MULTI-LEVEL CONTEXT ADAPTATION IN THE WEB OF THINGS

GENERAL INFORMATION

Position type	Master degree research internship
Duration	5 months
Location	Lyon, France
Salary	436€ per month
Laboratory	LIRIS (Laboratoire d'InfoRmatique en Image et Systèmes d'information), http://liris.cnrs.fr/
Project name	Adaptive Supervision of Avatar/Object Links for the Web of Objects (ASAWoO)
Project funding	French national research agency (ANR)
Project website	http://liris.cnrs.fr/asawoo/
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CONTEXT: THE ASAWOO PROJECT

The Web of Things (WoT) aims at interconnecting network-enabled appliances using Web standards. However, Web protocols and languages are not adapted to those connected objects. There is also an emerging need for usages of meaningful services relying on interoperable objects. The major challenge of the ASAWoO project is to enhance appliance integration into the Web. Our project builds an architecture to provide users with understandable features under the form of WoT applications, while enabling collaboration between heterogeneous physical objects, from the basic sensor to the complex robot. The project builds on the concept of avatar, which represents and extends the features of an object on the Web and uses Web standards and technologies. An avatar exposes user-understandable features to users and other avatars and is in charge of having the corresponding behaviors seamlessly implemented by the objects. This requires various different works in domains such as embedded systems, networking, software design, Web services, Semantic Web and context modeling.

REQUESTED WORK

CONTEXT MODEL

The first objective of this internship is to define a multi-level, semantic context model. Avatars must be aware of how a particular feature will be achieved, in order to identify where to deploy the different code modules the feature requires and to adapt the communication process with their managed objects. At the same time, avatars must only expose features that their objects are contextually able to fulfill. Moreover, we intend to establish a proactive, MAS-oriented feature composition process. This process relies on semantized QoS data to describe the composition context and allows deciding which features to compose, in order to expose a complex one.

For being able to achieve these four goals, we need to define a multi-level context model that can be processed at the different abstraction levels required by the context engines defined below. Numerous descriptions of context models exist in the literature, designed for specific purposes and at different abstraction models. A state of the art will be led to determine the most appropriate ones and lead to the reuse or specification of a semantic context model for physical object feature description. In particular, the multi-scale context model proposed in [1] will be studied.

CONTEXT ENGINE

The second objective of this internship is to design and implement a context adaptation engine, both compatible with the high-level features defined in the project and the contextual and QoS data provided by the objects or other resources. This engine will reduce the avatar complexity by fulfilling by itself time four different goals:

1. **Object configuration:** regarding the resource levels available on the object (memory, processing power, autonomy, network availability), the avatar must decide which modules (layers) needed to fulfill a given feature can be uploaded and executed on the object and which ones must be executed in the cloud infrastructure. This requires the context model to be compatible with the high-level feature QoS model. Then, the different modules can be seen as a service chain, in which each service has an implementation on the object and another one in the cloud infrastructure.
2. **Avatar-object communication:** Avatars are in charge of adapting the communication protocols with the object, at the routing level to the current context state and at the applicative level to the requested task. In this scope, the different communication protocols are implemented in services that respond to the same interface.
3. **Functionality exposition:** the avatar decides which high-level features to expose, according to (i) the object capabilities and resources and (ii) the context model. The context model must thus describe features in a semantic manner, so that they can be mapped with the object capabilities and resources model to define a generic service chain composing the object capabilities corresponding to a given feature. Then deciding whether to expose a feature or not consists in finding contextually valid implementations for each element of the service chain. If one service interface cannot be realized by an implementation having a QoS matching the actual context state, the corresponding feature will not be exposed.
4. **Functionality composition:** avatars are defined as agents that can communicate to define complex features that cannot be performed by a single object. Processing high-level features for exposing their composition will be done in the same manner as processing object capabilities for exposing feature performed by a single object.

We view these goals as service substitution problems. Thus, the context engine is an adaptation planning engine that performs service substitution using service QoS and contextual information. It will rely on semantic models, to be sufficiently generic to be able to process these models at different levels. This engine will be proposed among the ones existing in the literature [2], [3]. Another example of an adaptation engine is the one recently developed by LYON 1-LIRIS using several fuzzy controllers to ease service variant selection using fuzzy logic [4]. Regarding the aspect of relying on semantic Web services descriptions, we plan to reuse the work on the semantic-aware part of the contextual adaptation engine for Web services presented in [5].

REFERENCES

[1] J.-P. Arcangeli, A. Bouzeghoub, V. Camps, M.-F. Canut, S. Chabridon, D. Conan, T. Desprats, R. Laborde, E. Lavinal, S. Leriche, H. Maurel, A. Péninou, C. Taconet, P. Zaraté. INCOME -Multi-scale Context Management for the Internet of Things. International Joint Conference on Ambient Intelligence, Pisa (It.), 2012. p 338-347. http://dx.doi.org/10.1007/978-3-642-34898-3, http://hal.archives-ouvertes.fr/hal-00753360

[2] J. Floch, S. Hallsteinsen, E. Stav, F. Eliassen, K. Lund, E. Gjorven, Using Architecture models for runtime Adaptability, Software, IEEE 23 (2) (2006) 62–70.

[3] K. Geihs, P. Barone, F. Eliassen, J. Floch, R. Fricke, E. Gjorven, S. Hall-steinsen, G. Horn, M. U. Khan, A. Mamelli, et al., A Comprehensive solution for Application-level Adaptation, Software: Practice and Experience 39 (4) (2009) 385–422.

[4] M Beggas, L. Médini, F. Laforest, & M. T. Laskri, Towards an ideal service QoS in fuzzy logic-based adaptation planning middleware, Journal of Systems and Software (2013), DOI: http://dx.doi.org/10.1016/j.jss.2013.07.023.

[5] S. Benmokhtar, D. Preuveneers, N. Georgantas, V. Issarny, & Y. Berbers, EASY: Efficient semAntic Service discoverY in pervasive computing environments with QoS and context support, Journal of Systems and Software (2008) 81(5), 785-808.