PowerPedia – A smartphone application for community-based electricity feedback

Smartphone 2010

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Motivation

<table>
<thead>
<tr>
<th>Year</th>
<th>Quadrillion Btu</th>
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<tr>
<td>1970</td>
<td>15</td>
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<tr>
<td>1980</td>
<td>20</td>
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<tr>
<td>1990</td>
<td>25</td>
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<td>2000</td>
<td>30</td>
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- Industry +10%
- Households +50%
Motivation

- Consumption highly depends on user behavior (more than factor 2).
- Energy consumption is intransparent and commercially available devices do not sustain long term usage.
- 50% of the batteries of inhome displays are not replace once depleted.

Handy energy feedback – Connecting smart meters with mobile phones

With eMeter, we

... can quickly develop & test new visualization concepts,

... develop engagement strategies and games

... provide the basis for device recognition
eMeter implements the most promising energy feedback features at a low usage barrier...

... Convenient & in real time

... Integrated in the user’s daily live

... At hand when needed

... contains a low usage barrier

... break-down of the energy consumption to single devices
The system architecture is loosely coupled and consists of three components:

- **Portable User Interface**
- **Parser**
- **Energy Server**
- **Data Base**
- **Gateway**
- **Smart Meter**
- **Gumstix**
- **Ethernet, TCP/IP**
- **WLAN, TCP/IP, http, REST**
- **Polling Measurement Data**
- **Query JSON**
- **http, REST**
- **Web Client**
- **Internet**
- **PowerPedia**

Using a restful approach guarantees high interoperability, loose coupling, faster prototyping, bigger flexibility, and robustness.

REST architectural style describes the following five constraints applied to the architecture:

- Client-server
- Stateless
- Uniform interface
- Uses http commands
- Layered system

http verbs: Get, Put, Delete, and Post to access, update, delete, and create resources

http header: for metadata and status information

http body: the actual data
Using a restful approach guarantees high interoperability, loose coupling, faster prototyping, bigger flexibility, and robustness.

The gauge view visualizes the current consumption in real-time:

- Shows current consumption in real-time
- How does my current consumption compare to my historical consumption (green to red)
- Depicts the level of home standby consumption (blue)
The history view lets users investigate their past performance

- Shows the historical consumption for different time periods
- Visualizes different equivalents such as kWh and cost
- Compare consumption to average household of same size
- Budgeting

The measurement functionality allows users to interactively determine the power consumption of switchable devices.

This allows users to link consumption to a device and draw effective measures to conserve energy.
Novice users judge this the most important eMeter feature

Measured devices can be saved in the device inventory
Towards a PowerPedia

- However, users stated they can not classify whether the consumption of a device is high or low.
- Users like to further information on how energy can be saved or is wasted with measured device.

Besides providing users with action-guiding feedback, PowerPedia also helps to facilitate device recognition.

- Allows users to share and exchange information about the electricity consumption of individual devices
- Automatically harvest most efficient devices and category-specific saving tips.
- Acquire signatures for device recognition.
Summary & Future Work

- System that allows users to interactively explore their energy consumption aiming at increasing transparency, ...
- User study shows users like more action-guiding information → PowerPedia
- At the same time gather DB for load disaggregation algorithm.
- Potential of pattern recognition algorithms applied to the measured load curve to automatically recognize devices.
- Providing feedback to get users in the loop is only the first step to achieve savings. Investigate engagement strategies that involve users over longer time periods.

Thank you

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Further system-related references


