Context-Enriched Personal Health Monitoring

AAL Kongress Berlin 2013, Mario Buchmayr

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INVERSIA

http://inversia.fh-linz.at

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This research is part of the INVERSIA project *(http://inversia.fh-linz.at)* which was funded by the European Regional Development Fund (ERDF) in cooperation with the Upper Austrian state government (REGIO 13)

Outline

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- ADL Detection Systems
- Telemonitoring of Health Data – Issues
- Personal Health Telemonitoring Data Enrichment
  - Use Cases for Data Enrichment
  - Integrating Contextual Information
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  - System Architecture
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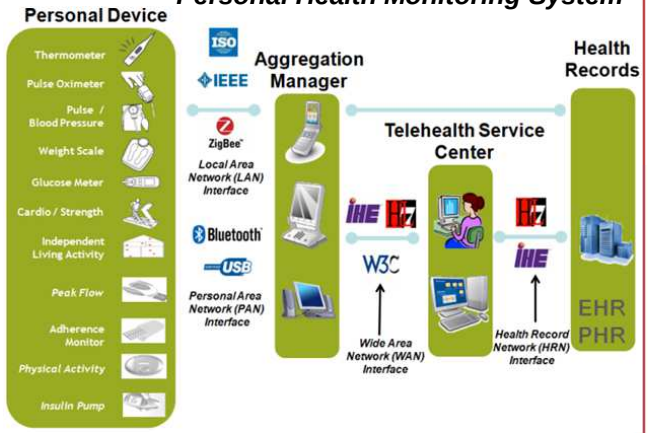
Telemonitoring Systems

- Repeated vital data measurements are necessary to make a reliable health diagnosis
- Regular measurement of vital signs for medical monitoring (blood pressure, blood sugar)
- Measurements can be performed by the patient
- Data is transferred automatically/ on demand to healthcare facility
- *Motivation: cost reduction*

- Various projects

PHM
Personal Health Monitoring System



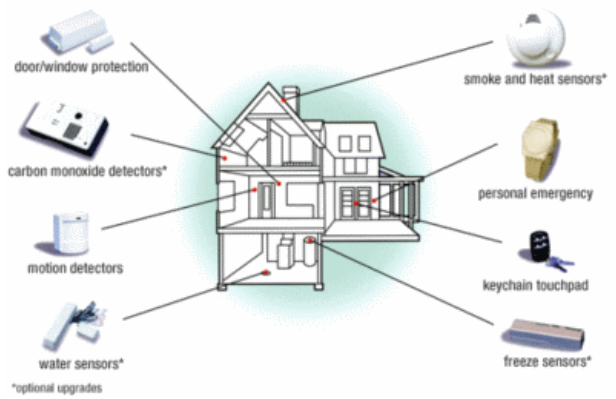
TeleMoni CARE

PIN

Patientenzentriertes integriertes Netzwerk zur Versorgung im Alter
http://pin.fh-ooe.at

ADL Detection Systems

- Usage of in-home sensor devices for activity detection /monitoring
- Different Motivations
  - *Increase safety:* detection of critical, life-threatening situations
  - *Cost reduction:* autonomy enhancement, ‘ageing-at-home’-principle [1]



- Project INVERSIA
  SENIOR: Prototype of ADL verification system and simulation environment

[1] Rantz, M., Aud, M., Alexander, et. al.: Tiger Place: An Innovative Educational and Research Environment, AAL in Eldercare: New Solutions to Old Problems, Washington DC, USA, 2008.

Telemonitoring of Health Data – Issues

- Issues
  - Inappropriate device usage by user
  - Only snapshot of person's fitness
  - Contextual information is missing

- Additional information is sometimes relevant for interpreting the measured data

type of vital data measurement	***potentially interesting context***
blood sugar	time of the last meal
blood pressure / pulse	physical activity before the measurement condition of the patient

Personal Health Telemonitoring Data Enrichment

- *Our Idea*

  Provide additional context information about what happened before the measurement of the vital data

- *Our Goal*

  Create a PHMR (Personal Health Monitoring Report) with containing the vital data as well as ‘relevant’ contextual information

- *How ?*

  After a vital data measurement is transmitted the processing component of the PHM (Personal Health Monitoring) System collects context-data from an ADL System and merges it with the measured vital data.

