Prototyping a Minimally-Invasive, Privacy-Compliant, Distributed AAL-System

www.projekt-zelia.de

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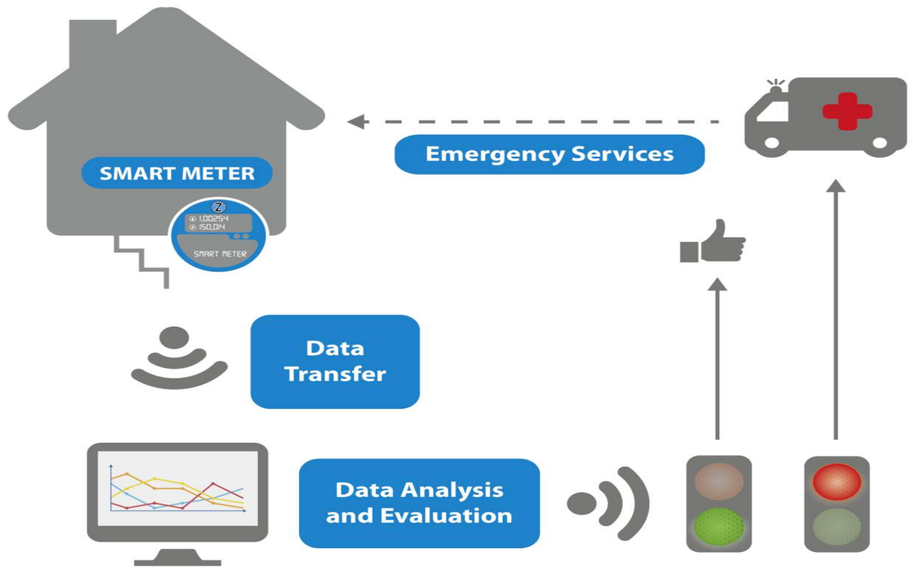
Abstract

In the research project ZELIA - Zuhause eigenständig leben im Alter, supported by the Federal Ministry of Education and Research, the conception as well as the opportunities and limitations of a minimally invasive AAL-system are investigated. An overview of the system is shown below.

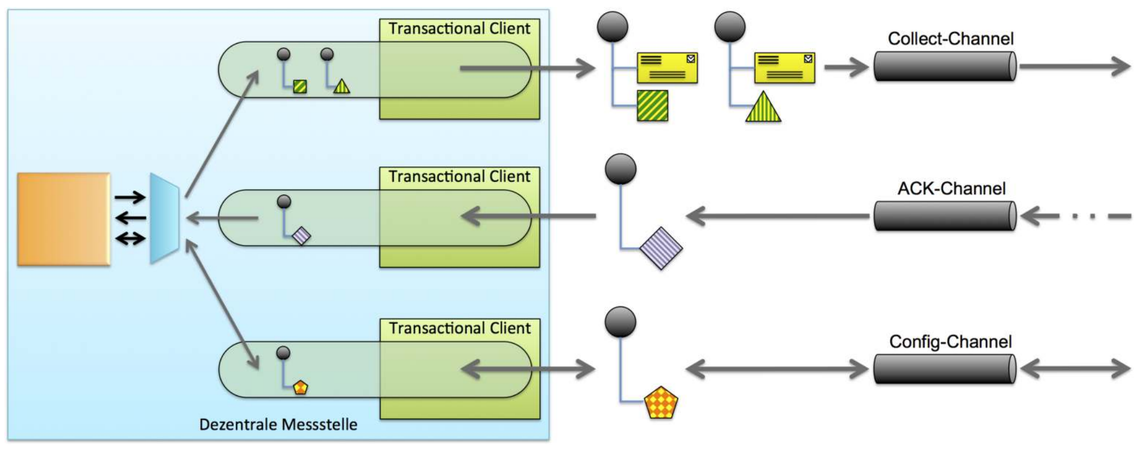


- The prototype is set up and tested with 17 test-households in a rural area in Germany.
- No need for the installation of sensors in the housing space as well as for interaction of the user.
- Cost- and privacy-issues are addressed.

