



ASSOLOMBARDA
Confindustria Milano Monza e Brianza

Sistema intelligente per la diagnosi precoce del degrado cognitivo nell'anziano

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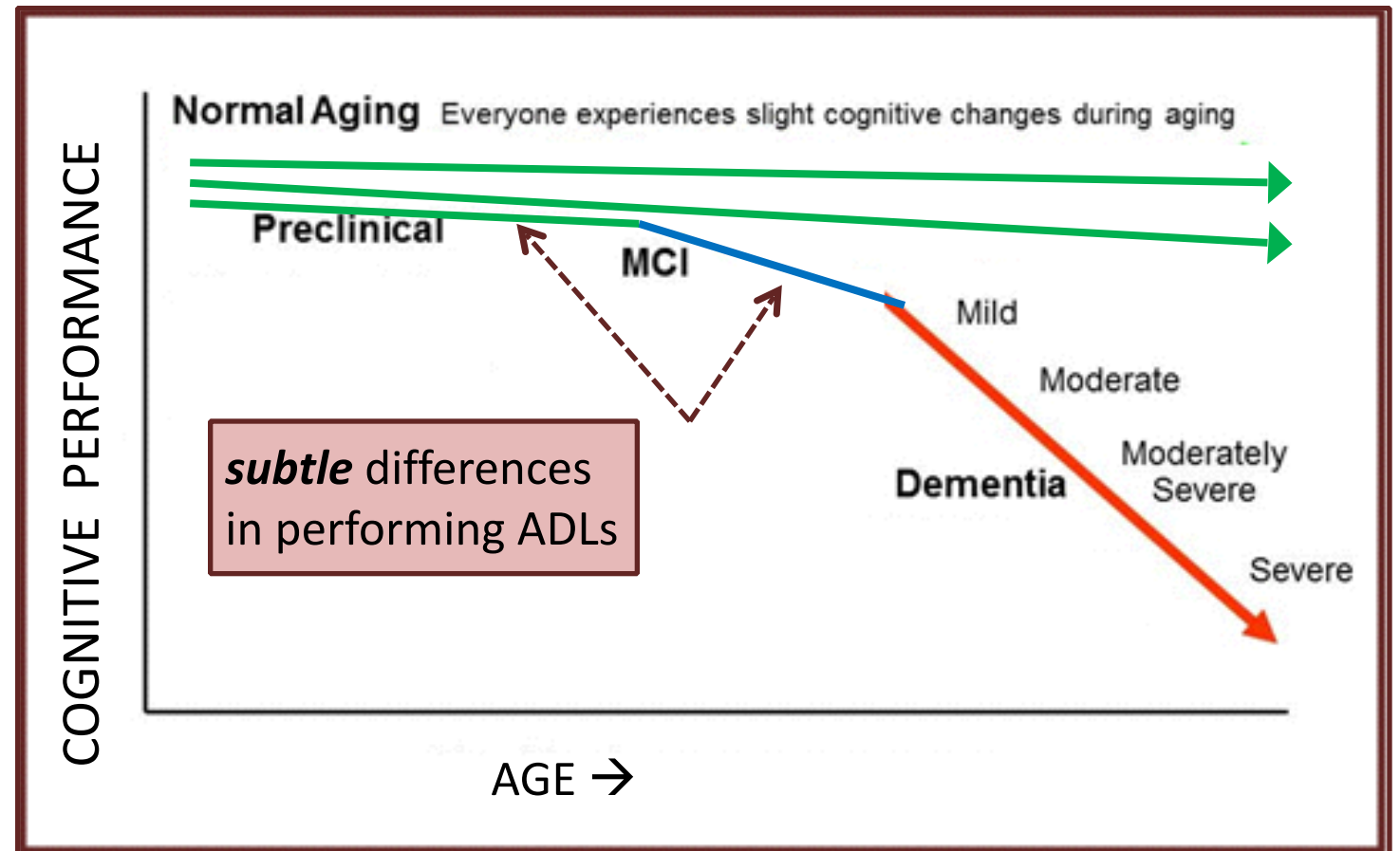
everywarelab.di.unimi.it