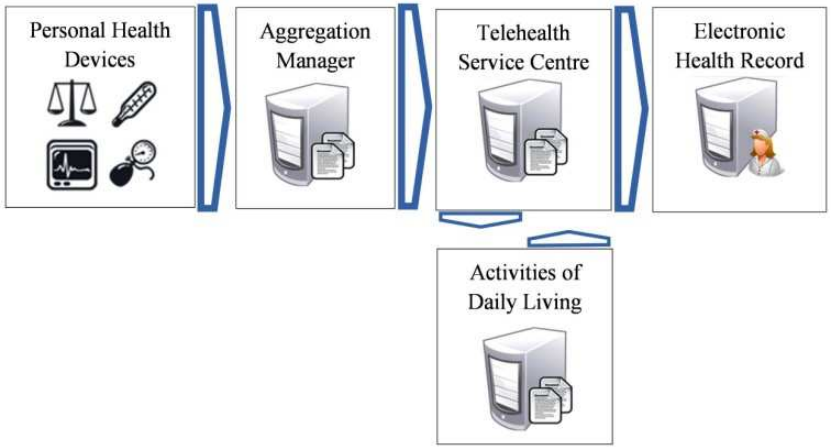
Use Cases for Vital Data Enrichment

- ***UC 1: Cardiac rehabilitation for patients***
  - Patients regularly have to do exercises at home and achieve weekly goals, f. ex. lose weight, burn calories
  - Vital data (blood pressure, pulse, weight) is telemonitored
  - ***Problem****: Measurement before workout, measurement after workout*

- ***UC 2 : Mobile nursing care***
  - Patients in the mobile home care program are regularly visited by care givers.
  - Care personnel takes hand written notes about the patient's condition and performs vital data measurement
  - ***Problem****: At which point in the information processing chain shall the information be added?*

Integrating Contextual Information

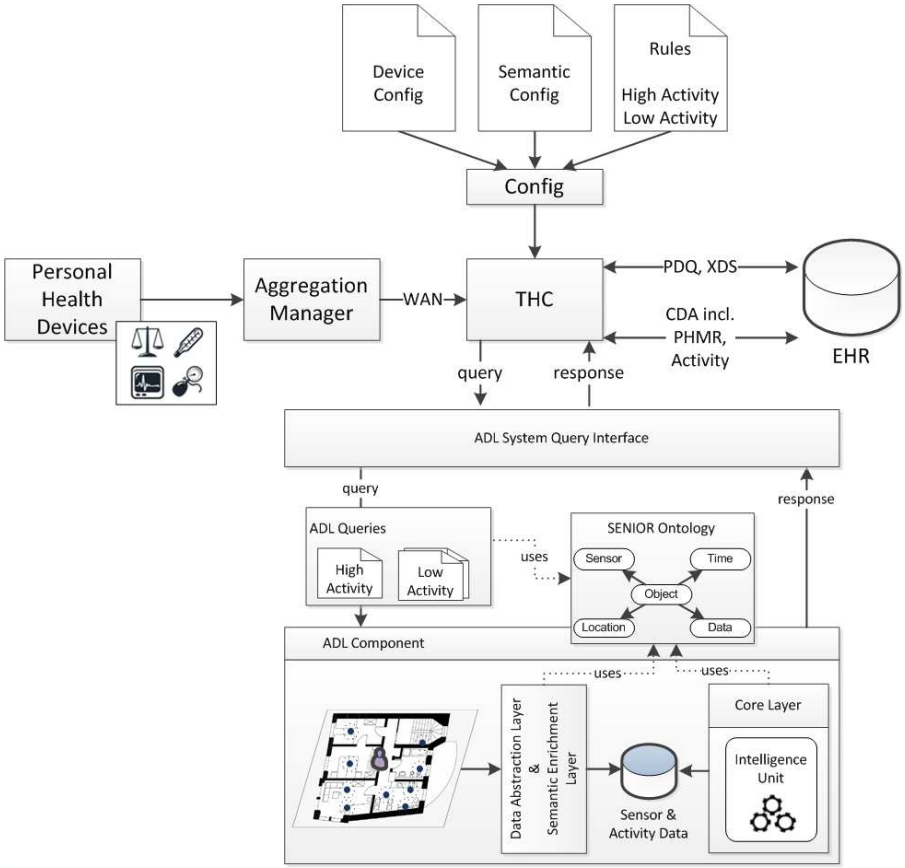
- Vital data is monitored at home by a ***Personal Health Device***
- ***Aggregation Manager*** receives monitored data (binary) and creates standard conform document (HL7 message)
- Message is forwarded to ***Telehealth Service Centre (THC)*** which
  - queries the patient's ***Electronic Health Record (EHR)*** and
  - Queries ***'relevant'*** context data from the ***ADL System*** and
  - creates an updated EHR.



