Stephan Dulman

Spreading sensors all over the place

Take a handful of sensors, release them from an aircraft and start collecting data, for example, to monitor a forest fire. Sensor networks and their potential applications are Stefan Dulman's hobby horse. The resources for these applications are limited, however. Given the sensors' random distribution, how can they be located?

'Disaster management is one of many areas in which application of sensor networks is being considered. Sensors can be distributed to monitor a forest fire's progression. Under which conditions do sensors remain active? Experiments have been conducted measuring air humidity at great heights in redwood trees.

We intend to investigate how the growth of algae can be monitored using one simple parameter – light intensity, for example – by placing a number of sensors in a pond. In future, sensor networks will be used to monitor the quality of oil pipes and the security of buildings in regions prone to earthquakes. Sensor networks have become real "hot" in just the span of four years. We have seen this development before with the – then much larger – packet radios in the seventies. In a sense, this is now happening all over again.'

'Bear in mind that each node acts independently. No "system administrator" tells it "now it's your turn". Nodes are inactive most of the time. In most applications – in buildings, for example – the ability to replace batteries is limited or even non-existent, which means that power consumption must be kept to a minimum.
But what happens when the nodes are activated and transmit their measurement data to the next node?'

'The node processor's memory may be limited to two kilobytes, which is insufficient for running an operating system. The classic OSI layer approach involves a layered structure of protocol stacks through which all of the instructions have to pass. Our approach disregards these stacks, making use of a dynamic architecture. Some say this isn't possible, but we think it is the only way. We always consider a particular operation's power consumption. External communication, for example, requiring 1,000 times more power than an internal operation within the node itself.'

'What interests me most at present is sensor localisation. They can be distributed at random and start transmitting their measurement data, but their individual positions remain unknown. That is a difficult challenge. Only their relative position is known while their precise position is required for such purposes as disaster management.
You may be able to see that sensor 15 measures a temperature of 20oC, but what is its position? Signal power provides some indication of the relative distance between the sensors and an initial impression of their distribution. If the mathematical concept of randomness is included in the method, the calculation time required can be reduced and energy savings achieved. In addition, we learn from systems using GPS technology. While we are unable to use these systems ourselves due to their high level of power consumption, the approach is interesting.'

Ambient Systems

"In our company, we explore applications based on ad hoc networking and using embedded systems. One of the key properties is energy efficiency: a battery has to last for at least five years. A new aspect is positioning: if a person or object has a sensor attached, how can we find out their position using ad hoc networking? CTIT strongly supported and encouraged us to start a company in this field of ambient intelligence. We cooperate in a lot of research projects like EYES and Smart Surroundings."

www.ambient-systems.net

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