HomeTree – an Art Inspired Mobile Eco-feedback Visualization

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ABSTRACT
This paper presents HomeTree a prototype of an art-inspired mobile eco-feedback system. The system is implemented on a tablet PC and relies on a non-intrusive energy-monitoring infrastructure to access consumption and power event information. Our prototype addresses an important problem in eco-feedback, which is the fact that users loose interest about their energy consumption after a period of several weeks. To accomplish this HomeTree implements a dual visualization strategy. Initially HomeTree presents users with a screensaver that shows energy consumption mapped in a dynamic illustration of the local forest. Through this strategy we leverage the emotional connection between the short-term energy consumption and the long-term effects on nature through the local depicted landscape. In a second mode of operation users can interact with HomeTree directly by checking the historical records of their consumption data, and check which days or weeks they have reduced or increased consumption. Furthermore a comparison with a more objective baseline, such as the city of Funchal energy consumption is provided, in order to give users a sense of the level of their consumption in a wider context.

Keywords Affective computing, Sustainability, Aesthetics, Art driven Eco-feedback ,User Interfaces ,Prototyping.

1 INTRODUCTION

Eco-feedback technology is defined as technology that provides feedback on individual or group behaviors with the goal of reducing environmental impact [1]. Many studies argue that providing users with real-time energy feedback is an effective way of changing consumption behaviors. Savings reported in the literature range from 5% to 10% energy consumption [2]. To maximize the potential of the eco-feedback technology, information must be easy to understand, presented in a way that attracts attention and is remembered, and also delivered as close as possible to the time of the decision [3]. However, researchers also found that attention in eco-feedback systems tend to decrease over time [4], and that can compromise the long-term effect of eco-feedback technology. Inspired by this challenge we designed HomeTree, an artinpired eco-feedback visualization based on changes happening over a landscape depicting the local endemic Forest (see Fig. 1).

2 DESIGNING AN ECO-FEEDBACK SYSTEM

Under the context of a sustainability research project we conducted three real world deployments across more than 20 households during 18 months in Funchal, Portugal. The system presented here is the result of reflection and design based on the experience, interviews and other qualitative studies with users of these deployments. Previously [4,5] the eco-feedback system was based on a netbook acting both as the non-intrusive energy sensor and the visualization device. For this version we opted to separate the sensor system from the visualization component that is implemented using a tablet PC that could be easily moved across the house, and accessible by all family members. Furthermore, this new version couples energy consumption with natural elements of the endemic forest in an attempt to leverage the emotional connection to keep users engaged with the eco-feedback. The system also provides detailed historical consumption reports as well as simple tips about energy conservation and best practices promoting sustainable behavior change. Finally our eco-feedback system provides a way for users to classify power events detected by the low-cost non-intrusive single-point sensor enabling the disaggregation of consumption per appliance (a power event is a change in the energy consumption, normally associated with an appliance ON/OFF transition).

3 THE HOMETREE SYSTEM

HomeTree is an art inspired eco-feedback visualization based on a low-costs non-intrusive energy sensing platform developed under the context of an HCI sustainability research project. The sensing platform is capable of calculating electricity consumption from a single point sensor in the house by detecting when an appliance is turned ON or OFF once a set of training data is given. The framework is responsible for acquiring, storing and providing data via web-services to multiple eco-feedback visualization systems, including HomeTree.

3.1 Implementation

HomeTree is implemented in a 7'' android tablet using the android native SDK. It receives real-time consumption, power events and historical data from the sensing framework. This communication is made using sockets and a specific communication protocol. It requires the tablet to be connected to the Internet in the same local network.

3.2 Operation

The system has two main modes of operation. When it is not used for two minutes it goes to the energy awareness mode that shows the consumption mapped as an digital illustration of the local endemic forest. Once the user interacts with the tablet, by removing it from a stationary position, or pressing the back soft key the system goes to detailed consumption mode and shows daily, weekly and monthly information about the home energy use.

Energy awareness mode.

In this mode we aim at leveraging the emotional connection between natural elements of the local landscape and the energy consumption in the household. In this mode, the tablet resembles a digital photo frame displaying a digitally generated landscape depicting a real place in the local endemic forest. The color of the landscape will alert the user about the energy consumption ranging from green (low consumption) to a brownish red color, indicating very high levels of energy consumption (see Fig. 1). The consumption displayed here is a combination between real-time consumption and historical baseline data.

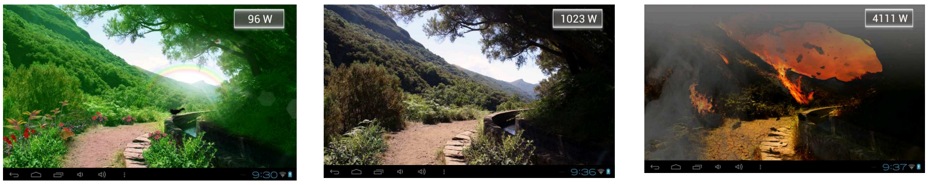

Fig. 1. Energy awareness mode at extreme levels of consumption, low at the left and high at the right.

Detailed consumption mode.

This mode is triggered when the user grabs the tablet from a stationary position or presses the device back button. As a consequence the system presents a tabbed menu with four options: “Home”, “Day”, “Week” and “Events”. The “Home” (Fig. 2. Left) tab shows a summary of the overall consumption as well as the current consumption. The summary contains aggregated consumption of the current day/week and month, and comparisons between homologous periods. Also in this tab the user is presented with a tip of the day with general sustainable actions. The “Day” (Fig. 2 Right) “Week” and “Month” tabs present a chart displaying the consumption over that period and the total aggregated consumption. It also informs the user of where the peak consumption happened. By default the information presented here refers to the current day/week/month but the user can select previous periods.

Finally, the “Events” tab presents information about the power events. The events are displayed as circles in a chart, the position on the vertical axis represents the consumption of that event, and the horizontal position represents time. The circle’s color expresses if our framework has enough training data to estimate which appliance caused that event. If the user selects an event in the chart the system displays its consumption, the time when it happened and which appliance triggered it. The user can always correct the system's guess or identify the appliance (if the system did not have any guess). Doing this will produce more accurate estimates over time. By default the system only displays the last 10 events (but the user can change that value).

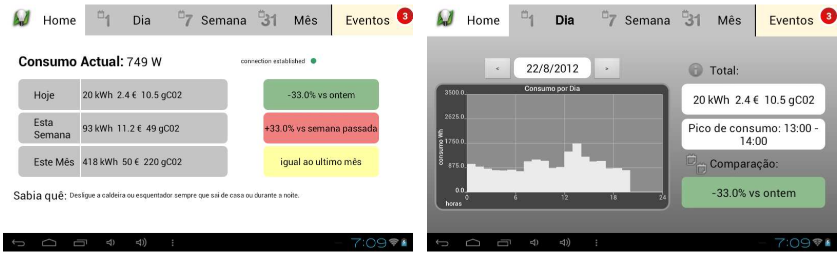

Fig. 2. Ont the left the home view of the system, and on the right the tab with the consumption of the current day.

4 CONCLUSION

This paper we presented an innovative eco-feedback system that attempts to overcome an important limitation of this technology related to the fact that people loose interest about their energy consumption after some weeks. Starting from a low-cost single point non-intrusive energy sensing infrastructure and based on two years of experience with eco-feedback deployments, we designed a new visualization that leverages the emotional connection between users and elements of the natural forest. We argue that our prototype will be more effective in retaining people's attention over time while also providing a way of enabling people to train the non-intrusive sensing system.

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