HCI Systems for Sustainable Energy-Management

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In this position paper we discuss some thoughts on the role of the user as well as HCI design patterns for optimized energy management within buildings in the context of automated building management systems and smart grid networks. Our central argument is that design patterns supporting the users in easily specifying their needs and restrictions with regard to automated control processes could help to improve the efficiency, acceptability and usability of such systems, and thereby contribute to more sustainable usage of resources.

Building management systems and smart grids have big potential to contribute to a more sustainable lifestyle, as notable increases in energy efficiency and savings can be achieved [1,5]. These systems automatically – based on the input of sensors – calculate the best state of the system and trigger adjusted actions. In the case of building management the control system for example might decide to close the blinds on a hot sunny day to reduce the needed energy for air conditioning.

Whereas there are clearly big potentials in such automation it also comes with a drawback. It takes control away from the users, and conflicting situations might commonly arise. In the example from above the users might want to show the nice view from his office to a visitor. A related problem that is encountered in this area is that the decisions of the system might not be intelligible for the users, thereby possibly increasing frustration in case of unwanted actions by the system even more.

A common way to address these problems is to provide the users with the possibility to overrule the system. However, this requires explicit action by the user, might be very difficult to implement in complex systems (you cannot provide a button for everything), and also has potentially unwanted effects, for example when the user leaves the system in the overruled state, even though it is not necessary anymore. In above example this might be that the blinds are still open and withdrawn from the systems control, even though the visitor already left, but the user forgot to switch back to system control from overrule.

The best way to overcome these problems we think is to develop dedicated interfaces that help to negotiate the level of control between human and system, and allow the end user to easily express her/his requirements and constraints for the building control. What we think is most needed is systems that allow the user to express the limits, within which automatic control can adjust the parameters targeting the best solution. Further complexity is introduced as these limits are not static, and different situations and influencing factors might be needed to considered. In our example with the automatic control of the blinds, a user might want to have the blinds open all the time. However, at times when the user is not in the office the system can do whatever is best with regard to sustainability. Spinning the example further, the preferences and acceptable limits might also be influenced by season, weather, daylight conditions, etc.

We are especially interested in developing design patterns for user interfaces that allow addressing these needs in an optimal way. Even though we are focusing on the context of building management systems, we also think that such design patterns could be helpful in many different application areas of sustainable design. The tension between automation (users don't want to bother about making sustainable decisions) and staying in control is relevant in many application areas.

We think such interfaces could be informed by approaches developed in the fields of end-user development [3] and graphic programming approaches such as used in Scratch [4]. We hope that user interface patterns developed in these contexts could help to design easy-to-use and understand interface mechanisms that allow users to express and specify complex and interlinked sets of rules and constraints in the context of building management systems.

Furthermore we think analyzing approaches and design patterns that are able to increase the intelligibility of system behavior such as e.g. [2] could provide benefit for energy management systems, as they could help the users to better understand and manage the involved processes.

References

1. D. Clements-Croome. 2004. Intelligent buildings: design, management and operation. Thomas Telford Services Ltd.
2. B. Y. Lim and A. K. Dey. 2010. Toolkit to support intelligibility in context-aware applications. In Ubicomp '10. ACM, New York, NY, USA, 13-22.
3. H. Lieberman, F. Paternò, V. Wulf. 2006. End User Development. Dordrecht, Springer.
4. J. Maloney, M. Resnick, N. Rusk, B. Silverman, and E. Eastmond. 2010. The Scratch Programming Language and Environment. Trans. Comput. Educ. 10, 4.
5. A. Molderink, V. Bakker, M.G.C. Bosman, J.L. Hurink, G.J.M. Smit. 2009. Domestic energy management methodology for optimizing efficiency in Smart Grids. IEEE PowerTech, Bucharest, 1-7.

Short bio/statement of interest in the topic

CURE is dealing with two projects about HCI and sustainability in the energy context: Consumer2Grid (C2G) and Persuasive End-User Energy Management (PEEM). The project Consumer2Grid is part of a programme containing several projects dealing with different aspects of smart grids. The overall goal of the Consumer2Grid project is to find the best way to inform users on their energy consumption. We develop different methods for providing feedback and evaluating them in a one-year comparative study with about 300 users. Within the project PEEM (Persuasive End-User Energy Management) we are dealing with the question how to integrate persuasive strategies into eco-feedback technology and evaluate their long-term effects.

Johann Schrammel is a social scientist and senior researcher at CURE. He is active in the field of HCI since more than ten years and is the author of a variety of publications in different fields. Johann has successfully led numerous national and international research projects, several of them focusing on aspects especially relevant for the questions discussed in the paper such as interacting with intelligent systems, information visualisation, persuasion and user experience. He has also substantial experience in industrial projects. Johann is also professionally trained in group dynamics and has worked as group moderator.

Cornelia Gerdenitsch's scientific background is psychology with a focus on cognitive sciences. At CURE she is leading the two mentioned national projects. Her research interest focuses on persuasive technologies, cognitive psychology and social psychology. She is actually dealing with the question how to design systems resulting in a behavioural change and also how to evaluate those systems.

Manfred Tscheligi is full professor for HCI & Usability at the ICT&S Center of the University of Salzburg and managing director of CURE (Center for Usability Research & Engineering) in Vienna. In Salzburg he initiated and is directing the Christian-Doppler Laboratory on Contextual Interfaces. He has been active in the international research landscape for numerous years and has been initiating and managing a broad variety of research and industrial projects. He was involved in several conference activities (e.g. cochairing CHI2004 in Vienna, recently co-chairing the AmI Conference in Salzburg in 2009) and co-organizing several workshops and SIGs (e.g. CHI2008 workshop on Ambient Persuasion, further workshops at AmI, EuroITV, Measuring Behavior).