



interview with Emile Aarts

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Although embedded software technology is profoundly present in real life for some time now, it never really came to a unified approach of research. Currently, a top institute on embedded system technology is burgeoning in the region of Eindhoven. Emile Aarts, never afraid to make some slightly stinging remarks, was challenged to speak frankly about this initiative.

The Development of a Top Institute on Embedded Systems

For historical reasons, research on embedded systems has been somewhat scattered over the place. Now the research questions, challenges, and required knowledge are gradually revealed, it is time to couple all existing necessities and resources by establishing a real institute on embedded systems. Prof.dr. Emile Aarts (Computing Science) and prof.dr.dipl.-ing. Jochen Jess (Electrical Engineering), both professor at Eindhoven University of Technology (EUT), are currently setting up the Eindhoven Embedded Systems Institute (EESI). XOOTIC Magazine interviewed Emile Aarts and talked about the characteristics of an embedded system, the process of developing EESI, the competition in the field, and the relation with OOTI and XOOTIC.

An embedded system: what is that?

"An embedded system is a high-performance hybrid electronic system that consists of a number of co-operating hardware and software components", explains Emile Aarts. This definition however includes almost any electronic device such as electronic shavers. "We have to add more to the definition. The systems have to be computation-intensive. This also includes systems that need to perform the very same simple calculation, let's say, a million times per second. Additionally, embedded systems are reactive; they interact with their environment through sensors and actuators." Aarts rounds up the definition with examples: "The car of the near future is actually a big electronic system on four wheels with an engine. Just think about embedded system technology such as anti blocking and injection systems, telecommunication, car navigation systems, and information display on the windscreen. The merge of PC and TV is another example of embedded system technology. Finally we should also mention personal communication systems such as PDA and GSM devices, which obtain more and more computation-intensive video components."

Meanwhile, today's embedded systems have to meet specific requirements. "Flexibility and reuse are key issues to reduce the costs of manufacturing in both the world of low volume, think of aviation, and the world of high volume, think of consumer electronics. Also, the presence of hybrid components in a variety of systems calls for formal specification. Families of architectures need to be developed by some co-design methodology to combine the best of both the hardware and software world. Lastly, requirements for portability and compatibility further increase the need for standardization."

We allowed Emile Aarts to take a philosophical peek into the future.

"A shift in terminology is apparent. The term 'embedded' suggests that it goes in a box and that it has means to communicate with the outside world. This idea is however slowly vaporising due to developments such as openness, think about Java technology, and distributed networks. That's why we are tempted to speak of compute-intensive systems instead of embedded systems."

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Emile Aarts also made us aware of the expected research issues, some five to ten years from now, that might 'capsize' our whole inheritance on formal specification. "Systems will be emergent, which means that they are not solely based on the specification as obtained in the requirements engineering phase; they develop themselves relying on the interaction with their environment. As an example, the flying of an aircraft is an emergent property. I know of no part of the specification of aircrafts that says that aircrafts fly. It has all something to do with things such as aerodynamics and mechanics, but the whole is more than the sum of its individual components."

A small history of EESI

In Spring 1996, the government issued a call for proposals to set up a number of Technological Top Institutes (TTI) in the Netherlands. A joint plan to start up a TTI on embedded systems by Hollandse Signaal Apparaten (HSA), Philips, and EUT was however turned down in the first round. "The plan was turned down because programmatic elements were not made sufficiently clear. In addition, the interest by industry was insufficiently indicated."

The current EESI initiative is actually a sequel to that plan. The initiators have learned their lesson: "One must produce a thick stack of paper and involve as many people as possible. The statement 'I am the best' can only be proved by quantity. Simply because the reviewing committee often does not have the insight with respect to quality." After asking whether this is really a standard way of doing, Aarts confirms and goes on: "Business plans, I know of, are mainly political statements with a lot of adherence declarations that reveal your network; that lay out your competitive position with respect to others. In many appendices, they proclaim what they have in store. Quality, but certainly also quantity are important factors." Renowned companies such as Philips, ASML, Océ, Ericsson, ABN/Amro, CMG, and TNO have already sent their adherence to the EESI initiative.

Bottom-up

The lack of financial room from the government has not defeated plans for an embedded system institute at all. What remains true is the need to facilitate co-operation, control, and coherence within embedded system research. Only other more modest ways had to be sought to carry this point.

