M3 in education and research: experiences and lesson learned

Fabio Vergari and Luca Roffia
ARCES                      ARCES
DEI                        DISI
fvergari@arces.unibo.it    www.unibo.it

Innovation House – Otaniemi
12th November  2013
UNIBO & M3 timeline

2nd International NoTA Conference
Spt. 30th - Oct. 1st 2009, San Jose, CA, USA

Smart M3 Lab Course

09 10 11 12 13 14

sotia

RECOCAPE

CHIRON
Cystic and person-centric Health management

IoE

Internet of Energy

Agriculture Food Chains LCA

ccpb
Controlla e Certifichi

DUCATI energia
Public Street Smart Lighting
Smart-M3 evolution

Developer tools

- APIs for multiple programming languages
- Support for developers (Tutorials - Tools)
- Time management functionalities
- SPARQL Update / Subscription
- SPARQL query
- Protection at RDF triple level

Smart-M3 v_0.9beta

Smart-M3 RedSIB_0.9
UNIBO Contribution

Platform
- Protection
- SPARQL support query and subscription
- Powered by RedLand or Virtuoso
- OSGI SIB

APIs
- Python
- Java
- C#
- PHP
- Javascript

Domains
- Public street smart lighting
- Agriculture food chains LCA
- Home health monitoring
- EV charging urban scenario

Education
- University courses and labs
- RECOAPE international cooperation project
Many domains, one solution

Public Street Smart Lighting
- Sensors data, lamps status and dimming messages
- Monitor and control

Life Cycle Assessment (LCA)

Surveys

Visualization

Web Browser

Web Browser
Life Cycle Assessment of agriculture food chains

- Ontology based Data entry GUI for on site operators
- Local caching (i.e. no Internet access) and re-configurable (i.e. ontology based)
- Showing collected surveys on a Web browser
Reconfigurable Data Entry Interface
Survey results visualization using SPARQL queries from PHP

http://mml.arces.unibo.it/sib_ducati/cms/admin/it/questionari_async/modifica/Questionario_634952516621197509
Smart Lighting on Public Streets

- Point-to-point lamp dimming
- Sensors (e.g. temperature, humidity, CO, CO2) on each lamp
- Power line communications
Smart Lighting on Public Streets: Ecosystem Architecture
Health monitoring at home
ARTEMIS Project CHIRON

• Patient at home
  – Local gateway to collect sensor data
  – Heterogeneous physiological and environmental sensors

• Local gateway services
  – Rule engine to detect anomalous situations

• Provide information to the medical world
  – Medical standards (HL7)
  – Standard solutions (Database, SMS services)
CHIRON ecosystem architecture for health monitoring at home
GUI for Health monitoring at home in CHIRON

Controller

Patient Data

Environmental Data

Rule Engine Status

Weight
Diastolic Pressure
Systolic Pressure
Arterial Mean Pressure
Heart Rate
SPO2
Rule Engine

Update CDA

Weight
Diastolic Pressure
Systolic Pressure
Arterial Pressure
Heart Rate
SPO2
Activity
Posture Angle
Skin Temperature
Breathing Rate

Environment

Ambiental Temperature: 24.16°C
Relative Humidity: 29.28%
Dust Concentration: -
Pollution: -

Rule Engine

Status
Help! Heart rate concern!

Authentication-Confidentiality-Integrity
ARTEMIS Project Internet of Energy: Electric Vehicles Recharging in Urban Scenarios

Simulation framework with person in the loop
IoE: Ontology, models and GUls for Electric Vehicles recharging in urban scenarios

- Information interoperability
  - SMART M3 middleware
  - Common ontology

- Mobile Services

- Urban traffic simulation

- EV battery model

In co-operation with SIEMENS and AICIA (Seville)
Smart-M3 Lab
Lab of Interoperability of Embedded Systems

• Starting from academic year 2009/10:
  – the lab provides a design style
  – the lab is a test bed for research results

• Topics:
  Semantic Web, smart space applications, Smart-M3 programming approach, design template

• Students are divided in teams of 3 to 5 persons. Each group proposes and develops a project

<table>
<thead>
<tr>
<th>Nr Projects / Year</th>
<th>8</th>
<th>6</th>
<th>5</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Projects spans from applications (E.g. Games, domotics, ...) to APIs (E.g. PHP and JavaScript)

ongoing

Interaction between projects, e.g. games use a common ontology
Smart-M3 Lab Contribution

Student projects and feedback

Course Website
http://didattica.arces.unibo.it/mod/resource/view.php?id=468

– Course Description
– Tutorials
– Tools
– LabExercise and Projects

Tutorial
SMART-M3 v.0.9: A semantic event processing engine supporting information level interoperability in ambient intelligence
http://amsacta.unibo.it/3877/

Available under License Creative Commons Attribution Non-commercial (CC BY-NC 3.0).