High-tech guardian angels

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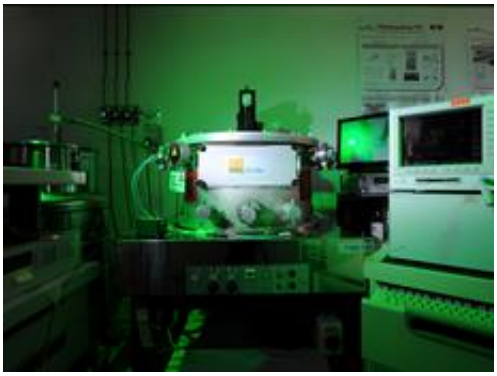

Futuristic technology will be necessary to achieve the goals of the Guardian Angels for a smarter life project. Credit: Thierry Parel

A scientific consortium comprising the EPFL and ETH Zurich is looking to push the boundaries of technical possibility with its 'guardian angels'. It is applying for an EU flagship project for the development of high-tech sensors, energy production and computer technology.

Chips, computers and data storage devices are getting ever smaller, faster and cheaper. Technology is being stretched to its limits, especially since it is virtually impossible to reduce the energy needs for information and communication technology (ICT) any further. The current battery technology is also holding back progress in this field. After all, what's the use of an iPad with all its network functions if the battery runs down in ten hours and has to be charged at the mains? New approaches are therefore needed in ICT, data collection and processing, and energy

storage, along with new possibilities for using energy from the immediate surroundings of the IT terminals.

A pan-European research consortium headed by ETH Lausanne and ETH Zurich was formed to pursue this approach in a large-scale project. The consortium has planned an EU flagship project called Guardian Angels for a Smarter Life with a view to creating personalised, interconnected electronic 'companions'. Under the project, the researchers want to investigate thoroughly and demonstrate new solutions for sensors and data processing, the communication between the electronic devices and new ways to supply them with energy. The scientists are presenting their project publicly for the first time at a pan-European conference in Budapest from 4th til 6th May.

Self-sufficient sensor technology

The 'guardian angels' will be inconspicuous, intelligent and self-sufficient devices designed to help people in daily life. They include sensors that help small children or people in need of care in complicated life situations. Sensors on and in the body measure different bodily functions, process the data and transfer it to mobile devices via corresponding communication channels. These tiny electronic guardian angels should help elderly or handicapped people retain their independence – even if their mental or physical faculties are in decline.

However, the guardian angels are also to act as sensors for the environment, to recognise environmental hazards at an early stage, for instance. The monitoring stations will communicate with one another and significantly improve the efficacy of the individual measuring stations, which could issue warnings immediately before natural disasters occur. This network made up of environmental sensors can also collect real-time data over a wide area that helps cut down on heating, transport and energy costs in general.

Finally, the guardian angels should be able to register human emotions and thus become valuable helpers in daily life for quadriplegics, for instance. In a nutshell, the electronic guardian angels could read thoughts and help people suffering from paralysis to interact with their surroundings.

Zero-power systems

'The project is extremely forward-thinking; it's just as ambitious as flying to the moon fifty years ago,' says Christofer Hierold, a professor of micro- and nanosystems at ETH Zurich, who is coordinating 'Guardian Angels' along with the project initiator, EPFL-professor Adrian Ionescu. The guardian angels are not just another, more extreme miniaturisation in the field of ICT; the primary goal is the development of a completely novel technology that can get by on as little power as possible.

The ETH-Zurich professor stresses that this flagship project is primarily about 'testing' certain physical principles that are discussed in the basic sciences and using them under normal conditions. By doing so, the researchers are looking to push – or leap over – the boundaries of what is currently possible.

This requires major technological progress on all levels: in power consumption per computational operation or sensor function; in technology for communication and software with a view to using less energy but still guarantee reliability, data security and privacy. Moreover, technological innovations are needed to obtain energy from the surroundings and store it temporarily.

As the networks will be wireless and changing or charging a battery is not an option, they have to generate the energy they need for operations, communication and computational power themselves. This is what the

researchers understand by the term ‘zero-power systems’. Vibrations or movements, possible temperature differences or radiation energy are to be converted into electric energy. Nanowires that, if integrated in larger surfaces, produce energy from low temperature differences extremely efficiently could be used. The amounts of energy generated, however, will be small since the guardian angels themselves will be small and inconspicuous. Consequently, besides the essentially new technologies for electronic components and sensors, the researchers also need to develop new high-performance software concepts.

Sensors could be based on carbon nanotubes, which require very little energy for their sensory function. The signal processing and wireless transmission of the data also needs to be feasible with tiny amounts of energy. ‘The whole system of the guardian angels is the demonstration of ultra-low power technologies and will thus elicit countless new solutions for other applications,’ says Hierold.

This is ambitious and still a long way off. The ETH-Zurich professor speaks of a radical change in thinking and paradigms that have to be turned upside down to achieve the objectives. However, the novel technologies that have to be developed and promoted in the context of ‘Guardian Angels’ are already partly in progress: spintronics, a concept for components and signal processing based on the spin of electrons and the associated magnetic moment in addition to their electric charge.

Many groups; one goal

For Christofer Hierold, the major challenge will be to focus the numerous research teams involved in the project on these common goals as the major challenge. All the teams involved have already built up a lot of expertise and some of the technologies sought are currently being researched. The two ETH universities are running the pan-European project. Adrian Ionescu from the EPFL is currently responsible for the

lion's share of the 'Guardian Angels' project. Apart from eight European universities, a number of other research facilities and eleven firms from the high-tech sector, including IBM Research Zurich and Siemens AG, Deutschland, are also involved. The ETH-Zurich teams under Lothar Thiele (D-ITET, Communication), Vanessa Wood (D-ITET, Energy Harvesting), Andreas Schenk (D-ITET, Novel devices and Workpackage 1 Leader), Bertrand Meyer (D-INFK: Software), Dimos Poulikakos (D-MAVT, Nanotechnology), and Christofer Hierold's own group (D-MAVT, Sensors) will also be working on the guardian angels.

One billion for EU flagship program

Under its seventh Research Framework Program, the EU tendered for major projects, so-called flagship initiatives, in the field of Future and Emerging Technologies (FET). With the FET flagships, the EU is looking to promote large-scale, ambitious research projects with a visionary goal in information and communications technology (ICT) by offering EUR one billion over a period of ten years. Twenty-six consortiums submitted projects. In March this year the six most promising candidates were nominated, including two projects with considerable ETH-Zurich involvement: 'FuturICT' and 'Guardian Angels'. The finalists will be presenting their projects publicly at the second FET conference and exhibition in Budapest on 4-6 May. The research groups will then have until May 2012 to put together a detailed proposal, which the final decision will be based upon. The successful consortiums will finally be able to start work in 2013.

Provided by ETH Zurich