



# Beyond Eco-feedback - Using Art and Emotional Attachment to Express Energy Consumption

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## ABSTRACT

This paper describes several art based eco-feedback concepts conceived around the potential of emotional attachment between people and the natural environment. Starting from a sensor-infrastructure that looks at how families consume electricity in their homes, we investigate several artistic visualizations of the Madeiran local landscapes exploring the connection between families and elements of the endemic laurel forest. The approach described here leverages digital art as a means to go beyond traditional eco-feedback technology. By coupling people and the forest landscapes we intend to narrow the physical, temporal and psychological gaps between our everyday actions and nature. We explore how people can build a direct emotional connection between their daily energy consumption and the impact on the natural environment (such as climate change and related forest fires, mudslides, desertification and erosion).

## Keywords

Art, case study, creative process, technology, visualization.

## ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI):  
Miscellaneous.

## General Terms

Experimentation, Design

## 1. INTRODUCTION

In this paper we discuss the challenges promoting a novel intersection between human-computer interaction (HCI) research, art and creativity. An artistic approach and mode of enquiry can often bootstrap and push existing technical developments, in our particular case in eco-feedback. In order to integrate an art-based approach with scientific led research we invested in an artist in residency program in connection with an HCI and technology driven research project [1] related to energy consumption in a domestic environment and sustainability.

Art is fundamentally a non-linear process resulting in an experience [2] that connects author and audience emotions

(through aesthetic values) and critical points of view (concepts). These concepts are then used to express, criticize and represent the current and envisioned states of reality. The artist explores reality in an emotional way, through aesthetic and conceptual values and reaches its audience beyond what is rational - connecting directly with its core life meanings. This approach is hard to document, measure or replicate in a scientific setting but in accordance with Gromala and Bolter [3], the main task of Digital Art is to stimulate, inspire and move people connecting to their ethic as well as aesthetic human and social values. In a way we envision the artistic approach as a complementary way of motivating people from the inside (intrinsic motivation) rather than from the outside (extrinsic motivation).

## 2. RELATED WORK

Most people are concerned about the consequences of the unsustainable lifestyle but are also unaware of the impact of their daily activities and how can they change their behavior to reduce resources consumption. With the advent of new sensing technologies, eco-feedback has proven to be one of the most effective strategies in reducing electricity usage in the home [4]. The advancement and availability of sensing systems for environmentally related activities (e.g., human activity inference [5]) and interactive displays to feedback this data provides a rich space of prospects for new types of eco-feedback solutions [6].

## 3. TECHNICAL INFRASTRUCTURE

Under the context of the SIN AIS project a pilot installation of about 30 families was deployed using a low-cost non-intrusive load monitoring (NILM) sensing system. The system reads voltage and current signals from the main power feed to detect and classify events at the appliance level. To reduce the cost of our NILM solution we are using a netbook as the data acquisition and processing components of the system.

During the evaluation of the system we found out that after 4 weeks the users stopped paying attention to the eco-feedback system. Even after changing the eco-feedback visualization with a new one the novelty effect only lasted for less than a week. We have witnessed similar results using other tangible eco-feedback prototypes [7]. This shows that current eco-feedback solutions based on simple qualitative and quantitative representations of consumption

are not particularly effective in retaining people attention over time. To overcome this problem as well as the lack of connection between long term effects of sustainable or unsustainable actions, we are exploring different eco-feedback strategies.

#### **4. DIGITAL ART ENHANCED ECO VISUALIZATION**

Bolter and Gromala [3] claim that any digital artifact is meant to change something in the user's relationship to their physical and cultural environment; otherwise there would be no reason to produce an artifact at all. Based on this premise we refined several concepts during the Artist in Residency, which we report and describe here.

