myHealthAssistant: A Phone-based Body Sensor Network that Captures the Wearer's Physical Activity throughout the Day

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Motivation, State of the Art, Main Objectives

Activity Recognition for Special Purposes
- Detection of daily activities [Kwapisz et al., Human Factors 2010]
- Detection of gym exercises [Chang et al., UbiComp 2007]
→ How to combine both?

Middleware and Activity Recognition
- Activity recognition with regard to given sensor constellation (e.g., daily vs. gym activities)
- Middleware handles constellation changes and triggers the corresponding activity recognition

Results, Ongoing Work

Daily & Gym Activities
- 5 fitness-relevant daily activities
- 16 gym activities
  - 5 cardio
  - 11 weightlifting incl. counting
- Activity recognition based on
  - Multivariate Gaussian model
  - Maximum likelihood method

Embedded Inertial Sensors
- Embedded in fitness accessories
- Custom prototype node with accelerometer
- 100Hz data pre-processed on sensor
- 1 second window, per axis: mean, variance, peaks

Daily Activity Recognition

<table>
<thead>
<tr>
<th>Walking</th>
<th>Running</th>
<th>Cycling</th>
<th>Standing</th>
<th>Sitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>3208</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Running</td>
<td>0</td>
<td>3094</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Cycling</td>
<td>0</td>
<td>0</td>
<td>2938</td>
<td>0</td>
</tr>
<tr>
<td>Standing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3120</td>
</tr>
<tr>
<td>Sitting</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Accuracy</td>
<td>100%</td>
<td>99.9%</td>
<td>99.5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Gym Activity Recognition
- Overall precision: ~92%
- Overall recall: ~95%
- Counting of weightlifting exercises
  - Normal workout speed: ~2.4% miscounts
  - Fast workout speed: ~12.1% miscounts

Adaptive Workout Counting (Ongoing)
- Wrist's mean values are sufficient for normal speed
- On-sensor peak detection for fast workout speed
- Chosen based on history of recent variances

The Whole System
- Low impact on the phone, lasts for >12 hours
- Works reliably, handles sensing artifacts

An Event-based BSN Middleware that supports Seamless Switching between Sensor Configurations.
Christian Seeger, Alejandro Buchmann, Kristof Van Laerhoven (IHI 2012)

Christian Seeger, Alejandro Buchmann, Kristof Van Laerhoven (MidSens'11)

Please visit: www.myHealthAssistant.net