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Design and Integration Principles for Smart Objects

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Abstract Tagging everyday objects with sensors, actuators and building an instrumented environment are recent practices in industry and academia. In fact, the smart object domain has matured over the years. Several successful prototypes and applications have already demonstrated and deployed. However, there is very minimal interoperability among the design principles of these projects, and the underlying infrastructures can be rarely shared among isolated applications. We believe the primary reason behind this phenomenon is the missing rationale for the design and integration of smart objects. Now it is the time to focus on current practices and align on some key issues to continue the rapid progress of smart objects. The primary motivation of this workshop is to look at the existing systems to extract and extrapolate the best practices using the lessons learned from those projects to rationalize the design and integration approaches towards smart objects.

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1 Workshop Goals and Topics

The intention of the workshop is to bring together researchers and practitioners from a wide variety of disciplines with the goal to discuss, identify, share experiences and formalize key issues surrounding the challenge of building scalable, interoperable smart objects and associated systems. Instead of narrowly focusing on new technologies, we are more interested in extracting practices from existing systems and in refining them through collaborative discussions. The immediate goal will be to investigate the key issues from a variety of angles influenced by the experience and the background of the participants. The ultimate goal will be to formalize the design and integration rationale of smart objects and to define research challenges to stimulate further research. Some key challenges are:

1. *Design, Development and Representation of Smart Objects*: What are the design principles for smart objects [1, 10, 5, 4]? How to describe smart objects, what information do they carry, where does this information come from, what quality attributes does this information need to have? What is the relationship between the physical nature and the digital functionality of smart objects and how it affects people's understanding? What kind of framework is suitable for selecting sensors and actuators? What is the appropriation of the sensor and actuator fabrication policy? What kind of smart objects are suitable for a specific application domain and why? What are the difficulties in building economically feasible smart objects?
2. *Integration and Co-operation Models of Smart Objects*: What is the best approach to integrate smart objects into pervasive applications? Do we need an external dedicated infrastructure or should objects be built with communication capabilities [9, 14, 13, 11]? How to remonstrate the resource constraints of embedded platforms? How to represent the ecological relationship of smart objects?

3. *Programming Paradigm*: What are the suitable programming paradigms for smart objects [2]? How to support Rapid Application Development (RAD) integrating smart objects? How to configure smart objects for new applications and existing applications?
4. *Interaction Paradigm*: What is the appropriate interaction paradigm of smart objects? How to incorporate the smart features to an object while keeping its interaction metaphor intact? What novel enabling technologies are required to support the interactions [15]?
5. *Application Scenarios with Smart Objects*: What kinds of application scenarios will be benefited from what kind of smart objects [12,6,7]? What kinds of services are expected from smart objects by applications? What are the hurdles in deploying real world application scenarios with smart objects? What are the driving economical factors that will influence smart object based application developments?
6. *Social Impacts, Privacy and Personalization*: Provoking smart objects as part and parcel of our life also magnifies the social awareness of people because of the common understanding of Being Monitored by Sensors. How to gain the trust of users? What are the social impacts of smart objects? How to provide a personalized smart objects system in a unified way?

We need a much better understanding of smart objects to approach the above mentioned challenges. In order to improve our understanding of these topics and to facilitate discussions, the workshop will be structured around the following three agendas extracted from the above mentioned issues:

1. *Identifying the primary design principles of smart objects. This can be decomposed into two questions: How to map an objects digital functions into it's physical appearance and how to select the augmentation role considering their potentiality and affordability in applications?*
2. *Identifying the appropriate way of integrating smart objects in existing or new applications seamlessly ensuring interoperability.*
3. *Identifying the social evocativeness of smart objects, i.e. how smart objects affect human's mental model?*

Answers of these questions underpin the primary question of the workshop, i.e. How to build socially evocative smart objects ensuring reusability and interoperability?

2 Expected Outcome

We hope, the workshop will contribute in establishing a multi-faceted research community in the smart object domain area. The expected outcomes are:

1. Survey of state-of-the-art work on smart object systems including the overview of existing prototypes and application scenarios.

2. Design and integration rationale of smart objects focusing on the existing practices that will provide a solid base for the rapid progress of smart object systems and stimulating further research in this area by identifying future directions.

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