Competitive Carbon Counting: Can Social Networking Sites Make Saving Energy More Enjoyable?

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Abstract
This paper reports on the design, deployment and initial evaluation of "Wattsup", an innovative Facebook application which displays live autonomously logged data from a commercial off-the-shelf energy monitor, allowing users to compare domestic energy consumption with friends on Facebook. Energy monitors and the Wattsup app were deployed and trialled in eight homes over an eighteen day period in two conditions - personal energy data viewable and friend's energy data viewable, to make comparisons. A significant reduction in energy was observed in the socially enabled condition. The paper argues that socially-mediated discussion and competition made for a more enjoyable user experience.

Keywords
Sustainability, Persuasive Technology, Social Networking, Competitive Energy Saving, User Experience

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

It is generally acknowledged that current levels of energy consumption are not sustainable [15]. Domestic households alone are responsible for 30% of the UK's total energy consumption [8] and, since 1970, household energy demands have grown by 32% [17]. Rising energy consumption currently still results in increased CO_2 emissions – hence domestic energy consumption is very much a world problem e.g. [13], [22].

It is increasingly recognised that interaction design can be exploited to address issues of sustainability, e.g.[2], [18], and indeed there has been a good deal of previous work conducted by the HCI community in the past decade on persuasive technology in general e.g. [14],[12]. However Fogg recently noted that persuasive technologies very often fail and urged practitioners to think small [11]. Monitoring technologies alone (e.g. energy meters) are often not enough to make meaningful changes in behaviour. This paper draws on work on persuasive technologies as well as on the emergent popularity of online social networks (OSNs) in order to address concerns over domestic energy consumption.

Background

Numerous studies have demonstrated that energy usage falls when people know it is being monitored [1]. Research by the environmental psychology community has indeed shown that feedback on energy consumption can achieve behavioural change - though it is not necessarily sustained without timely reminders [7],[10]. The goal of the work described here, therefore, is not just to effect behavioural change but to demonstrate larger reductions in energy consumption through the addition of a social normative influence [21].

Smart Meters

The Wattson home energy monitor is a standalone monitoring device, see figure 1, which is designed to raise awareness of domestic energy consumption by means of its display and bundled PC software. It is an off the shelf 'smart-meter' technology which takes readings from an electricity meter and displays the information as real-time energy usage data.

figure 1. The Wattson energy monitor from DIY Kyoto

Facebook

The social networking site Facebook now has over 300 million active users [9]. Studies of Facebook have demonstrated that users read other people's postings, play games, upload comments on photographs and add to their own 'profile' many times daily [16]. These sites provide a powerful means of delivering small, asynchronous applications to peer groups of likeminded real-world friends in a manageable and pleasant way. There may then be potential in leveraging the engaging power of small applications, offering rich social interactive features to help change energy behaviour.

This study aimed to address a gap in current work by embedding live, continuous energy data into a fully interactive socially-enabled energy application. Using the Facebook Developers Kit (FDK), Wattson devices were linked to Facebook allowing us to investigate whether sharing live energy information between friends might make for further reductions in energy consumption.

Design Process

Focus groups were conducted with a convenience sample [20] of four Facebook users aged between twenty three and thirty eight. There were three males and one female and all were responsible for paying the energy bills in their homes. Discussions took place in a home lab on campus at a university and helped the participants focus on the home as a design space.

Participants were shown the Wattson monitor and a large number of ideas were generated and discussed. Various graphical metaphors were suggested such as a mouse running in a cage turning faster or slower depending on energy consumption, balloons with user's faces on them were pictured being inflated larger or smaller and floating higher or lower to indicate ranked consumption rates (see figure 2). Smiley and sad faces were also suggested as simple but very easily understood graphical elements (see figure 3).

Much of the discussion revolved around the difficulty of relating to the kilowatt as a unit of energy measurement: "*Kilowatts, watts, I don't want to see any of that, money yes*". It was generally agreed that introducing a competitive element between friends who were free to opt in or out of the group might help drive a reduction in consumption.

figure 2. Initial Sketches developed in the focus group

Implementation

Following discussions in the focus group the main interface attributes for displaying energy in the Wattsup application would be expressed in Watts and UK £ sterling as well as CO_2 emissions measured by weight. In addition to numerical representations, a graphical representation was selected to display alongside both numerical values for energy and Co_2 emissions in the form of the happy/sad face theme as shown in figure 3.

Three core interfaces were developed to provide an engaging user experience: My Energy, Friends and Rankings. The 'My Energy' interface, as shown in figure 3, would show energy consumption with a dial visualisation and a seven day history bar chart. The **'**Friends' interface would display personal energy consumption against selected friends. The 'Rankings' interface would show a table of highest and lowest energy users of the application.

