P O B I C O S

Platform for Opportunistic Behaviour in Incompletely Specified, Heterogeneous Object Communities

The goal of POBICOS is to design, implement and test a platform that simplifies the task of developing and deploying opportunistic applications in heterogeneous and incompletely specified object collections for the domain of home automation.

KEYWORDS: **Opportunistic pervasive computing, domain-based resource modelling, programming abstractions, middleware, home automation, energy-efficient home**

At a Glance: POBICOS

Platform for Opportunistic Behaviour in Incompletely Specified, Heterogeneous Object Communities

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Partners

- VTT Technical Research Centre of Finland *(Finland)*

- Warsaw University of Technology *(Poland)*

- Center for Research and Technology Thessaly *(Greece)*

- Accenture Technology Labs *(France)*

- SAE - Automation, s.r.o. *(Slovakia)*

- Center for Renewable Energy Sources *(Greece)*

Duration: *36 months*
Start: *May 2008*
Total Cost: *3.2 M€*
EC Contribution: *2.3 M€*

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Main Objectives

The POBICOS project targets computing environments which feature collections of objects, equipped with sense-compute-actuate embedded nodes, which differ in their sensor, actuator and computing resources. Moreover, the actual mix of objects, and the resources provided by those objects, which will be available during execution is partly unknown when programming the application(s).

POBICOS aims to design, implement and test a platform that simplifies both the development and the deployment of applications for such heterogeneous and incompletely specified systems. The key challenge is to enable applications to take the best advantage of whatever "resource opportunities" exist at runtime, provided by the objects that happen to be available. The platform shall make such "opportunistic" behaviour largely transparent to the programmer.

POBICOS will focus on developing programming abstractions and corresponding middleware support for opportunistic pervasive computing making it possible for the application to exploit resources in a flexible and transparent way for a range of different environments

Towards this goal, the main objectives of POBICOS are:

- The design of a programming model and supporting mechanisms for opportunistic pervasive computing;

- An ontology-driven approach for modelling and flexibly accessing resources for a given application domain;

- The implementation of a corresponding middleware on top of embedded wireless sensor/actuator nodes;

- The provision of suitable resource abstraction and domain-based customisation tools as well as application development, simulation and deployment tools;

- The experimental validation of the middleware and tools for a selected application domain in the area of home automation.

The domain of energy efficiency at home will be used as the source of scenarios and requirements. Proof-of-concept applications will be tested in a real setting.

Technical Approach

The envisioned middleware and development support will be achieved by combining three main technical dimensions in a tightly coupled fashion.

(a) Ontology-driven multi-resolution representations of sensor and actuator resources

Objects and their resources will be represented at multiple levels of abstractions, using a formal domain model. Such representations will give the programmer flexibility in specifying the resources of interest. Using a more abstract level allows freedom in choosing actual resources at runtime. Using a less abstract level makes the behaviour of the application more predictable – but also more dependent on the existence of specific resources. Based on the specifications, the middleware can locate nodes that offer compatible resources and engage them as needed on behalf of the application.

Domain model
POBICOS uses ontologies to capture concepts of a given domain and enable resource access at the desired level of abstraction/detail.

(b) Abstractions and mechanisms for physical node transparency

To simplify application programming, the existence of physical nodes and underlying networking topologies should remain hidden from the programmer as much as possible. This will be achieved by adopting an abstract programming model based on logically separate components, also referred to as micro-agents, and by letting the middleware place them onto concrete physical objects at runtime while trying to meet their sensor, actuator, computing and communication requirements as best as possible subject to the current load.

Object cooperation
Each application running on POBICOS represents some goal. Its achievement is facilitated by the middleware mechanisms to find, combine, and exploit proper resources of the object community.

(c) Concepts, mechanisms and tools for security, privacy and deployment

Straightforward application deployment with special care for ensuring security and privacy is of major importance if pervasive computing is to become popular in the home automation domain where the users are ordinary people, rather than experienced administrators. Special care will be paid as to capture such requirements in the early stages of the project, and corresponding mechanisms will be built into the middleware. Moreover, the envisioned application model will enable a simple and intuitive deployment of applications.
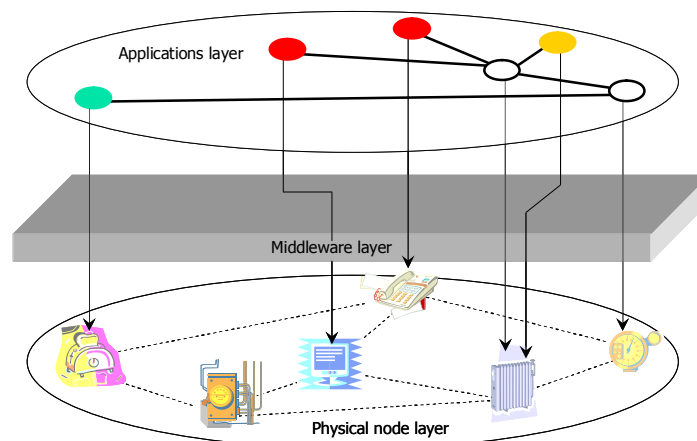

Application pill
The application can be packaged into a small hardware unit, which the user activates at any point in time. As a result, the middleware spreads the application's micro-agents to the objects with the suitable resources found in the environment.

Application: Energy-efficient Houses

The core of the POBICOS platform, including its algorithms and mechanisms, will be designed and implemented in a domain-independent way. In addition, the platform will be customised for the area of home and building automation with emphasis on applications for reducing the energy consumption. COTS hardware devices with the POBICOS middleware and some indicative proof-of-concept applications will be deployed and tested in a bioclimatic building using various sensors and actuators. The sensors measure key environmental parameters, such as temperature, humidity and luminosity, and the actuators feature controllable elements, such as blinds, windows, air-conditioning units and lighting.

Expected Impact

The technology to be developed in POBICOS will enable programmers to develop, in a simple way, portable applications that can be deployed and harness the resources available in different operational settings. Such functionality could be important in many different application areas. POBICOS will focus on the home automation domain, where such technology could play a particularly crucial role towards boosting application development, not only for the industrial players that provide the facilities and appliances but for practically any third party, including SMEs.