Master project
Winter term 2018/19

HPI Hasso Plattner Institut
IT Systems Engineering | Universität Potsdam

Engineering a Smart Factory

Background

Smart Systems are systems that support a combination of data processing, sensing, actuating and communication. These abilities allow for complex situation analysis and autonomous decisions making while remaining invisible to the consumer. Furthermore Smart Systems are often able to recognize each other and to interact with the environment and with other "intelligent" systems. Their application is expected to lead to systems with, for example, improved safety, reduced emissions or more energy-efficient infrastructure elements. It is expected that their incorporation will be key for the competitiveness of products in many sectors. On a broader spectrum they are also considered to provide solutions to address many grand challenges and risks for mankind in social, economic and environmental terms such as, for example, pollution of the environment, depletion of energy and materials resources, or increased needs for the mobility of people and goods (cf. [1]).

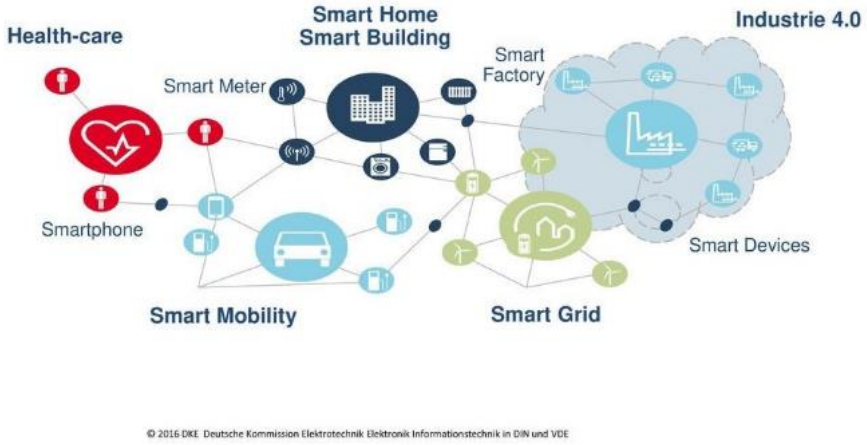


Figure 1. Overview of Smart Systems and possible interconnections

If such smart systems are connected to the cloud, the data they generated can be employed to produce smart services to control, maintain and enhance the offering. For private consumers, a smart service might offer them to employ mobility services online instead of having to purchase and operate their own mobility solution. The technical infrastructure underlying smart services are usually cyber-physical systems. The users who employ services in their respective roles as consumers, employees, citizens, patients and tourists are at the center and can obtain the right combination of products and services to meet their needs according to their current situation, anytime, anywhere (cf. [2]).

Motivation

In contrast to regular systems engineering, interconnected smart systems require a more challenging engineering approach. These systems have heterogeneous software and hardware properties affecting all stages of the development.

Starting with the initial setup, engineers will rarely face similar situations. The systems at the different levels in the architecture range from embedded devices to cloud systems which require unique knowledge about their installation and configuration.

Building an architecture that ties these different systems together to one big system is even more challenging. Interfacing devices with their very own demands for communication for example, will require detailed consideration of how to bring them together.

An even harder problem might be the planning of systems workflows: what subsystem is responsible for which task and when? How will the system organize this: centralized, decentralized (self-organized)

or even a mixture? How will the parts interact to avoid less than optimal processes, erroneous processes or are they even able to guarantee a certain service level provision?

Another challenge is the requirement that engineers from different technical domains need to work together. This will usually result in a negotiation phase in the development process, where engineers have to create a common understanding.

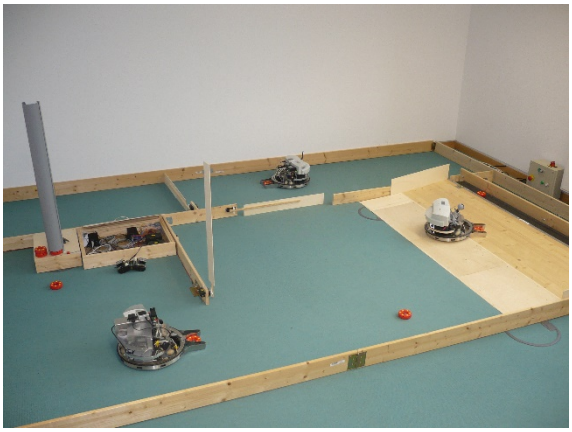
During development, the smart systems environment will also create hurdles. Debugging for example, will no longer be a pure software, network, electronic device or mechanical device bug-detection issue. Unforeseeable interactions will require to install a rigorous testing scheme in order to maintain a productive development cycle.

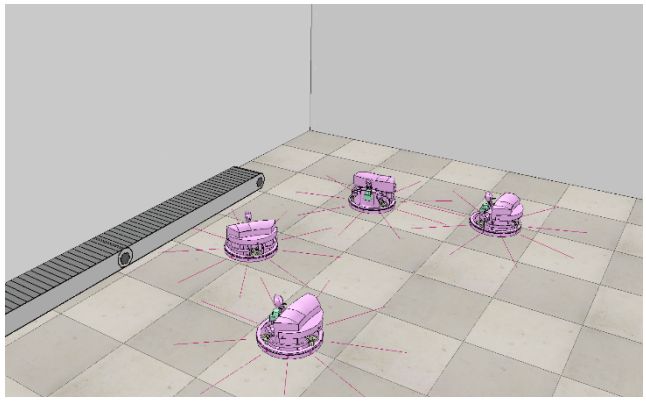
The project will provide a framework to explore this problem domain and to find solutions to some of the described challenges.

Project Description

The purpose of this master project is to realize a smart factory scenario in a simulation and to deploy it to the Cyber Physical Systems Lab. In detail, this means:

- To design a scenario
- To Develop the scenario's:
  - Service infrastructure
  - Graphical user interfaces
  - Simulation environment (VRep Simulator)
- Actual realization in the Laboratory





The project may build upon the Masters project-seminar "Engineering Smart Systems and Services", but participants are free to create the scenario from scratch.

Information

We expect interested students to be familiar with JAVA and an IDE (preferably Eclipse or IntelliJ IDEA). For questions and more information about this project, contact Holger Giese (holger.giese@hpi.de) or Joachim Hänsel (joachim.haensel@hpi.de).

Literature

[1] Smart Systems in the Multi-Annual Strategic Research and Innovation Agenda of the JTI ECSEL, Part D, 2014.

[2] Smart Service Welt. Recommendations for the Strategic Initiative Web-based Services for Businesses., 2015.