Context Aware and Device Dependent Interaction in Smart Environments

Candidate: Emanuele Furci

Supervisors: Fulvio Corno, Dario Bonino, Luigi De Russis

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Outline

- Introduction
- Thesis work
  - Data Modelling
  - Software Development
- Scenario Test Case
- Conclusions
Goal:

- An intelligent notification system for smart homes

- Take into account the surrounding context to select end user devices and send them generated messages
Steps:

- create a data modelling infrastructure able to represent information about the context (domain of interest)

- develop a software to elaborate data model information and deliver house related messages to the appropriate end users device
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Data Modelling
Data Modelling

- Definition of the Domain of Interest
  - Users
  - User Devices
  - Smart Home
  - Message Categories

- Ontology-Based Modelling
- Exploration of existing ontology for context modelling
Notont the Notification Ontology

- 4 directly imported ontologies
  - Locont
  - Device
  - DogOnt
  - Core

- 27 overall imported ontologies
- 1385 classes
Notont – User Modelling

- Activity (e.g. eating, sleeping)
- Accessibility (e.g. freeable_hands)
- Location (e.g. livingroom, kitchen)
- Obtrusiveness (e.g. mobile_only, no_audio)
- End-User-Devices (e.g. smartphone, tablet)
- Message Categories (e.g. AppliancesAlert)
Notont – Device Modelling

- Physical Features (e.g. screen size, camera)
- Capabilities (e.g. audio and video reproduction)
Notont – House Modelling

- Architectural aspects (e.g. wall, window)
- Appliances (e.g. oven, HVAC system)
- Devices (e.g. smart tv, HiFi system)
- Furniture (e.g. couch, table)
Notont – Message Category Modelling

- Priority (e.g. lower_level, highest_level)
- Attributes (e.g. min_temperature_value)
Information modelling

- Information as Class instance
- Instance data properties
- Connections by means of object properties
  - A single .owl file as data model
Scenario Test Case

- 2 users (Luca, Giulia)
- 3 devices (LG Nexus 4, Samsung Galaxy Nexus, Samsung Galaxy Tab 10”)
- 1 smart home (temperature and humidity sensors, smart plugs, door sensors, Hifi system)
- 6 message category (EnvironmentalComfort, PowerOverThreshold, EnergyManagement, AppliancesUsage, AppliancesAlert, SecurityAlert)
Software Development
Software Development

- Data Model Management
  - Notont Manager
- User Interfacing
  - UserManager
- House Interfacing and Message Generation
  - House Message Manager
- Device Message Delivery
  - Device Manager
NINS: Notont-based Intelligent Notification System

- Update User State (Obtrusiveness level, Location, etc)
- Assumptions:
  - User Activity and Location are known
  - Receive Generated Messages
  - Get end user Devices from Notont Manager
  - Send Messages to Devices
  - Receive Generated Messages
  - Get end user Devices from Notont Manager
  - Send Messages to Devices

• Data Model Management
• Insert
• Update
• Delete
• Query

Implements the device inferring process
NINS – Device Manager

- Android – Based Devices
- Gcm Service
- Mobile application on Devices
Scenario Test Case
Scenario Test Case

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Video
Conclusions

- Notont – Notification Ontology
  - Formal representation of context information in Smart Environments
  - Inferring of the most suitable end user device

- NINS – Notont-based Intelligent Notification System
  - Data model Management
  - House and User interfacing
  - Sending messages to devices
Future Works

- Test in a real home setting
- Usage of the context to infer “how” send a message to end users devices
- Increase supported devices
Thank You!

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Notont
the Notification Ontology
Notont & scenario modelling
Scenario: Giulia modelling

<!-- http://elite.polito.it/ontologies/notont/scenario.owl#giulia -->
<owl:NamedIndividual rdf:about="&scenario;giulia">
  <rdf:type rdf:resource="&locont;Employee"/>
  <foaf:birthday rdf:datatype="&xsd;date">1987-02-26</foaf:birthday>
  <foaf:familyName rdf:datatype="&xsd;string">Brambilla</foaf:familyName>
  <foaf:firstName rdf:datatype="&xsd;string">Giulia</foaf:firstName>
  <foaf:nick rdf:datatype="&xsd;string">Giuly</foaf:nick>
  <notont:hasObtrusivenessLevel rdf:resource="&notont;obtrusiveness_available"/>
  <core:preference rdf:resource="&scenario;AppliancesAlert"/>
  <core:preference rdf:resource="&scenario;AppliancesUsage"/>
  <core:preference rdf:resource="&scenario;EnvironmentalComfort"/>
  <core:preference rdf:resource="&scenario;SecurityAlert"/>
  <locont:hasCurrentActivity rdf:resource="&scenario;activity_giulia"/>
  <locont:hasCurrentSymbolicLocation rdf:resource="&scenario;kitchen"/>
  <locont:usingArtifact rdf:resource="&scenario;galaxyTab"/>
  <locont:usingArtifact rdf:resource="&scenario;nexus4"/>
</owl:NamedIndividual>

<!-- http://elite.polito.it/ontologies/notont/scenario.owl#activity_giulia -->
<owl:NamedIndividual rdf:about="&scenario;activity_giulia">
  <rdf:type rdf:resource="&locont;Eating"/>
</owl:NamedIndividual>
Query the model – Giulia’s activity

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX locont: <http://webmind.dico.unimi.it/CARE/locont.owl#>

SELECT ?activity ?activityType WHERE {
  ?person foaf:firstName "Giulia"^^xsd:string.

  ?activity rdf:type ?activityType.
  ?activityType rdfs:subClassOf* locont:Activity.
}
```
Android user application

Categoria

EnvironmentalComfort

messaggio:

Ambiente non confortevole, temperatura a : 18 C