Digital Single Market

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Smart software for smart products

From cooking pots to cars and aeroplanes, the products of the future will be increasingly intelligent - able to communicate and cooperate with humans, other devices and their environment. EU-funded research is assisting this smart products trend that promises to make everyday life easier, more comfortable and productive.

 [1]

Anyone who has ever tried to install a new entertainment system in their home, fit a child seat in their car correctly or learn how to use a new hi-tech kitchen appliance knows just how complicated and frustrating some products can be. Paper instruction manuals are often hard to follow and getting two or more devices or components to work together can be a nightmare. But what if the products themselves could tell users and each other what to do?

'The complexity and variety of products - whether domestic appliances in your kitchen or components in your car - is not going to change. In fact, products will keep getting more complex and difficult to use and the traditional solution of providing an instruction manual with them simply doesn't work very well,' says Dr Daniel Schreiber, head of the Telecooperation Group at Technische Universitaet Darmstadt in Germany. 'Smart products are one way to address these issues.'

Smart products have knowledge, artificial intelligence and communication capabilities built into them. They know what they are, what they are supposed to do and what they need to work. They can even know where they are and what other devices and users are in their environment. Embedded with sensors, actuators and ambient intelligence, smart products can engage proactively with users and other devices through multimodal interfaces, enabling them to communicate and provide guidance

and suggestions.

'Take the example of a smart kitchen, if you have a steamer it would be great if it could explain to you which is the best setting to cook fish and then let you know when the fish is perfectly cooked. In our view, products should explain how to use them while you are interacting with them,' Dr Schreiber says.

Dr Schreiber has led the technical development of innovative software and systems to enable a wide variety of products to do precisely that.

The work, carried out in the SmartProducts [2] (1) project and supported by EUR 6.9 million in funding from the European Commission, was coordinated by SAP and involved partners from seven European countries.

The team focused on the core technologies necessary to enable products to store and share proactive knowledge about themselves. To do so, they needed to bridge the gap between ubiquitous computing (a key element in the so-called 'internet of things') and ontologies-based knowledge management - a major technical challenge, particularly when dealing with many distributed, dynamic and heterogeneous devices.

Making knowledge ubiquitous

'Knowledge-based technologies are very good at describing things when it all stays in the software, while ubiquitous computing is all about connecting sensors and actuators to hardware and embedded systems. You can't just put this knowledge technology into the embedded system and expect it to work because the software and the real-world hardware environments are very different,' the project technical manager explains. 'With software you can roll back and try something else, but that's not the case with hardware: if the steamer is already on and the water is boiling, turning back and trying something else is simply not possible.'

The team therefore developed a set of ontologies and reasoning methods to characterise proactive knowledge and embed it into smart products in order to support context-aware interactions with users and other products. In some instances, knowledge is stored directly in the product, while in other cases a simple RFID chip is used to identify the product and knowledge about it is drawn from a distributed database using an internet connection, for example. The team also developed ubiquitous computing middleware, called MundoCore, that combines different communication methods and ensures interoperability.

The technology was integrated in the SmartProducts platform, based on OSGi and Java and designed to provide all essential services and functionality for a wide variety of smart products. Three demonstrators, built around real-world scenarios, show just how diverse the applications for the system are.

Working with consumer-electronics manufacturer Philips, the team applied the technology to kitchen appliances, developing smart chopping boards, cooking pots and a cocktail mixer that guide users on ingredients, recipe preparation, nutrition and cooking.

A second scenario looked at the product-lifecycle management of vehicles. Together with Centro Ricerche Fiat, the team demonstrated how a smart car and smart snow chain can share information and provide the user with advice and guidance via their smart phone on how to fit the snow chain.

'The same concept could apply to fitting a child seat,' Dr Schreiber notes. 'Say you rent a car and bring your own child seat with you. Every child seat and every car is different so installing it correctly can be difficult: Should it go in the front or backseat? How can the airbag be deactivated... etc? If the child seat is equipped with an RFID chip that identifies it then a smart car can read the chip, automatically obtain installation instructions from the internet and guide the user on fitting it via an on-board display or via their smart phone.'

The third application scenario focused on industrial applications for the technology. With EADS, the SmartProducts project researchers implemented the system in tools and components used in aircraft assembly in order to help technicians during the manufacturing process. Smart tools and smart components, used in combination, could dramatically reduce human error, improve worker productivity and speed up production processes.

'Initially, manufacturing and industry are likely to be the biggest markets for smart products technology,' explains Dr Oliver Kasten, a senior researcher at SAP Research in Zurich, Switzerland, and the technical coordinator of SmartProducts. 'There are also many applications for this technology in consumer products as we demonstrated in the project. However, the market is probably too price sensitive for systems such as this to be widely implemented in the near future.'

Dr Kasten says several of the project partners are exploiting the results of the project internally, although at present there are no plans to develop the SmartProducts platform into a commercial product.

Nonetheless, much of the underlying software has been made available under open source licences for other researchers to continue the project team's work. The MundoCore middleware, for example, is now being used in the EU-funded Smart Vortex project, which is developing interoperable tools, services and methods for large-scale industrial innovation engineering projects.

SmartProducts received research funding under the European Union's Seventh Framework Programme.

(1) 'Proactive knowledge for smart products'

Useful links:

- 'Proactive knowledge for smart products' website [2]
- SmartProducts project factsheet on CORDIS [3]

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