Personalization of an Energy Awareness Pervasive Game

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ABSTRACT
One of the recurrent major environmental problems is the high energy consumption. It has been challenging to find methods of persuading people to have better habits on energy usage. We are proposing the use of personalization to enhance a mobile and pervasive-based gaming approach to better foster domestic energy awareness close to people. The game is based on real-time domestic energy consumption data and presents persuasive feedback information, beyond the competitive feeling of the game. The personalization mechanisms are provided by an external web service that is designed to serve different applications, even if from different systems or domains.

Author Keywords pervasive game; personalization; energy awareness; persuasive.

ACM Classification Keywords K.8 [Personal Computing]: General – games.

General Terms Design, Experimentation, Human Factors.

INTRODUCTION
Over the years, it has been a challenge to find ways of educating people to have better habits, especially on domestic energy consumption. HCI research groups have been devoting a lot of effort in designing and developing systems focused on feedback technologies. Results show that technology-enabled consumption feedback can promote awareness and lead to energy savings [6]. However, if monthly utility bills are ineffective at persuading for sustainable energy consumption habits [4], usual commercial off-the-shelf real-time energy monitor devices do not apply motivational techniques for energy savings. This way, different alternatives of persuasive feedback systems appeared, with an interesting emphasis on serious game approaches. Power Agent [1] and Power Explorer [2] are similar casual games for encouraging long term behavior change directed to the teenagers. The focus is on real-time feedback, using custom-built energy sensors and a mobile phone game. EnergyLife [3] is another system for households providing appliance-level data through a mobile application and feedback on the total energy consumption using an ambient display.

However, environmental sustainability involves efforts such as informing individuals’ personal choices in consumption and behavior [6]. Moreover, He and Greenberg present a set of guidelines for a more motivational presentation of information, highlighting “People are more motivated to act when presented with vivid and personalized information” [4]. This personalization factor cannot be explicitly found in the aforementioned projects, although the EnergyLife’s authors are improving it in order to tailor the game to users, which was an indication obtained with its use [3].

We take a step forward presenting the adoption of personalization by a mobile and pervasive-based game approach - LEY (Less energy Empowers You) [5] - to help people understand domestic energy usage in order to change potential negative habits and potentiate the positive ones to a whole new level. Personalization is becoming a major factor, because current technology resources allow the possibility to provide applications that adapt themselves to their users’ needs and desires. A dominant driver for personalization is to help people coping with information overload, but another one is the appearance of smart environments that sense and respond to their inhabitants, such as the one we present. This pervasive computing approach can be more effective with a personalized game, matching the individual’s current context and implicit behavior and preferences.

LESS ENERGY EMPOWERS YOU
The mobile game’s user interface presents the house represented by an avatar, which is the main game character. The game presents a single competition mode, Status view, and two secondary competition modes, combat and tournament, directed to measure performances against others. The first corresponds to the main view and the user’s challenge is always to bring his house to the best consumption level and to obtain the best possible score over time (see Figure 1). The consumption levels are defined according to the official energy efficiency rating (from D to A+++). The score is calculated by: real energy consumption values; and competitions results. The avatar mood is green if the consumption is below the usual mean value of the current period (yellow and red are obvious alternatives). A notifications service is executed if abnormal consumption values appear or when the user should be notified in competition situations. In combat mode, a user can challenge another user. An environmental sustainability-based quiz will be launched to each one of the “fighters”, which will receive points according to the result. The
tournament competition can be organized by a player that invites others to participate for a pre-defined period.

In terms of architecture, the system consists of three main components: sensor platform, supporting web-based IS and the mobile game app. See [5] for more information.

**ADDING PERSONALIZATION TO LEY**

The personalization mechanisms are provided by an external web service that is designed to serve different applications, even if from different systems or domains. The web service is based on a generic configuration data model mainly divided into Personalization Options, Parameters and Resources (see Figure 2). Data concerning direct user interaction with the application, such as clicks, time spent on menus, and number of log-in operations, are considered as Resource data. Parameters are usually defined by mathematical expressions based on the Resources (seen as variables) and used to characterize the different options for each desired personalization (see Table 1 for an example). Moreover, for instance, the number of logins or amount of time spent logged-in are used in an expression to obtain the Parameter value that will define a user as basic, intermediate or advanced, which will determine a specific personalization. This mathematical expression results in a numeric value that represents a specific user interaction (behavior). A vector composed of those values, which represent each user, is built and used as input for a clustering operation, which will divide the users in several groups, representing their profiles. After the clustering operation, the personalization service checks which personalization options are associated to the users and saves the results in the database. An example in Table 1 defines status, combat and tournament screens as the options that can appear as first screen to the user, according to her calculated competition profile.

![Figure 1. Interfaces examples: (left) status view (level, scoring and avatar mood (green); (right) a notification is received.](image)

**Figure 2. Generic personalization configuration model.**

In order to use the ubiquitous personalization service, there must be an initial configuration step for each application. The developer of LEY sends an XML file defining all the Resources, Parameters and Personalization options according to the configuration model Schema. After that, the server will be updating in a regular basis the application's users' profiles that define the personalization.

**CONCLUSIONS**

We are in the process of personalizing LEY to help people understand domestic energy usage in order to change negative habits. We consider personalization essential to this kind of systems that should automatically adapt the game to be more effective, matching the individual’s current context and implicit behavior and preferences.

**REFERENCES**


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**Table 1. An example of personalization options for LEY.**