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HARTING's Technology Newsletter

NETWORKED WORLDS

Guest Contributor: Prof. Dr. Wolfgang Wahlster

Automation IT becomes reality

Electronic label with RFID

HARTING

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leads the world's largest center for intelligent software technologies, the German Research Center for Artificial Intelligence (DFKI GmbH) in Saarbrücken, Kaiserslautern, Bremen and Berlin, from which 46 new companies have been founded. Prof. Wahlster is a member of the Royal Swedish Academy of Sciences in Stockholm and was honored with the German President's Future Prize for his work on man-machine communication. He is a member of the Wirtschaft-Wissenschaft (industry-science) research alliance convened by the federal government, which has also appointed him promoter for the information and communication technologies innovation field.

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Digital Product Memory: Embedded Systems Keep a Diary

Information and communication technologies (ICT) are the foundation of innovations in all other economic sectors and consequently rank as the number one innovation engine. They pervade all areas of life and work in our society and form the technological basis for the information and knowledge society. As a key technology in an economy increasingly based on knowledge, ICT additionally functions as a growth accelerator for all key branches. According to statements made by executives of relevant companies participating in Germany's Federal Ministry of Education and Research (BMBF) ICT strategy group, of which I am the scientific director, more than 80 % of the innovations in the automotive industry, medical technology and logistics are driven by ICT (software systems, electronic systems, network technologies and knowledge technologies).

Today Germany is no longer playing much of a role as a country manufacturing classical computers, basic software (such as operating systems, database systems and office software) and peripheral devices (such as computer screens and printers). In contrast, Germany is leading in the corporate software sector and is home to the world's third largest software provider. But Germany also holds a leading position in developing innovative application software for embedded systems in automotive, automation and medical technologies. After all, German companies, thanks to their special ICT competence in logistics, are leaders in new marketing and distribution concepts. Within the framework of the German government's hi-tech strategies the idea is to build the innovation process around these application areas and target branches, as this is the only way to guarantee that the complete value added chain is carried out in Germany, thereby creating new jobs here.

The following is intended to present the underlying innovative concept of digital product memory as a concrete technological vision for the future which, as an enhancement of RFID (Radio Frequency IDentification) technology and embedded systems, has enormous potential for application in the above named target branches through the integration of artificial intelligence methods.

DIGITAL DIARIES FOR PRODUCTS

ICT-supported logistics and services (from consulting services to maintenance and repair to recycling) involving premium products have become the most important success factor in many branches. Due to the shorter and shorter product and innovation cycles and ever more complex logistics chains, digital recording of the life cycle of premium products, constant monitoring of the status and tracking of a product's position, as well as ubiquitous access to all relevant product data, are vitally important to a production and commercial company's competitive position. Finally, digital product memory is opening up a new dimension in protection against product piracy, in consumer protection and in product liability.

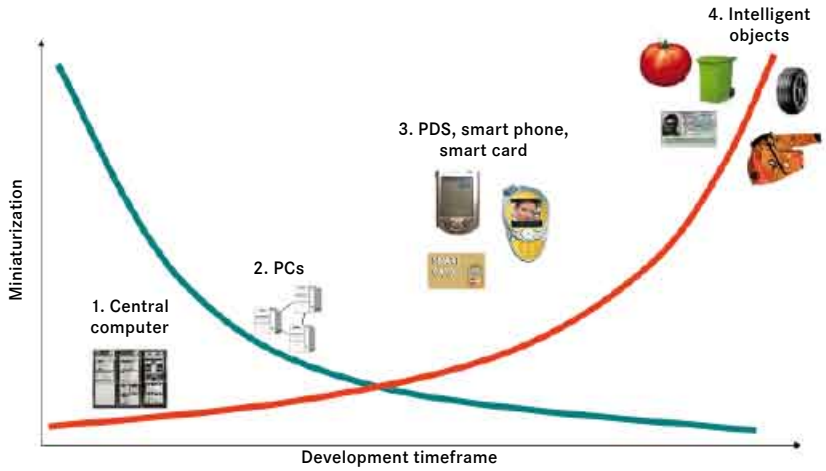
The next generation of "Smart Items" built into products will extend beyond the pure identification function of RFID tags and, in addition to reading various embedded sensors (e.g. temperature, position, brightness or humidity), will also record all relevant product and operating data and will be able to actively exchange information with their surroundings and their users, in the sense of an "Internet of Things".