Emile Aarts explains why reorganizations at EUT are excellent carriers to found EESI: "EESI is a joint initiative of the department of Mathematics and Computing Science and the department of Electrical Engineering of the Eindhoven University. Starting of with a small joint interest group in embedded systems we wish to establish EESI along the lines of a phased plan. First, all knowledge in the subdepartments is clustered. Thereupon, a research programme will be developed. Further, this programme must get involvement from other departments of EUT such as Mechanical Engineering, and eventually parts of Applied Physics and Chemical Engineering. Ultimately, the institute must serve a national function; we hope that other universities will participate within the institute."

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Those who might not have had much exposure to the new phraseology at the EUT, the term 'spearhead' is introduced during the latest reorganization. It symbolizes the means to intensify current research within departments. On the other hand, room for research diversification is still available within this framework by the definition of small projects on distinct subjects. Aarts emphasizes that the term 'umbrella' is an inappropriate imagery for the current process.

Emile Aarts and Jochen Jess are currently working to put EESI on the map of academic Eindhoven. The initiative has already resulted into a bulky development plan in which aim and motivation are explained, competences are discussed, adherence from government and industry is notified, and the organization, finance, and realization phases are described.

Competition

Funding from government and industry can only be spent once. The question therefore raises whether there are any other competitors for the same cash-box. Emile Aarts mentions two other parties interested. "PROGRESS (Programme for Research On Embedded Systems and Software) is a national plat-

form, headed by prof.dr. Maarten Boasson. It is aimed at setting up a steering committee for defining a common national research programme on embedded system technology. They receive funding from the government and decide what submitted proposal for research on that area will be accepted. There is a mutually good understanding between EESI and PROGRESS. Big local initiatives always queries the government; it is therefore politically wise to work along with a national platform."

EESI must serve a national function.

"Another nice initiative on ubiquitous computing is recently launched at Delft University of Technology. They have also defined a project in which professors and PhD-students are involved on subjects similar to ours."

Organization

The initiators are heading for an institute with its own accommodation. The organization in view is a foundation with its own management, technical and administrative staff, and supervising board. The signature of the research scientist within EESI depends however on the conditions as stated by the implementation of the MUB ('Modernising Universitair Bestuur'). "The MUB works along the principle that one can purchase both education as well as research from the departments. Departments might become a sort of employment agency; employees are still appointed within a department but are 'body-shopped' by the very same department for research or educational purposes to other organizations such as EESI. Other parties can, in turn, buy research and education from EESI. We are still discussing the distribution how to accomplish this financially; to give both EESI and the department a fair share of money. In addition, employees can be detached from industry."

Relation with OOTI and XOOTIC

The OOTI programme contains both a module on embedded system and hardware/software co-design. A close co-operation between OOTI and EESI is therefore expected by Emile Aarts. "Just to mention only four opportunities. Interesting parts of EESI projects might be passed onto OOTI as final design projects. OOTIs might attend EESI courses as part of their core curriculum. Via the network of EESI, OOTIs might be informed about job opportunities in the field of embedded systems. EESI seminars might be attended by OOTIs, or OOTIs might even give presentations at the EESI."

Many ex-OOTIs are currently affiliated to the em-

bedded system branch. Aarts argues that 'communication within work' is extremely important. "To know what opportunities and problems exist, if you are a solution provider, and to know where the answers are, if you have a problem, is the basis of networking." He also stresses the impact of alumni associations, such as XOOTIC, for universities: "If a university wants to stay in step with industry, any external advising committee won't do. Its members are often out of running for some time or take a rather managerial point of view. I find it important that a university has the disposal of people who speak the right language and know about the things going on at the other industrial work floor".

Excellence in Eindhoven

Honestly, being a top institute on embedded systems in the region of Eindhoven is not that hard for obvious reasons. Being a nationally, or even a mundially, excelling institute requires, however, world famous research scientists. Aarts deliberately replies: "On the one hand, we are strong at formal techniques for electronic systems design and, on the other hand, we have a strong coupling with industry. These industry partners have potentially an enormous supply of contract research. EESI and its employees are, thus, able to stress their distinctive features by working with the right competences on the right topics."

Even without the financial help from the government, research on embedded system will be clustered and extended at EUT. Whether this 'spearhead' will ultimately mature to a national top institute is yet another question. Although the local bottom-up approach restricts the number of political debates on the implementation of such a institute and requires no extra funding, it will unnecessarily harden the process to become a widely honoured institute.