The sketching process was invaluable not only in generating the final designs but also in recognizing a wider design space e.g. [3].

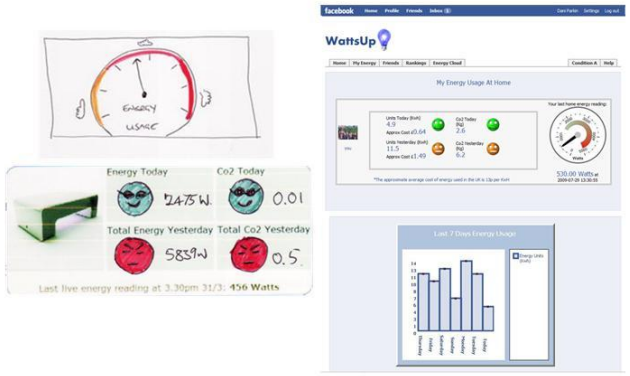

figure 3. My Energy: Workshop sketches and final design

Experimental Method

Aim

The aim of the study was to see if energy savings could be increased by the addition of a social element to energy monitoring. To this end, we made a socially enabled version of the Wattson energy monitor via Facebook. The hypothesis was that less energy would be used whilst the Wattson was socially enabled than when it was not socially enabled.

Participants

Eight households were recruited to trial Wattsup over 18 days. The lead participant from each household was responsible for paying the electricity bill and was a daily user of the Facebook website. In total the participants belonged to households with 6 couples and 2 families of four, so twenty people in all were involved in this study. The lead participants had all been regular users of Facebook for at least one year and were all friends who were on one another's Facebook friends list.

Design

The experiment followed a within subjects design [4] due to limitations on participant numbers and available energy monitors with each participant taking part in two conditions or social modes. In condition A the Wattsup application was socially enabled, i.e. users could see their friends' data as well as their own, in condition B the Wattsup application was manipulated so that there were no social features i.e. users could only see their own energy usage. The households were divided into matched groups and the conditions were counter-balanced between the groups to avoid ordering effects [4]. Group 1 started in condition A, group 2 in condition B and switched conditions halfway through.

Participant energy data was collected for analysis using a web service via a MySQL database. Additionally, semi-structured interview data was taken at the end of the study to help gauge the participant's experience.

RESULTS

The energy usage, in kWH, in both conditions for each household is summarised in figure 4. A Wilcoxon test, for comparing repeated measures of non-parametric data, showed that energy consumption was significantly lower when using the socially enabled condition of Wattsup ($Z = -2.1$, $N=8$, $p=0.036$).

A total of 57Kw units of energy were saved by the participants in condition A as opposed to condition B. This amount of energy would be expended by leaving a 60W bulb on for 4 days and result in Co2 emissions similar to those produced by driving a medium sized car for 60 miles.

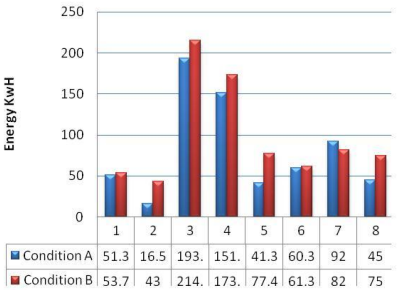

figure 4. Wattsup participant energy usage in each condition

DISCUSSION

One UK study has claimed that sustained behavioural change with domestic energy consumption was unlikely to alter until more than 3 months had elapsed [7]. However, the energy feedback in that study was not delivered within a socially enabled context; therefore it is possible that the claim of 3 months minimum for energy usage behaviour change may not hold when a contemporary online social network is used to deliver the feedback. Due to time constraints and resources available this project could not address the experiment duration issue for sustained behaviour change. These findings then may be viewed as a pilot study leading onto a larger and longer term study.

The interview data indicated that all of the participants enjoyed participating in the social condition: "*I preferred the second one (socially) because I am quite competitive, it gave me further incentive. I think putting a bit of fun in it is quite important".* The competitive attribute was mentioned by several of the participants as being a motivating factor in reducing their energy usage. Future work direction improving on the interface design could have greater focus on competitive elements.

An important issue in the development of energy applications that share information are privacy concerns. A recent US home energy study received feedback from participants regarding privacy issues and how other people, possibly in their own neighbourhood, could make inferences about their lifestyles by their energy consumption [5]. This does raise legitimate ethical and privacy concerns in how the Wattsup application shares information between users and presents a challenge in how to integrate fine grain control over sharing energy data. Interestingly, the issue of privacy when using Wattsup was not highlighted by any of the participants taking part in the experimental part of this study. However, similar to the privacy issues in the aforementioned US study, concerns such as "*The risk of failure in front of your friends*." and "*Not sure if I would want to compare to others*" were discussed in this studies focus group.