The digital product memory more or less has the function of a black box in airplanes, and, like a flight recorder, records all relevant ambient parameters in digital form. But the best of today's embedded systems are so small that they can be built into any everyday object in such a way that they cannot be seen from the outside. In addition to a microprocessor, memory, microsensor systems, GPS (Global Positioning System) chip and radio modules, they also contain their own energy supply. Product memories can exchange information with each other or with their surroundings in an ad-hoc network via local area radio. This results in a kind of ambient intelligence. Consequently, wine crates and chocolate candy boxes in a refrigerated truck can "complain" to the air conditioning that their critical values for air humidity have been exceeded, and the air conditioning can automatically adjust itself. But most importantly, people can access these digital product diaries at any time.

When such digital diaries are kept in the blue lid of the beluga caviar jar, in the bottom of the box of Belgium luxury chocolates and in the cork of a top French wine, the dealer, and even the end customer, can always check whether or not the premium product has been subjected to any ambient influences that would lower the quality. The microsensors note where and when the wine was not stored flat or was exposed to vibrations, daylight, or even strong temperature fluctuations. The end customer can then decide whether or not to purchase the product at the offered price, in spite of this shortcoming. The dealer can send luxury chocolates that were exposed to excess humidity for a few days during transport directly back to the supplier.

In the future, if a used car buyer were to read out a vehicle's digital diary and discover that the car had been driven without enough oil for more than 300 km three times in the last two years and that the driver's airbag had already deployed twice in the last six months, these facts would certainly influence buying behavior. Given that important spare parts in cars, airplanes and production machines will also be giving out information about themselves in the not-too-distant future, it will be possible to quickly check whether or not only original, guaranteed parts were really used for a repair.

In a future SmartFactory along the lines of the facility that the German Research Center for Artificial Intelligence (DFKI) is currently setting up in a demonstration and development center in Kaiserslautern with companies such as Bosch, HARTING and Siemens, it will be possible to write and use digital product memory during the product's manufacture.



From a central computer concept to the "Internet of objects". Source: DFKI GmbH

Intelligent shopping assistants use digital product memories. Source: DFKI GmbH

safe cars. And again, this is not possible without semantic technologies among the product memories. Because when a French Peugeot with a water sensor discovers that a large puddle of water on the road presents an aquaplaning hazard, it should use universally understandable semantics, not French, to report this over an ad-hoc Internet connection to the local hazard warning system of a BMW motorcycle that is following it. The motorcyclist could then receive a warning that might save his or her life: "Watch out – aquaplaning in 200 meters!" Our German automotive industry is the world's leader in this form of car-to-X communication between vehicles and the traffic infrastructure. In a few years, we will probably have to take our cars to the workshop for a semantic software update more often than for an oil change.

THE KEY ROLE OF SEMANTIC TECHNOLOGIES

Access to the product memory by user-friendly dialog and interoperability of various product memories and intelligent surroundings require semantics that a machine can understand. Product diaries' added value can only be activated if a service robot handling goods can understand the information on size, weight, stability and grip points from the digital memory of the product. The core of semantic technology is formed by markup languages such as OWL (Ontology Web Language) that have formal semantics and provide a standardized concept for describing digital contents in an ontological form. When searching for information, reasoning can accelerate the search process or derive the information sought.

If objects used in everyday life are more and more strongly networked online with semantic connections, the result will be the "Internet of Things". People will no longer perceive the digital network around them – it will simply be there, as an ambient intelligence. The embedded systems in our vehicles, which, with more than 70 microcomputers, have become moving computer networks, must communicate among themselves, one vehicle to another, in order to bring about an even higher level of mobile safety and to come closer to the vision of 100 %

Naturally, protection against unauthorized access or forging and destruction of product memory will become a central issue in safety research.

In the joint projects SmartWeb, Specter and SharedLife sponsored by the BMBF, DFKI researched important fundamentals of semantic technologies for digital diaries, which were on display as demonstrators at the CeBIT 2007 research exhibition hall. The above outlined elements provide all of the important preconditions for a beacon project from the German government's hi-tech strategy in the area of digital product memories, which can lead to industrial implementation along the entire value chain in Germany.