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Detection of cognitive decline

- Mild Cognitive Impairment (MCI)
- Transitional state between normal ageing and dementia



- Goal:
 - Supporting early detection of MCI by unobtrusively detecting the elderly's behavioral anomalies at home



The SECURE project

Intelligent System for Early Diagnosis and Follow-up at Home

A Project funded under the Industrial Research and Experimental Development in the strategic sectors of the Lombardy Region and the Ministry of Education, University and Research.



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Provincia Lombardia - Veneto
Online Operatori di S. Giovanni di Dio - Fatebenefratelli
CENTRO S. GIOVANNI DI DIO - FATEBENEFRATELLI
ISTITUTO DI RICOVERO E CURA A CARATTERE SCIENTIFICO

3Caravelle
the reliable ICT partner



State of the art

- Clinical diagnosis of MCI based on ADL scales
- Interviews about the patient's ADL abilities

issues:

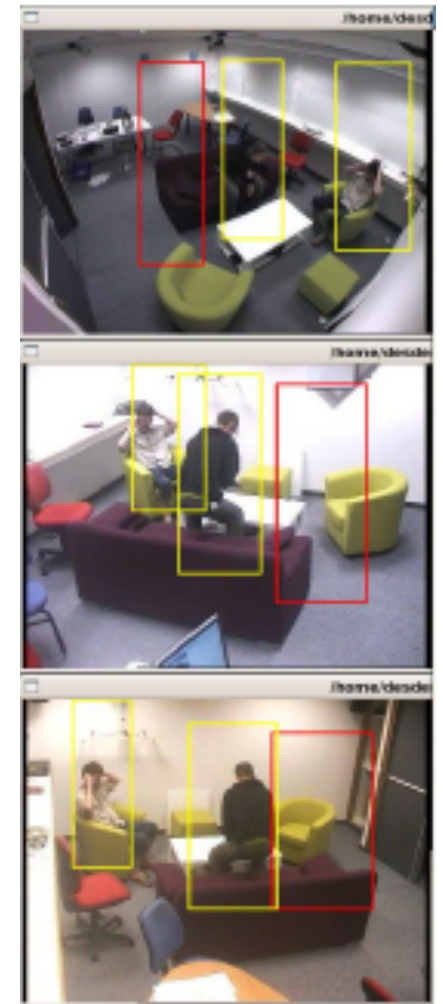
- Sporadic evaluations
- Reporting bias



Pervasive computing can help

Activity recognition

- Based on the use of sound, image and scene recognition software
- Based on data coming from different sensors
 - Accelerometers
 - Body-worn sensors
 - Environmental sensors
 - RFID (objects' use)
 - ...



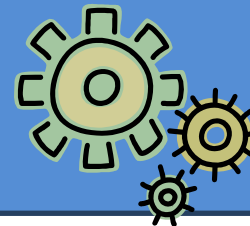
Our approach

ELDERLY at home



SENSOR
DATA

FABER
ALGORITHMS



NEUROPSYCHOLOGIST

MEDICAL
MODELS



ALERT

FINE-GRAINED DESCRIPTION OF THE ANOMALY

Difficulties in using the phone

Details:

- 2015-03-18 08:51 : Re-dialed multiple times
- 2015-03-19 18:23 : Did not answer several calls
- 2015-03-19 10:40: Failed to place a call
- ...

