

Making sensors smart

Intelligent sensor networks: the subject of an ambitious research programme to build a knowledge portfolio and give TNO a prominent role in responding to future market demand.

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Our society has ever-increasing mobility, energy, water and safety needs. In order to provide sustainability various advanced technologies should be put into practice resulting in optimal use of our limited resources, management of emissions, etc. Networks of sensors and actuators are key to this provision. Microclimate control in greenhouse horticulture, energy neutral "intelligent" houses, traffic management based on combined vehicle and road-embedded sensors, crowd monitoring in large public areas (e.g. airports, stadiums, parking areas) are typical examples where distributed sensing and actuation open the way for new solutions. Unprecedented increase in accuracy, coverage, performance and robustness can be achieved if these new technologies are fully embraced.

INTEGRAL DATAPROCESSING

Dr Zoltan Papp, a TNO expert in the field of intelligent sensor networks explains: 'An intelligent sensor network uses autonomous devices spread out over an area or a production process that cooperatively monitor the processes and their operational conditions. Although the individual elements of the network (the sensor network nodes) are relatively *simple*, the cooperation among the elements lifts the intelligence to a higher level: the intelligence emerges from the interactions. This collaborative data processing gives you relevant information rather than raw data – and this is a unique capability of the sensor networks, or more generally, the distributed problem solving networks.'

Sensor network nodes resemble normal computer hardware with serious performance limitations. Papp: 'Powering the sensor network is always one of the major concerns. Unfortunately – due to the technological constraints – the sensor nodes are very limited in processing capabilities, the memory is small, the communication is short-range, slow and unreliable, and the available power is scarce. Not the easiest environment to work with. But this is the research challenge around sensor networks: how can we realise sophisticated data interpretation and reliably control an inherently low performance, unreliable platform? This problem domain has many interacting aspects: you need thorough expertise in sensor technology,

digital signal processing, distributed systems, radio communication, power-aware hardware design, antenna design – just to name a few, but there are many others. Fortunately TNO, as a whole, is well equipped to face these challenges.'

FIELDLABS

Fieldlabs, like the one in the soccer stadium of the Dutch premier league ADO Den Haag, play crucial role in this research/development process. The soccer temple and its corresponding infrastructure offer excellent possibilities for external parties to deploy new crowd monitoring concepts and technologies in a realistic environment populated with thousands of visitors. The experience and insight gained can be directly translated into other environments, like stations, shopping malls, city centres and various public places that have thousands of visitors.

Papp elucidates. 'The fieldlabs serve multiple purposes. A fieldlab is always attached to a complex real-life case, so our solutions can be scaled up to size of the real problem and can be tested under real-life conditions. This level of validation cannot be achieved in lab environments. But also fieldlabs enable us to demonstrate our technology to a wider audience and attract potential clients.'

THINKING OUT-OF-THE-BOX

Dutch motorway traffic is expected to involve more and more smart applications from 2011 onwards. Other intelligent sensor networks are already commercially available, like Sensiplant, a wireless measuring system for the greenhouse horticulture sector whereby the soil moisture of potted plants is determined by sensors that can communicate with each other and the control station. Papp: 'The possibilities are endless. We invite our customers to think out-of-the-box and present us problems that seem unsolvable. Because perhaps they are not so unsolvable anymore!'

Info: zoltan.papp@tno.nl

The soccer stadium of ADO Den Haag is (also) a fieldlab where new sensor concepts can be tested in practice.

