Computing for the Future of the Planet

Andrew Rice, Andy Hopper, David Cottingham, Jonathan Davies, Mbou Eyole-Monono, Anthony Hylick and Brian Jones

UNIVERSITY OF CAMBRIDGE
Computer Laboratory
Digital Technology Group

Background

There are many issues threatening the future of our planet. The impact of climate change is a prominent topic. However, there are numerous other problems such as overfishing, desertification, deforestation and rising energy demands. These are all compounded by a global population which is expected to grow to 9 billion people by 2050. We believe that computing has a significant role to play in solving these problems and have highlighted four initial areas of research.

Modelling and Simulation

Tools and theoretical techniques are required to ensure that software bugs or fundamental limitations such as floating-point precision do not distort the results produced by complex models.

Power-Sensitive Computing

Power consumption is a problem affecting all forms of computing, from server farms to mobile devices. In order to inform the development of algorithms and strategies for power saving we have developed a measurement platform to provide direct, live measurements of PC components. Our initial results focus on the power consumption of hard drives [1] (Figure 1). One significant finding is that the power consumption of reads and writes is asymmetric.

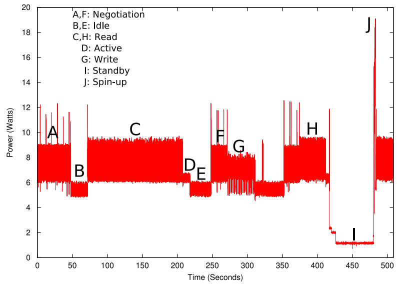

Figure 1: *Hard-drive power consumption*

Many modern-day computing tasks do not require huge amounts of computational power. Common examples occur in sensor networks where data from a distributed network of sensors are aggregated or filtered. The SpotCore processor has been developed to show the potential power saving available using low-power processors for low-power tasks [2] by placing particular emphasis on supporting parallel execution across multiple cores.

Sensing the Planet

The ability to collect and record detailed sensor data about the planet will be vital to understanding the impact of our current activities and for providing feedback on the success of any mitigating strategies we adopt. Mobile sensors are a promising strategy for efficiently achieving good sensor coverage. The Sentient Van [3] incorporates various sensors including GPS, accelerometers, gyroscopes, CO_2 measurement and networking technologies such as 802.11b, GPRS, and 3G. Our measurements of 3G signal strength are shown in Figure 2.

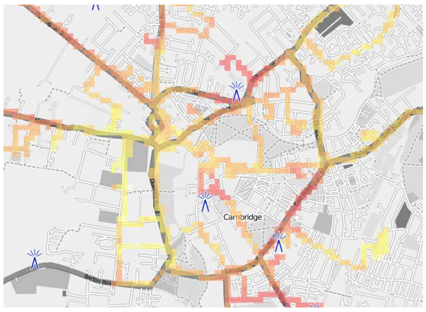

Figure 2: *3G signal strength in Cambridge*

Location information is highly important for interpreting measurements from mobile sensors and for surveying positions of static sensors. We are currently investigating the potential for visual marker tags [4] to provide a large scale location service. Tags provide a passive infrastructure which draws no power and is cheap to produce and maintain.

Living in Cyberspace

Electronic equivalents are emerging for many of our physical activities. Examples include: newspapers on the web, downloadable music, and online shopping. We are researching ways in which participating in virtual worlds might replace the profligate activities of the physical world. This has the potential to be an alternative to legislative restrictions on people's activities by instead providing alternatives which are compelling in their own right.

Papers

[1] Anthony Hylick, Andrew Rice, Brian Jones, Ripduman Sohan. Hard Drive Power Consumption Uncovered. In *Sigmetrics Student Workshop*, 2007.

[2] Mbou Eyole-Monono, Robert K. Harle and Andrew Rose. SpotCore: A Power-Efficient Embedded Processor for Intelligent Sensor Networks. In *Proceedings of Second International Conference on Body Area Networks*, June 2007.

[3] Jonathan J. Davies, David N. Cottingham and Brian D. Jones. A Sensor Platform for Sentient Transportation Research. In *EuroSSC 2006* Series LNCS, Number 4272, Pages 226–229, Springer-Verlag, October 2006.

[4] Andrew C. Rice and Robert K. Harle and Alastair R. Beresford. Analysing fundamental properties of marker-based vision system designs. In *Pervasive and Mobile Computing*, Special Issue on PerCom 2006, Volume 2, Number 4, Pages 453–471, Elsevier, November 2006.