foot

Hip

Dominant wrist

1s
Cubic Spline Interpolation

Data window (1s)

Before interpolation

After interpolation
Feature Extraction

For each of the acceleration axes, compute features such as...

**Signal variability**
- Variance

**Posture information**
- Posture Distances

**Activity intensity**
- Energy between 0.3-3.5Hz

**Frequency/periodicity of motion**
- Top 5 peaks of the FFT

**Simultaneous patterns of limb motions**
- Correlation between various axes and sensors
Training Classifier

ACVar (9)
ACFFTPeaks (90)
ACBandEnergy (9)
DCPostureDist (9)

[val_1 val_2 … val_117]
Vector size: 117

C4.5
Decision Tree Classifier
Real-time Classification
Wockets, phone, real-time recognition, real-time activity training...
Data collection at Stanford

New “obstacle” datasets of people doing everyday things while moving around the Stanford campus will be used to help improve activity recognition and determine how to optimize wireless transmission in new designs and usability.

Now adding:
- Wockets (wrist, ankle, hip)
- Phone (accel + GPS)
- GPS (pocket)
- Air quality sensors

+ BodyMedia armband

Oxycon mask
Oxycon harness
Polar strap
Zephyr bioharness
MITes wireless accelerometers
Actigraph
Omron
Wockets website
(overview, join mailing lists)

http://web.mit.edu/wockets

Wockets Wiki
(designs, questions, code, ideas…)

http://wockets.wikispaces.com