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<th><strong>Title</strong></th>
<th>Robotic UBIquitous COgnitive Networks (RUBICON)</th>
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<tr>
<td><strong>Authors(s)</strong></td>
<td>Abdel-Naby, S.; Amato, G.; Bacciu, D.; Chessa, S.; Coleman, S.; Di Rocco, M.; Dragone, Mauro; Gallicchio, C.; Gennaro, C.; Guzman, R.; Lopez, R.; Lozano, H.; Maguire, L.; McGinnity, T. M.; Micheli, A.; O'Hare, G. M. P. (Greg M. P.); Pecora, F.; Ray, A.; Renteria, A.; Saffiotti, A.; Swords, D.; Vairo, C.</td>
</tr>
<tr>
<td><strong>Publication date</strong></td>
<td>2012-02-22</td>
</tr>
<tr>
<td><strong>Conference details</strong></td>
<td>Poster presentation at the 5th International Conference on Cognitive Systems (CogSys 2012), TU Vienna, Vienna, 22-23 February, 2012</td>
</tr>
<tr>
<td><strong>Publisher</strong></td>
<td>CogSys 2012</td>
</tr>
<tr>
<td><strong>Link to online version</strong></td>
<td><a href="http://cogsys2012.acin.tuwien.ac.at/doc/CogSys_Poster.pdf">http://cogsys2012.acin.tuwien.ac.at/doc/CogSys_Poster.pdf</a></td>
</tr>
<tr>
<td><strong>Item record/more information</strong></td>
<td><a href="http://hdl.handle.net/10197/4340">http://hdl.handle.net/10197/4340</a></td>
</tr>
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Robotic UBiquitous COgnitive Networks

FP7-ICT-2009-6 (269914),  http://www.fp7rubicon.eu,  coordinator@fp7rubicon.eu


Robotic Ecologies

A Robotic Ecology is an heterogeneous system of “robotic devices”, including mobile robots, wireless sensor and actuator networks (WSAN), and automated home appliances. By collaborating together, such ecologies:
- extend the variety of robotics applications that can realistically be envisaged
- reduce the complexity of the overall system
- enhance the value of the services delivered by each device

Problems Addressed

Current Robotic Ecologies lack the ability to proactively and smoothly adapt to evolving situations and to subtle changes in the environment, user’s habits and preferences, as they exhibit:
- Excessive reliance on pre-defined and symbolic representations, including models of human activities, environment, services, and of systems’ capabilities.
- Primitive learning capabilities.
- Excessive reliance on humans for Configuration, Training and Supervision.
- Limited Sharing of Situated Knowledge.

Solutions are still difficult and costly to deploy in real world applications, as they are tailored to specific environments, hardware configurations, applications and users, and they can soon become unmanageably complex.

Overview & Architecture

The participants of a RUBICON ecology cooperate using their past experience to improve their performance by autonomously and proactively adjusting their behaviour.

The RUBICON Architecture combines:
- Communication Layer: Existing Robotic Ecologies and WSAN Middleware to support collaboration among heterogeneous devices using a common tuple-space publish-subscribe communication abstraction.
- Control Layer: Hybrid Plan/Agent-based Systems to find and execute coordinated sensing, action and collaboration strategies.
- Learning Layer: Statistical and computational (neuroscience) learning methods based on Reservoir Computing (RC) models to classify events/activities and adapt control strategies to the environment.

Validation & Future Work

The RUBICON consortium has conducted preliminary experiments to validate the use of Reservoir Computing learning techniques to predict user movements in indoor environments.

Future work will implement the RUBICON Architecture and define a set of adaptive, extensible and robust services (based on activity-recognition, navigation, transport) by leveraging available resources (wireless sensors, robots) while requiring minimum pre-programming, configuration and human supervision. Final validation will be conducted in the Ambient Assisted Living (AAL) TECNALIA Home Lab (left) and in the Stella Maris Hospital (right).

Consortium


5th International Conference on Cognitive Systems
CogSys 2012
February 22 – 23, 2012, TU Vienna, Austria

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