System Architecture

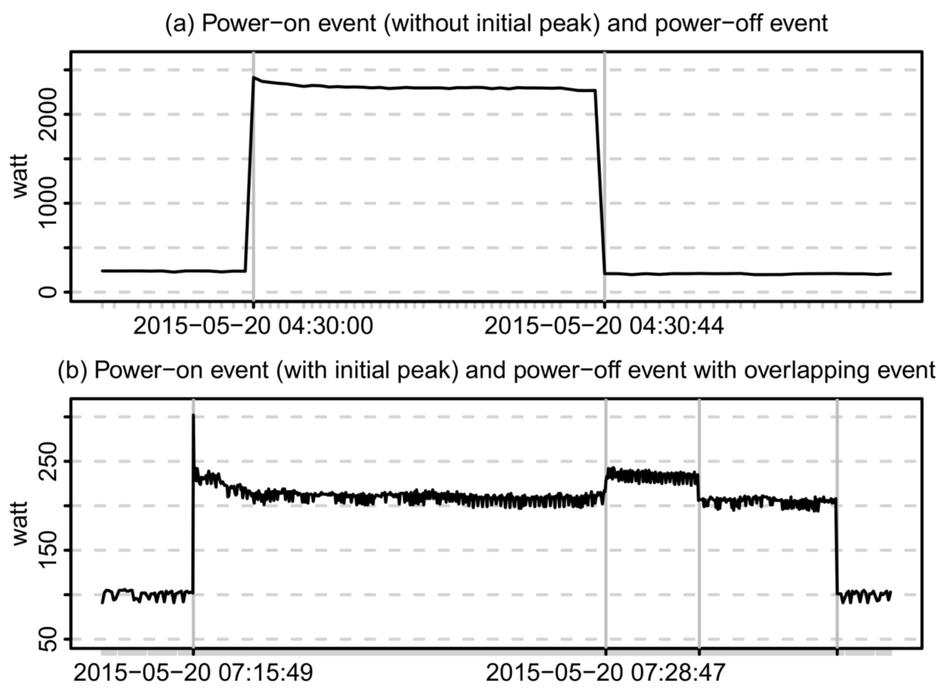
- A Raspberry Pi as shown below is installed nearby the power meter to capture power-consumption data.

- The OS on the Pi is a Raspbian with modifications to protect it from adversaries.
- For the communication between the components the message-broker-system RabbitMQ is employed.
- The figure below provides some details on the design of the messaging-system which uses channels and queues to transfer the messages.

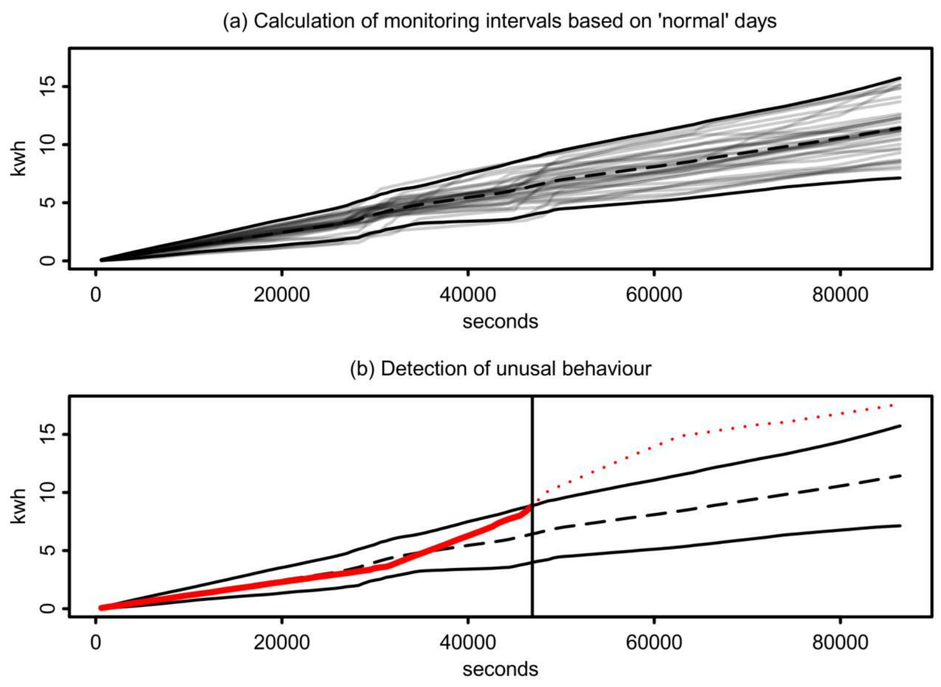


Materials and Methods

- For each household up to 55,000 data points of the real power consumption are recorded every day.
- Stylized facts are defined, e. g. the power consumption itself, power-on events, power-off events and the usage of detected specific devices (NIALM). Two sample windows of the data are shown in the figure below.



- The stylized facts in the historical data are aggregated to daily paths. These paths are the daily cumulative sums of the stylized facts up to equidistant supporting points and represent the daily distribution of stylized facts.
- Based on the paths of 'normal' days in the historical data monitoring intervals are calculated (confidence intervals for the mean or quantiles of poisson distributions). For the stylized fact 'power consumption' this is illustrated in panel (a) of the figure below. If a path of the actual day leaves its interval an alarm is triggerd. This is illustrated in panel (b) of the figure.



Results

- The proposed architecture meets all predefined requirements in terms of flexibility and scalability.
- Security-by-Design approach makes it hard for a potential attacker to gain access.
- Detection of device independent stylized facts works satisfactory.