Geosensor Network

Summer is quickly approaching and some of you may have taken a lead on the coming summer holiday season by travelling to exotic locations during Easter or Ascension. Of course, who am I to spoil your good mood and pollute your sweet memories by questioning whether it was really necessary to waste tons of fuel just for pleasure, in a world where we have started to distillate fuel from food, making the hungry more hungry and the poor poorer? Who of you have I heard talking about poverty eradication?

Sensor
I am pretty sure that some of you have used mobile phones to take pictures of enjoyable, quaint or breathtaking sites, seen by millions before, to send them by short message service (SMS) to the other side of the world so that family and friends instantaneously see what you observe, how beautiful the scenery is and how wise it was to decide to feast your eyes and mind especially on this part of the world. Those with an evil mind may even take pleasure in imagining the defeated eyes of those who stayed at home. Some may have sent streaming visual data to the other side of the world by connecting a laptop to a wireless network and switching on the inbuilt webcam.

Array
This brings me, via a detour, to my subject. When wirelessly sending pictures and videos via SMS or the internet, digital cameras actually act as web sensors and the bytes that together constitute the visual data are wirelessly transferred to another device equipped with electronic chips. When the general public is able to continuously carry a web sensor in the small pocket of t-shirts, why would it not be possible to configure an array of sensors in a network to manage the complex environment or to resolve geo-management problems? Indeed, the attention for web sensors by professionals in a wide range of applications and management fields is greatly increasing. "Can web sensors partly replace the presence of nurses (who are becoming more and more scarce) in greying societies?" the care manager might think. The observation tasks could be done by sensors and the nurse can jump in after an alarm sounds. (But what about privacy, others might wonder?) "How can web sensors ease my task to prevent and fight wild fires?" the forester might ask. "How can I better act in advance to possible evacuation needs of people living in a river delta endangered by floods?" the water board director may ponder.

Sensor Web
The continuing miniaturisation of sensors, coupled with improvements in distributed computing and the development of open standards that facilitate interoperability, foster the ubiquitous presence of sensors. Furthermore, the prices of sensors are rapidly falling, with zero as the target. However, sensors just generate data; or rather, it is better to say bytes. To establish an operational system suited to carrying out tasks as indicated above, an infrastructure of sensors, connections and processing units, consisting of hardware and software, is required. Such an infrastructure has already been baptised the Sensor Web. Placing sensors in a network may not only support care managers of elderly people but also ease monitoring of phenomena in geographic spaces. Indeed, fixed and mobile sensors connected to the web are able to observe many different spatial and temporal phenomena, such as weather, traffic flow on high ways, embankments along rivers, earthquakes, volcanism and forests under threat of wild fires. When combining topographic data and satellite/aerial data with in situ measurements, a great variety of geo-related applications can be put on ground. The infrastructure to monitor geographic space has already been baptised the Geosensor Network.

Ontologies
The road from technological idea to becoming a solid, operational system on the ground is not only winding but also paved with many challenges. The amount of sensors may be vast and together they all produce masses of real-time data that need to be transferred over powerful wireless communication systems. Data are not yet information and thus need processing to become usable. Processing is nice, generic work and it may suffice the user to think of it as a black box but the developer has had to thoroughly understand all the cogs that pave the pathway leading from bytes to usability. He or she should also be able to translate his or her understanding into algorithms and software agents. As sensors may collect a great variety of data – such as temperature, air particles and satellite data – that have different temporal and spatial resolutions and different data models and formats, a fusion problem arises. Another challenge is that the meaning of data and how they should be interpreted depends on application and context. The data generated in a Geosensor Network are derived from many and diverse sensors, and combining miscellaneous data requires defining ontologies and their mutual tuning.

Moore's Wicked Brother
Though the degree of miniaturisation is high and the end is not yet in sight, sensors still consume electrical power. The energy is often hauled from batteries. Progress in the capacity of information technology, such as the number of nozzles on print heads, is often expressed in terms of Moore's law: capacity doubles nearly every two years. Unfortunately, Moore has a wicked twin brother: the capacity of batteries increases by only about 8%, doubling in only every 10 years. Batteries are the bottleneck.

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