Relevant Contextual Information

- Relevant information depends on
  - measured vital data and
  - available infrastructure for ADL detection
- Detailed activities (watching TV, grooming) are of little avail, because
  - state of the art activity detection not so fine-grained
  - details are typically of less interest, more interesting physical strain
- Aggregated activities (categorized by physical activities) are sufficient for most cases
- The details of an activity are stored in rules. Depending on the measured vital data different rules can be executed.
- Query is not only restricted to physical activities
  Example: blood sugar measurement -> query time of the last meal
- For our use cases we aggregated activities by
  - High physically demanding activities (exercise, frequently walking from room to room)
  - Low physically demanding activities (watching TV, sleeping)

System Architecture



Evaluation

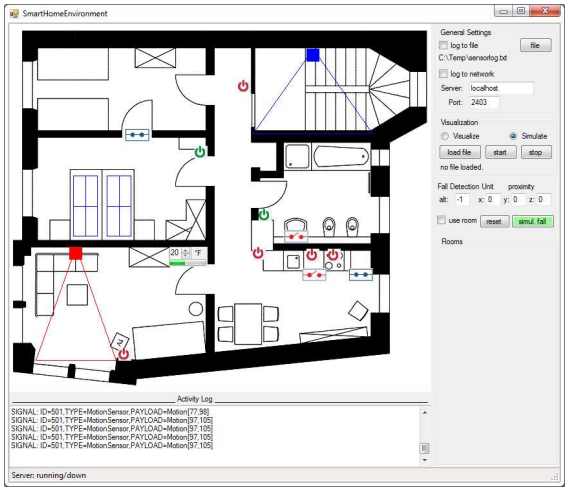
- Test Setup
  - Data from productive Telemonitoring System (PIN)
  - Simulated AAL Home Environment (SENIOR Simulator)

- Evaluation of UC 1 (cardiac rehabilitation)
  - Vital data measurement was performed (blood pressure, pulse)
  - Person described what he/she did before the measurement
  - The activities were simulated in the AAL Home Simulator (with proper time manipulation) and forwarded to the ADL framework

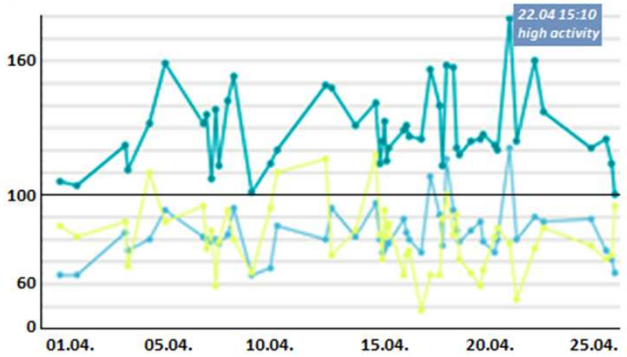
- UC2 : Mobile nursing care
  - Vital Data Measurement was performed (blood pressure, pulse)
  - Person described what he/she did before the measurement.
  - Based on the description the activity data was directly inserted into the data base of the ADL framework (manually created activities)

Evaluation

Simulated Home Interaction



Vital Data View provided by the THC



Conclusion

- Benefits
  - Demonstrated feasibility of approach
  - Improved monitoring of home exercises of rehab patients
- Drawbacks
  - Can’t replace personal contact from care giving personal
  - Additional effort for defining ‘interesting’ activities
  - AAL Environment necessary
- Alternatives when no AAL Environment is available
  - App for patient where he/she can enter the activities he/she performed
  - Personal Tracking Devices, like Fitbit Ultra, Jawbone (Quantified-Self Hype, community growth 2010 about 500% [1])
- Future Work
  - Evaluate feasible detail level of activities and their relevancy

[1] http://quantifiedself.com/topics/lab-notes/