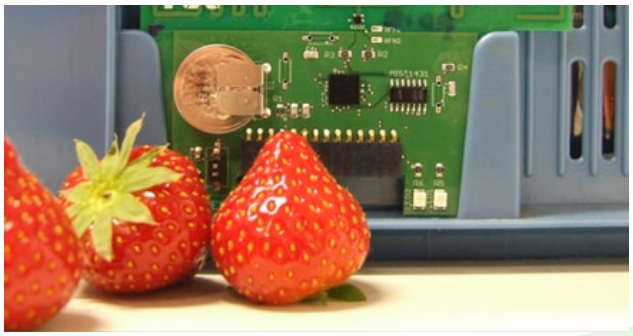
Project result

Cluster for Application and Technology Research in Europe on NanoElectronics

CT204 | Using smart electronics (RFID) to monitor quality of perishables (PASTEUR)

PASTEUR touches our daily lives. In helping to ensure perishables arrive at their destination in good condition, this project reduces the amount of damaged food and spoilage – an annual loss of €25 billion to the food industry and €300 to every household. Deploying sensors based on Radio-Frequency Identification (RFID) technology, PASTEUR has developed a wireless sensor platform that is able to monitor a far-wider range of environmental parameters than was previously possible, and extend environmental monitoring to crates and boxes of perishable goods along the logistics supply chain.



Central to this solution is the wireless sensor tag, based on a multi-sensor chip that connects to an RFID chip and a low-power microcontroller. This combination of technologies enables autonomous logging of the environmental conditions of products during transport and storage in the cold chain. RFID-based environment monitoring is a technology with the potential to transform the present-day supply and distribution chain. On the one hand, it will improve cold-chain distribution quality and record-keeping; on the other, it will also assist in identifying problems, assigning liability, and ensuring timely preventive measures are taken.

Successful delivery of key technologies

The main project deliverables are several important technologies (power, sensors, wireless communication and security) key to the sensor tag and related equipment, and which were developed and integrated in a single unit. These were tested – with the help of 'demonstrators' – for integration, cost-efficiency and application relevance.

PASTEUR deals with quality monitoring of food products in two main application areas:

1. Fruit: cold chain monitoring (logging of temperature and different gas fractions);
2. Meat: monitoring temperature and pH (acidity or alkalinity) value after slaughtering.

Considering that these measurement systems differ widely by their very nature (measuring in gas is quite different from measuring in liquid), it was logical to define and develop two separate demonstrators:

1. An integrated smart sensor tag (with temperature, humidity and possibly CO_2 sensor capability) for fruit (explained above);
2. An integrated smart pH sensor package (with temperature and pH sensor functionality) for meat.

The pH sensor consist of two components: a moulded stick (containing the sensitive pH sensor device), which is connected to a small custom printed circuit board which contains an ARM microcontroller, a battery and several other auxiliary components, including a connector for serial communication and a connector for a (optional) external reference electrode.

All deliverables successfully were tested and verified in field trials comprising a simulated cold chain, and a carcass in a slaughter house. There were also encouraging technical achievements in the deployment of active RFID labels in cold chain monitoring. Energy consumption was reduced to a low 0.5 mA (current). The tag size was kept to a compact 10 cm^2 and all functionality integrated in a single interface between printed and silicon element for both types of tags. In addition, a low tag price (of just over US$ 1.00) was achieved.

ENERGY-EFFICIENT DEVICES AND ENERGY CONTROL SYSTEMS

Partners:
Boschman Technologies
Centro Nacional de Microelectronica (CNM)
IMEC-NL
Inkoa Sistemas
KU Leuven
Netherlands Packaging Centre (NVC)
NXP Semiconductors
Philips Consumer Lifestyle
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Prelonic Technologies
Royal DSM
Stichting IMEC-NL/Holst Centre
TNO/Holst Centre
TP Vision
TU Delft
TU Eindhoven
Verhaert New Products Services
Wageningen UR

Project leader:
Romano Hoofman
NXP

Key project dates:
Start: July 2009
End: September 2012

Countries involved:
Austria
Belgium
The Netherlands
Spain

PROJECT CONTRIBUTES TO

Communication	
Automotive and transport	
Health and aging society	
Safety and security	
Energy efficiency	
Digital lifestyle	
Design technology	✔
Sensors and actuators	✔
Process development	
Manufacturing science	✔
More than Moore	✔
More Moore	

Benefits all around

Typically, around 20% of temperature-sensitive healthcare products are wasted during transportation due to a broken cold chain. Each year, suppliers of perishables ship over five billion pallets valued at $2.6 trillion of chilled meats, seafood, cheese, and produce, as well as temperature-sensitive pharmaceutical and biomed products.

This means everyone in the supply chain of any transported goods will benefit from PASTEUR's technology solution: from manufacturer to transporter to retailer, and finally end-user. In the future, retailers could use this technology to install a shelf-based quality control system at sales outlets, and consumers to check (through their mobile phone) the quality of their food at home. And reduced spoilage is also good for the environment.

European co-operation and collaboration

Key to the success of this project was the pooling together of European expertise and experience, combined with good management and communications. Crucially, the various project participants and partners contributed essential components and know-how on the different technologies in the 'value chain' of RFID-based intelligent sensor systems. Notable examples of this type of co-operation include FlexSMELL, a European project deploying RFID technology in developing an olfaction system; and Devlab in the Netherlands where wireless sensor networks are developed.

Future co-operation is also on the cards. The European project Chill-On, whose development work – combining TTI and RFID to locate and trace any food product – is of interest to PASTEUR's own R&D. Chill-On is also developing an Information Management System, similar to PASTEUR's own model, to control the parameters throughout the food supply chain. And Belgium's Flemish Institute for Logistics is also interested in collaborating in a national project.

Going forward

The real attraction of the PASTEUR solution is its use of smart sensor tags in environment condition monitoring, combined with integrating multiple sensors and applying this technology solution in multi-item management, followed by item-level tagging and monitoring.

Competitive solutions in this fragmented market either offer temperature-monitoring only, or are extremely expensive and bulky, serving high-end markets (such as pharmaceuticals) or logistic bulk management (such as large shipments).

PASTEUR therefore has a competitive price-performance edge. However, it has to move fast if it hopes to get a slice of this potentially huge pie: potential competitors, who currently do not provide sensors, only wireless ICs, are quickly moving in.

One way is to approach companies are already showing interest in using the PASTEUR solution in the environmental monitoring of their supply chains. Another is to involve insurance companies, already in the logistics chain, in the smart monitoring process. Some large forwarders are already working with insurance companies to implement monitoring systems in containers. By continuously monitoring a shipment, insurers can identify the time and probable cause of damage, and, importantly, the party liable. This could even promote and facilitate the introduction of PASTEUR's technologies in cold chain management by providing a clear picture of cost and performance benefits.

The application areas for technologies developed in the PASTEUR project are not limited to the monitoring of cold chains for perishable goods. The potential variety of applications from the successful development of marketable platforms are actually quite vast. They include for example: supply chain uses such as traceability and quality management; domestic applications like detecting hazardous gases such as carbon monoxide; as well as medical monitoring to ensure therapy compliance; and corrosion monitoring for the construction industry.

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