Visualizing Energy Consumption of Radiators

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Abstract. Heating is a significant expenditure of many households today but the actual power consumption of the heating devices are seldom recognized. To help people understand and reflect upon their domestic energy consumption, we have designed an electrical radiator that emits heat entirely from light bulbs. This appliance responds to temperature changes in the room via sensors. The idea was to combine the product semantics of lamps and radiators and direct focus on the latter neglected product category. We argue that by re-designing domestic appliances adding means to visualize energy consumption in engaging and interesting ways it is possible to make energy utilization less abstract and easier to comprehend.

1 Introduction

In domestic environments, we seldom recognize that appliances are consuming electrical energy. Since the home appliances do not communicate their consumption behaviour it becomes difficult to understand and make rational decisions about energy-related issues.

We believe that by visualising the energy consumption of various devices, consumers can learn when and how the devices consume electricity and be encouraged to save energy [1,2]. Direct feedback, for example, could help consumers build conceptual models of how energy-consuming devices behave in different situations making the perception of electricity less abstract [1].

Researchers and artists have created artefacts that visualise and draw attention to energy and heating in various ways [3]. Our work is – in its form – related to the art of Höller [4] and Veilhan [5]. Both these artists are using light bulbs as building blocks in their pieces. For example, Veilhan created the Big Light Machine, a screen by acting pixels that merge visuals with heat experiences [ibid.]. However, their work are not intended to direct the viewers' attention to the energy consumption of the object per se.

The overall aim of our research is to explore new designs for energy awareness and clarify the abstract phenomenon of electricity. In this paper, we present an alternative radiator and information display, designed to raise awareness, visualise and make a statement on the invisible energy consumption in the home. We discuss the design concept and the results from a user study.

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2 Rationale

Verbeek and Kockelkoren discuss *engaging objects* [6]. These are attractive artefacts in terms of form and interaction and the appealing properties are designed so that users become *involved and learn* from them. Following Heidegger, the idea is to move underlying operations of objects to a visible level and make users part of the functional processes. These authors discuss typical engaging object such as a heating device developed at the Cranbrook Academy of Arts. This device can direct its output spatially and allow people to interact with heat. This means that users can actively and playfully reflect on its function and the environment that it aims to control.

Our work is also inspired by augmented reality designs where the aim is to superimpose information directly onto the physical world such as the Heatsink [7]. The Heatsink was developed at the MIT Media Lab and it incorporates red or blue colour information (light) in ordinary tap water depending on its temperature. We believe that engaging objects generally have good persuasive powers – due to the reflective learning process that they support – and this has been one of the starting points in our work with radiators.

Lights and lamps have a very central and personal role in the Swedish home. Radiators, on the other hand, are seen as solely functional objects and they are placed out of the way in the home. Typically, people buy the most inexpensive and efficient ones. In other words, lamps are more in the centre of attention in the Swedish home than products like radiators. This is fairly self-evident, but from a use-of-energy point of view it should be the other way around, because radiators consume much more energy than lamps and they should preferably communicate this.

3 The Element

The Element was constructed from 35 light bulbs that were attached in a metal frame between two panes of tempered glass. 60-watt lamps were chosen to obtain the same heating effect as a conventional electrical radiator (approximately 2000 watts). The casing contains control electronics and a set of internal and external heat sensors – attached via a cord – and they determine the temperature. A dimmer circuit connected to a microprocessor controls the intensity of the lamps. A control wheel is placed on the right side and it is used for temperature settings and this value can be seen on a display on the top of the casing. Figure 1 shows the Element.

When the appliance is turned on, it will slowly start to glow increasingly brighter and the temperature in the room will rise to the value of the control wheel. If the temperature in the room suddenly drops or the control wheel is altered to raise the temperature even more, the Element attempts to balance this by emitting more light. The external heat sensor does not only portray the immediate thermal climate near the radiator, but also disclose the climate of the entire room. For example, when the external sensor pick up a small change in temperature the light bulbs signal this information immediately as they try to compensate for this. The climate in the room is in this way portrayed and the users can see the consequences of various activities such as opening the windows.

Fig. 1. The Element

4 User Interviews

We presented the prototype to ten individuals to collect user feedback in a semi-structured interview approach [8]. The aim was to let users explore the prototype and discuss their experiences [9]. The group consisted of students between ages 20 to 29.

In the first part, each person was shown the prototype and encouraged to explore it. We did not provide explanations letting users create their own interpretations of the object. To investigate the results of the blurred product semantics, we wanted to find out if the participants could understand the relation between the control wheel setting and the light, that is, see it as a radiator. Moreover, we were interested in the emotions the artifact imposed on the subjects to determine if it was seen as an engaging object.

However, very few saw it as a radiator when they turned the control wheel. People usually started with the assumption that it was connected to the intensity of the light like an ordinary dimmer. When proven wrong whilst turning the knob, most participants suggested that it was a temporal light control and that it was a delay. Apparently, the connection between heat and light is not a very clear one, at least not when interacting with light bulbs. In some cases, we also showed an ordinary radiator before we presented the prototype and they still failed to recognize it as a radiator.

This is possibly an indication of how strong the product semantics of light bulbs are. A common remark in our sessions was “I don’t think it’s just a lamp”. In other words; a lamp was their first association. However this was often quickly ruled out probably due to the placement of the bulbs or the form of the casing. Naturally, possible bias situations are difficult to rule out in experimental designs such as these.

During the second part of the evaluation, we were interested in what kind of information the object conveyed. Specifically, how the subjects related it to external factors that influence power consumption, heat, and light. That is, what kind of energy information the test persons would be able to gain from the prototype and their general understanding of the functionality of the radiator. The subjects were asked to rate the Element in relation to other electric devices in terms of its energy consumption. Subsequently, an ordinary radiator was shown to them and we asked

questions regarding the relationships between the two. Finally, a brief explanation of the Element was given followed by some concluding questions on how they would use it in their homes and what kind of benefits they saw.

Some participants said it would be useful as an indicator of changes in the domestic climate such as open windows and function as a reminder of it being on or off. The information given by the Element was also seen as something that could provide a more environmentally sustainable way of thinking about energy because it visualizes the actual consumption. Moreover, almost all participants found the Element aesthetically pleasing and were intrigued and fascinated by it.

5 Conclusion

In this paper, we have presented a concept and prototype for an electrical radiator that visualizes energy and emits heat entirely from light bulbs. The aim was to blur the product semantics of lamps and radiators to create an engaging object that disclose hidden properties of heat and energy. Users found the ambient display to be an intriguing and interesting way to present energy consumption. To conclude, engaging objects such as our Element can influence users to reflect on energy and render such intangible phenomena more understandable.

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