CONCLUSION

The paper has described the design, deployment and evaluation of a Facebook application designed to allow friends to compare their domestic energy consumption.

The results of the energy data collected from participants in this study suggests that social networking sites may be able to play a role in reducing energy consumption in the home by making monitoring more enjoyable. This was a small scale study and only a larger investigation could conclusively determine how effective such applications may be. However, these results are encouraging.

Social networking sites like Facebook and Twitter are increasingly being appropriated by users for political and social ends. Facebook is of course primarily for fun

but it may be that the enjoyable aspects of the service that make for effective platforms for persuasive technologies.

REFERENCES

[1] Abrahamse, W., Steg, L., Vlek, C., Rothengatter, T. A review of intervention studies aimed at household energy conservation. In *Journal of Environmental Psychology 2005*, 25 273-291.

[2] Blevis E. Sustainable Interaction Design: Invention and Disposal, Renewal and Reuse. In *Proc. CHI* 2007, 502-512.

[3] Buxton B. *Sketching the User Experience: Getting the Design Right and the Right Design*. Morgan Kaufman. Amsterdam, Holland, 2007.

[4] Cairns, P., and Cox, A.L *Research Methods for Human-Computer Interaction*. Cambridge University Press, Cambridge, UK, 2008.

[5] Chetty, M., Tran, D., Grinter, R.E. Getting to green: understanding resource consumption in the home. In *Proc. UbiComp 2008,* vol. 344. 242-251.

[6] Consolvo, S., Everitt, K., Smith, I., and Landay, J. A. Design requirements for technologies that encourage physical activity. In *Proc CHI 2006*, 457-466.

[7] Darby, S. The effectiveness of feedback on energy consumption: A review for DEFRA of the literature on metering, billing and direct displays, Environmental Change Institute, University of Oxford, Oxford, 2006.

[8] Defra, Department for Environment, Food and Rural Affairs: Autumn Performance Report 2006. http://www.defra.gov.uk/corporate/apr/apr2006.pdf

[9] Facebook, Facebook | Statistics http://www.Facebook.com/press/info.php?statistics

[10] Fischer, C. Feedback on household electricity consumption: a tool for saving energy? *Energy Efficiency 1,* 1 (2008), 79-104.

[11] Fogg, B.J. Three possible futures for persuasive technology. In *Proc. Persuasive 2009*, vol 350.

[12] Fogg, B.J. *Persuasive Technology – Using Computers to Change What We Think and Do*. Morgan Kaufmann, San Francisco, 2003.

[13] Francis, P. The impact of UK households on the environment through direct and indirect generation of greenhouse gases. Office for National Statistics, London, UK 2004.

[14] Ham, J., Midden, C., and Beute, F. Can ambient persuasive technology persuade unconsciously?: using subliminal feedback to influence energy consumption ratings of household appliances. In *Proc. Persuasive 2009*, vol. 350.

[15] IPCC, IPCC Fourth Assessment Report: Working Group I Report "The Physical Science Basis" http://www.ipcc.ch/ipccreports/ar4-syr.htm

[16] Joinson, A. N. 'Looking at', 'looking up' or 'keeping up' with people? motives and use of Facebook. In *Proc. CHI 2008*,1027-1036.

[17] Kinver, M. Saving Energy on the Home Front (BBC News – 23/10/06) http://news.bbc.co.uk/1/hi/sci/tech/6056398.stm

[18] Mankoff, J., Blevis, E., Borning, A., Friedman, B., Fussell, S., Hasbrouck, J., Woodruff , A., and Sengers, P. Environmental Sustainability and Interaction. In *Proc. CHI 2007,* 2121-2124.

[19] National Statistics, National Statistics Online http://www.statistics.gov.uk/cci/nugget.asp?id=1710

[20] Robson, C. *Real World Research, 2nd edn*. Blackwell Publishing, Malden MA, 1993.

[21] Schultz, P.W., Nolan, J.M., Cialdini, R.B., Goldsteing, N.J., and Griskevicius, V. The Constructive, Destructive and Reconstructive Power of Social Norms. *Psychological Science, 18*, 5 (2007), 429-434.

[22] Walker G., and King D. *The Hot Topic: How to Tackle Global Warming and Still Keep the Lights on*. Bloomsbury, London, 2008