0.1 Commercial disaggregation systems

0.1.1 Sentec

Sentec is a research company which developed a disaggregation technology called Coracle. In 2008, Onzo (a company which makes home energy monitors) partnered with Sentec to develop Coracle. However, at the time of writing all mention of Coracle has been removed from Onzo and Sentec's websites. I emailed Sentec to ask for more information about Coracle and they replied on the 20th Oct 2011 to say: "*Coracle is a disaggregation technology that we developed to the point of proof of the concept - but further development would be required to meet the requirements of a particular application. On this basis, we are not promoting Coracle as a product, but the algorithms could form the basis of a product if we were to find a partner willing to invest in its further development.*"

0.1.2 Navetas

Navetas appears to be an evolution of a technology spin-out company from Oxford University called Intelligent Sustainable Energy (ISE). Navetas have raised a total of £12million of funding, including £5m in April 2012 in strategic investment from Sensus, a leading utility infrastructure company in the US.

Navetas have a smart meter on the market which does disaggregation. However, their system relies on advanced sensing (it uses 8-80 kHz sampling). Some details of their technique are described in a patent number GB2471536 [4]. Trials are currently taking place with UK utility companies.

Whilst I have not been able to find pricing information, it is probably safe to assume that their smart meters are more expensive than most, which is likely to be an issue, especially considering the current economic climate.

0.1.3 AlertMe

AlertMe's website currently states that their Analytics product[1] *"is able to disaggregate the whole-home data for each customer to identify individual home appliances, analyse their performance and provide personalised feedback and recommendations... Unprecedented consumer insight into energy use by appliance WITH recommendations for more efficient use... Identifies more economical ways to use household devices and recognises appliances that are operating inefficiently*".

I emailed AlertMe on the 15th December 2011 to find out more. Ben Coppin, VP of Data Analytics at AlertMe replied to say "*This is a very interesting subject, and one that we have been doing a lot of work on. Miroslav Hamouz... leads this development programme, and I was wondering if you'd be interested in meeting him to discuss the subject further? We won't be able to reveal the full details of what we're doing for commercial reasons, but we can probably give you a useful indication of where we're going with it.*" I met with AlertMe on Friday 20th Jan 2012. They do indeed have a disaggregation system but Hamouz strongly encouraged me to pursue disaggregation as a PhD research topic because so many issues are still to be worked out.

There's every reason to expect that Coppin and Hamouz will deliver an interesting system. Coppin wrote a book called "Artificial Intelligence Illuminated" [1] and Hamouz has extensive experience in pattern recognition.

AlertMe have several patents discussing disaggregation including [2, 3].

0.1.4 Veutility[2]

Veutility's product certainly sounds interesting but very few details are mentioned on their website. Veutility is a spin-out company from University College Dublin based on work done by Dr

[1] http://www.alertme.com/business/analytics.html

[2] When I last checked veutility.com and veutility.ie on 22nd May 2012 neither website was available. A `whois` search reveals that both domain names were due to be renewed in April 2012. Neither domains were renewed. It's not clear if Veutility is still trading. A search on the Irish companies registration office www.cro.ie/search gives their status is "normal" but their "next accounts receivable" date was July 2011.

Antonio Ruzzelli (Ruzzelli is CEO of Veutility). [5] describes an artificial neural network system for recognising device signatures which I presume is the basis for the Veutility system.

[5] shows some performance metrics. Their system successfully detects the activation of the kettle, microwave and fridge but gives three false-positives for the heater. But note that these four devices are very "simple" devices: they each only have two states (on and off). It is not clear how Ruzzelli's system would handle devices which deterministically transition between multiple states (like a tumble drier) let alone devices which non-deterministically transition between multiple states (like a washing machine).

Bibliography

[1] Ben Coppin. *Artificial intelligence illuminated*. Jones & Bartlett Learning, 2004.

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[3] Hamouz and Beart. Appliance monitoring and control systems, October 2011. URL: `http://www.ipo.gov.uk/p-find-number/patents?csbtype=F&csbpub=GB2479798`.

[4] James Donaldson, Sarah Surrall, Alex Matthews, Semen Trygubenko, and Malcolm McCulloch. Non-intrusive utility monitoring, January 2011. URL: `http://www.ipo.gov.uk/p-find-publication-getPDF.pdf?PatentNo=GB2471536&DocType=B&JournalNumber=6368`.

[5] A. G Ruzzelli, C. Nicolas, A. Schoofs, and G. M.P O'Hare. Real-Time recognition and profiling of appliances through a single electricity sensor. In *2010 7th Annual IEEE Communications Society Conference on Sensor Mesh and Ad Hoc Communications and Networks (SECON)*, pages 1–9. IEEE, June 2010. `doi:10.1109/SECON.2010.5508244`.