##### **4.1 Coupling eco visualization feedback to families / home activities / appliances**

The SINAIS infrastructure enables low-cost detection and classification of energy events. Using complex algorithms the system is capable of detecting power on/off events and classify those events at the appliance level (e.g. when was the microwave turned on and how much energy was consumed by it). These information enables various possibilities in terms of eco-feedback visualization mapping, in particular, feedback per family activity.

When faced with the rich data available, the artists proposed to map energy events and activities to the already complex, but yet very natural, elements of the existing local forest and trees. Differentiation of branches or trees in the virtual forest can be coupled with home activities (detecting in which room is the energy consumption activated). A different tree branch or a different tree in the forest can be mapped to different appliance. In the future, prior development of more accurate sensing technology and a more engaged choice of specific trees from the families, we envisage coupling each tree on the photographed landscape with a household and different branches to each of the household inhabitants.

##### **4.2 Expressing Consumption**

The real challenge in the domain of eco-visualization is how to express the energy consumption to the public. For a filmmaker, movement is what differentiates this art from other static forms of visualizations. The movement inside the image was proposed as a way to map variations in energy consumption by the users: i) consumption as movement in a landscape (e.g. clouds moving in the sky); ii) power events as elements the landscape (e.g. more or less animals moving next to the trees); iii) mapping consumption to weather changes (e.g. fog or rain).

##### **4.3 Creating awareness**

Without a specific message regarding the consumption, avoiding positive or negative feedback, the visualization will create and foster awareness towards preservation of nature in its endangered sites and landscapes. In order to reflect these different movements, behaviors and intentions of the users we have designed an installations that responds

accordingly: first level of interaction - Coupling movement in front of the screen detected by a web camera to start the visualization or movie; second interaction - coupling moving clouds, glowing tree or flowers on the trees to the amount of energy consumed; third level of interaction - a detailed screen of the consumption data, per day, week and month, according to the level of details requested by the user.

#### **6. CONCLUSION**

With the growing impact of climate change and limited energetic resources, sustainability is becoming an important research theme. Several projects tackle the technical challenges of developing new renewable energy sources and eco efficient cities. Other projects look at ways to promote energy savings by motivating people to consume less through behavior change. All of these efforts are valid and important to promote a sustainable lifestyle.

Through this paper we explore digital art as a way to promote sustainability awareness. By drawing on previous experience [7] motivating sustainable behaviors through context awareness and social networks, we propose to take the challenge further and explore art as a way to inspire people to act sustainably. The approach described here combines the technical infrastructure developed in the project with innovative art explorations, in order to promote sustainable practices by drawing on intimate and emotionally connections between families and elements of the natural ecosystem - in this case trees in a forest.

#### **REFERENCES**

1. J.P. van Leeuwen, I. Oakley, N.J. Nunes, V. Nisi, and V. Kostakos, "Sensory Social Networks to Motivate Sustainable Behaviour," Presented at EuroIA 12 International Conference, 2009.
2. Dewey, J., *Art as experience*. Trade pbk. ed2005, New York: Perigee Books. viii, 371.
3. Bolter, J.D. and D. Gromala, *Windows and mirrors: interaction design, digital art, and the myth of transparency*. Leonardo2003, Cambridge, Mass.: MIT Press. xi, 182 p.
4. Gupta, S., Reynolds, M., *The Design and Evaluation of an End-User-Deployable, Whole House, Contactless Power Consumption Sensor*, CHI'2010, Atlanta, ACM
5. Froehlich, J., Findlater, L., Landay, J., *The Design of Eco-Feedback Technology*, CHI'2010, Atlanta, ACM.
6. Mankoff, J., Matthews, D., Fussell, S.R. & Johnson, M. (2007). *Leveraging Social Networks to Motivate Individuals to Reduce their Ecological Footprints*. In Proc. HICSS 2007.
7. Quintal, F., Nunes, N., Oceanu, A., Berges, M., SINAIS: a low-cost eco-feedback energy-monitoring platform, in *Proceedings of the Designing Interactive Systems Conference*, 2010.