CLINICIAN



Abnormal Behaviors

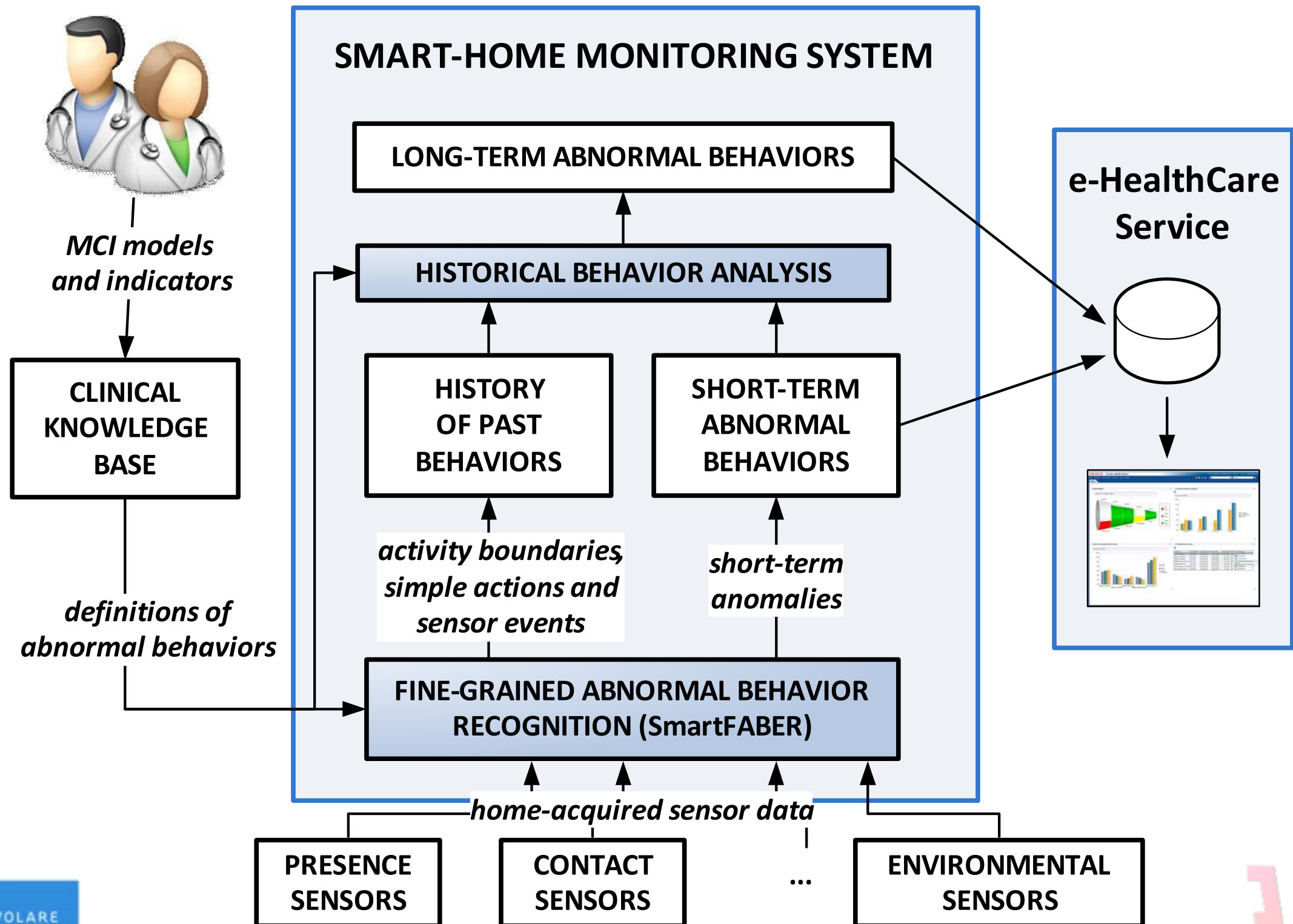
(defined by neuropsychologists)

- Omission (e.g., forgetting to put water when preparing coffee)
- Addition (e.g., retrieving milk from the fridge when not needed)
- Commission

