EcoBears: Augmenting Everyday Appliances with Symbolic and Peripheral Feedback

Nick Nielsen, Sandra B. P. S. Pedersen, Jens A. Sørensen, Nervo Verdezoto, Nikolai H. Øllegaard
Department of Computer Science - Aarhus University
{nerq, sbp89, jas2012, nervo, narhval}@cs.au.dk

ABSTRACT
In this paper, we introduce the EcoBears concept that aims to augment household appliances with functional and aesthetic features to promote their “use” and “longevity of use” to prevent their disposal. The EcoBears also aim to support the communication of environmental issues in the home setting. We present our initial design and implementation of the EcoBears that consist of two bear modules (a mother and her cub). We also present our preliminary concept validations and lessons learned to be considered for future directions.

Author Keywords
Augmented Appliances, Ambient Awareness, Sustainability.

ACM Classification Keywords
H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

INTRODUCTION
Recently, the HCI and UbiComp communities have tried to address sustainability issues concerning water, heating, and energy consumption through the use of eco-feedback technology [4]. These technologies have managed to raise awareness about consumption through the use of lighting mechanisms, attentive feedback and visualisations [4]. However, many people do still not engage in the use of these technologies [1, 8]. Moreover, issues around appliance waste have received little attention. In this paper we explore how to promote the “use” and “longevity of use” [2] of household appliances. In addition, we investigate how enhancing household appliances with symbolic and peripheral feedback could support the communication and awareness of environmental issues.

THE ECOBEARS
The EcoBears are designed as an extension module to existing household appliances to prolong their lifespan [2]. Based on the related work and inspired by our own experiences using household appliances (that serve as initial personal observations), we purposefully selected the refrigerator (one of the most common recycled appliances in Denmark that is also related to food deterioration and waste) to further explore how symbolic and peripheral feedback can augment existing appliances with additional functional and aesthetic features. The EcoBears also aim to support the communication and reflection of environmental issues in the home [6].

We identified three main requirements: a) digitally display an accurate temperature to prevent consuming too much energy or possible deterioration of food, b) provide a notification system to communicate the temperature status (too cold, too hot, optimal), and c) foster communication and awareness of environmental issues at home. After considering several abstract representations, the Polar Bears (a cub and his mother - see Figure 1a and 1b) were selected because they represent one of the most familiar “losers” of global warming.

During our design process, we moved from brainstorming sessions using early low fidelity prototypes to 3D prototyping to support our interactive and physical computing design process as suggested by Hallgrímsdóttir [5] to elicit discussions, communicate ideas, and get early feedback.

We wanted to create a non invasive feedback system. Based this decision we used two design patterns; symbolic and information monitor display [7] to create aesthetically pleasing objects. We therefore use ambient light as peripheral feedback in symbolic sculptures. Peripheral feedback is manifested using light colours with a natural mapping such as hot equals red, blue equals cold and white indicates functioning (no errors). The light intensity is modified to communicate changes from a neutral state (stable light) to situations in which the user should be more attentive to the system (bright pulsating light).

Figure 1. The EcoBears: (a) a cub; (b) a mother; (c) the electronics.

SYSTEM DESCRIPTION
The EcoBears consist of two physical computing modules - one per bear. The initial models were based on 3D models.
The Bear Cub and the Mother Bear
The bear cub is designed to be placed inside the refrigerator (see Figure 1a). The small piece underneath the bear is designed to resemble ice that provides more space for the electronic components and also enhance the environmental aspect of the concept. When the cub displays the temperature inside the refrigerator, it will glow with a pulsating blue colour if the temperature is below four degrees Celsius or will pulsate with a red colour if it is above six degrees. If the temperature is in the optimal range (4–6°C), the cub will dimly lit by a constant white colour. When there is no light (e.g. fridge door is closed), LED’s and displays are turned off to save power.

The mother bear is designed to be placed in a common area (e.g. living room – see Figure 1b). It operates as a hub collecting information from the cub and shows the same lighting states (pulsating or dimly lit) without showing the temperature. To make it less intrusive, it will switch off the dim white light if the light is very low in the room, but it will always pulsate to alert the user in the case of changes. It is modelled from a scan of a real polar bear and is bigger than the cub.

CONCEPT VALIDATION
To validate our concept we first conducted a preliminary user study based on informal interviews with three potential users (2 male, 1 female - average age 27). Overall participants could identify the symbolic abstraction of the avatars and understood the interaction and semantics of the lighting mechanisms. We also got additional feedback on the functionalities in the home setting with eight additional potential users (6 female, 2 male - average age 53). This validation includes two semi-structured interviews and a focus group with a family (5 participants). Overall participants highlighted the potential of the EcoBears to support the dialog and communication of sustainability issues especially when there are children at home. We additionally identified technical issues with the EcoBears regarding the insulating material of the fridge and the 3D-printed models (see Figure 1c) that blocked out the wireless XBee signal.

CONCLUSION AND FUTURE WORK
Overall, participants were positive about the concept and were able to immediately identify the abstract form of the avatars and the semantic association attached to every colour. Instead of using sound, our participants confirmed that the use of ambient lighting is easy to decode. In the future, we are planning to conduct a long-term evaluation of the EcoBears to explore the socio-technical context and how they affect and get affected by the dynamics of everyday practices [3]. Indeed, we are currently working on the next iteration of the prototype based on our initial findings. We are currently testing a different wireless communication, Bluetooth low energy (BLE), as the Xbees were not powerful enough for all kinds of refrigerators. In addition, we want to further explore the user experience of the EcoBears when they move back and forth between the centre and periphery of user’s attention.

Many challenges still remain and we encourage the AH community to continue exploring how augmenting everyday appliances with symbolic and peripheral feedback could extend their lifespan going beyond raising awareness around appliance waste. We also hope that our initial proof of concept can inspire future work on ambient awareness systems that can support and sustain people’s engagement and motivation in relation to their sustainability intentions.

REFERENCES

CONCLUSION AND FUTURE WORK
Overall, participants were positive about the concept and were able to immediately identify the abstract form of the avatars and the semantic association attached to every colour. Instead of using sound, our participants confirmed that the use of ambient lighting is easy to decode. In the future, we are planning to conduct a long-term evaluation of the EcoBears to explore the socio-technical context and how they affect and get affected by the dynamics of everyday practices [3]. Indeed, we are currently working on the next iteration of the prototype based on our initial findings. We are currently testing a different wireless communication, Bluetooth low energy (BLE), as the Xbees were not powerful enough for all kinds of refrigerators. In addition, we want to further explore the user experience of the EcoBears when they move back and forth between the centre and periphery of user’s attention.

Many challenges still remain and we encourage the AH community to continue exploring how augmenting everyday appliances with symbolic and peripheral feedback could extend their lifespan going beyond raising awareness around appliance waste. We also hope that our initial proof of concept can inspire future work on ambient awareness systems that can support and sustain people’s engagement and motivation in relation to their sustainability intentions.

ACKNOWLEDGMENTS
We thank all our participants and Robert S. Brewer, Olav W. Bertelsen and Marianne Dammand Iversen for their feedback.

REFERENCES