Type of anomaly	Description	Example
Substitution	A different object than appropriate is used or a different component action than expected is performed	Using spoon to spread butter
Replacement	The subject replaces a correct action with a wrong one	Putting the butter inside a non-refrigerated cabinet
Improper activity	The subject performs an activity that is not consistent with the model	Taking a medicine that was not prescribed
Repetition	The subject repeats the same action or activity more times than expected	Consuming the morning breakfast twice in a day
Improper order	The subject performs actions in different order than appropriate	Putting pasta before boiling water
Quality	The activity is performed to minimize its complexity	Preparing meal by only pre-heating the same food every day



Hybrid reasoning algorithms



A dashboard for clinicians

SECURE

Sistema intelligEnte per diagnosi preCoci e follow-Up domiciliari

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Patient Id	First name	Last name	Date of Birth	Place of Birth
24785	Patient	Test	01 December 1978	Brescia

Activities Anomalies Physiological Data

Anomalies log for last 90 days:

Show 10 entries Search:

Interval Selection: Last 90 Days

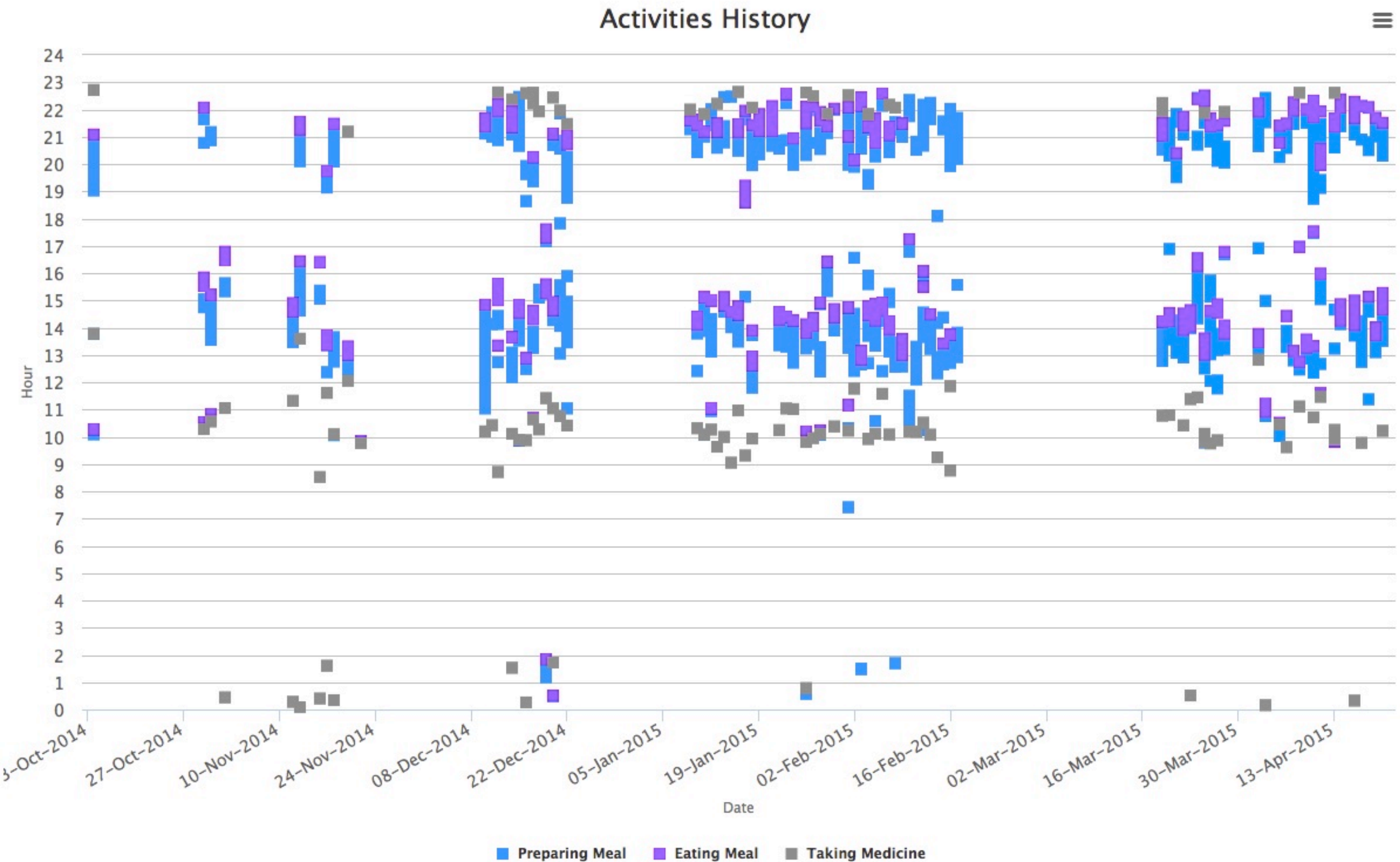
Anomaly ID	Day	Time	Type	Anomaly's Objects	Activity Name
An99	08-09-2014	18:39:11	Omission	cabinet	Taking Item 99
An98	03-08-2014	12:07:48	Repetition	refrigerator	Taking Item 98
An97	26-09-2014	05:03:45	Substitution	table	Taking Item 97
An96	04-09-2014	06:28:26	Omission	stove	Taking Item 96
An94	26-09-2014	12:11:56	Substitution	refrigerator	Taking Item 94
An93	02-09-2014	11:47:01	Omission	table	Taking Item 93
An92	10-08-2014	02:33:03	Repetition	stove	Taking Item 92
An91	26-10-2014	11:58:45	Substitution	cabinet	Taking Item 91
An90	11-10-2014	08:53:46	Omission	refrigerator	Taking Item 90
An9	20-09-2014	08:25:15	Omission	table	Taking Item 9

Showing 1 to 10 of 113 entries Previous 1 2 3 4 5 ... 12 Next

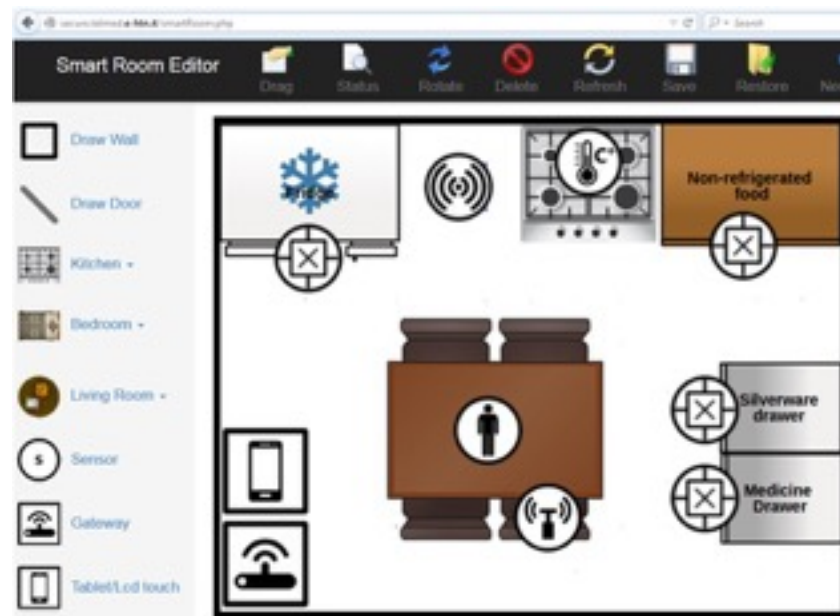
Anomalies history:

Type	Occurrences in last 7 days	Occurrences in last 30 days	Occurrences in last 90 days
Omission	2	15	38
Substitution	5	14	37

Activities on the dashboard



Validation in real homes



- 3 months of monitoring
- Anomaly detection accuracy: 80% ($F1=0,8$)

What are we offering

Expertise in

- designing and implementing activity recognition algorithms
- sensor data acquisition and management
- data analysis
- data privacy



Thank you!

