

# Conscious data trails about my – and my family – relationship with energy

I. Rodríguez, A. Puig, D. Tellols\*, K. Samsó†

Departament de Matemàtiques i Informàtica, University of Barcelona.  
UBICS and IMUB research institutes.  
Gran via de les corts catalanes, 585. Barcelona, Spain.  
inmarodriguez@ub.edu

## ABSTRACT

Energy is needed for almost everyday task, from waking up and having breakfast in the morning, to working at the office, and to having fun. This vast use of energy encourages the development of applications for sustainable behaviour. In this research we bet for digital Cultural Probes (CP) – a well-known HCI technique used to inform and inspire applications design – to get (conscious) data trails from users and so design smart cities facilities and tools for energy conservation and sustainable consumption. Participants of the cultural probes are children who develop tasks to provide designers with information about families' habits of energy consumption and their knowledge and interest in Smart Grid related issues. While performing the CP we engaged the children in performing CP tasks with the mission of saving people wasting energy crazily, under the influence of a devil wizard.

## Author Keywords

cultural probes; energy; gamification; data trails

## ACM Classification Keywords

D.2.2 Design Tools and Techniques: User Interfaces; H.5.2 User Interfaces: Methods;

## INTRODUCTION

The Smart Grid is a technology-based electricity network that supplies electricity to consumers using a two-way digital communication between the utility and them. Consumers in the Smart Grid are also named prosumers because they may either consume or generate electricity. Then, there are opportunities for developing a number of applications to inform prosumers about the state of the grid (real time prices, peaks) and let them sell their own energy. Ultimately, give them an active role in the system.

Nevertheless, the design of Smart Grid applications requires data about prosumers' needs, values and habits. Users can

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generate energy-related data trails consciously (sharing the data directly with the designers, using HCI user research techniques) and unconsciously (leaving data trails by means of, for example, smartmeters). In a previous research, we focused on the former and advocated for the use of Cultural Probes (CP) to gather data about families' relationship with energy. Cultural probes are physical packages with artifacts and evocative tasks [4] [2], or digital apps [7], which allow participants to record specific events, feelings or interactions in their daily life.

Specifically, we designed a gamified<sup>1</sup> digital cultural probes for children between 11 and 12 years of age. The goal was to provide designers with insight and understanding concerning energy habits and practices of the children and their-families [12] [13]. We used a narrative to engage the player in several missions corresponding to energy-related tasks. Random prizes, rewards and avatars customisation aimed to further engage and motivate participants. We measured average number of completed tasks and average time to complete the probes in two experimental groups, gamified CP vs non-gamified CP. Although we did not find significant differences between the two conditions, we firmly believe that digital cultural probes are effective user-research methods to trace daily and weekly data about energy use at home [11].

In this paper, we analyse the probes as conscious data trails about energy use in families. This analysis is done using the so-called CAAR (Consent, Anonymity, Availability, Revert) framework, that helped us to plan and deploy the energy cultural probes.

## RELATED WORK

Since the apparition of Cultural Probes [4], they have been used in many projects in order to obtain data about the user's habits and needs. Classically, in the Cultural Probes process, every participant of the study obtains their own package with tasks and, after performing them, valuable data about the individual participant is obtained, i.e. it is the same subject the one in charge of performing tasks and the one that designers want to collect data about.

<sup>1</sup>Gamification is the use of game elements in non-game contexts.

(\*) Research done by D. Tellols and K. Samsó while affiliated at UB

In our proposal, we slightly differ from this idea by giving the Cultural Probe to children in order to get data not only from the children, but also from the rest of the people who live with them. Research using Cultural Probes with children has already been conducted, but following the 'classical' approach of Cultural Probes i.e. where only data from the children who are participating is collected [8] [14]. In our case, we decided to choose children as CP participants because they can be more engaged and active in this kind of gamified and dynamic tasks than adults.

Other research works involved the use of digital and gamified cultural probes. In [8], cultural probes were used to get data about what was important in students's lives and so to inspire the design of educational tools for them. The participants used the mobile device to take photos and record audio clips. Another gamified probe [5] was performed to foster social relations in a cooperative learning classroom setting.

Finally, the literature includes research projects and applications that are focused on energy literacy [10] and on influencing people's behaviour [1] [6] [9]. Alternatively, in this research work we elicit and inspire the design of energy applications by means of data gathered (user data trails) from cultural probes.

#### DATA FRAMEWORK

One important aspect of families relationship with energy relies on the emotional side. If we know user feelings when using electric appliances, we could recommend alternative activities using less energy and others that don't need the use of electricity. We could also suggest to change the hour and timing of use of electric apparels. Additionally, users are not always aware of their (good or bad) habits. Thus, our goal is also to raise awareness. Finally, people have not enough knowledge of energy-related issues such as contract conditions, invoice details, and energy efficiency labels (A+, A++). Thus, we categorise data to gather in:

- Users' emotional relation to energy.
- Users' energy habits.
- Users' awareness on (good and bad) behaviour.
- Users' needs of energy-related information.

Our design matches previous data categories and assigns one role-based CP task to each category of data just presented above: "Task 1. Become a psychologist", "Task 2. Become an electrician", "Task 3. Become Sherlock Holmes", "Task 4. Become a journalist" (see Figure1).

Additionally, we stated key aspects in the development of the project that we called the CAAR framework:

- Consent.
- Anonymous.
- Availability.
- Revert.

#### Cultural Probes Tasks:



Figure 1. Cultural Probes Tasks.

The *consent* form should be clear and informed. In our project, it should be signed by the parents. The consent form included the purposes of our project and what we would do with the data. Moreover, the user could withdraw the consent at any time. Users were also informed about the *anonymous* use of data, and its use for research purposes.

We consider *availability* under two perspectives: designers availability, and data availability. First, the designers should be available to the users and explain the project's goals. They also should be at the disposal of users to fix doubts and problems at the very beginning and during all the process of data collection. In our project, we went to the schools to present project's goals and to explain the children the CP functioning. We also were available by email to answer children's doubts and concerns during the time the cultural probes took place. Second, results from data trails should be shared with the research community, and data could also be available under request. Regarding the *revert* element, we think that researchers should return back to the user findings and insights resulting from the data trails. In our project, once the cultural probes finished, we met the children again to explain the results of the project. In the same line of reverting valuable insight to users, we think that the probes facilitated and fostered children's reflection on energy use at home.

#### CULTURAL PROBES DESIGN

In the following we briefly describe the proposal of the Cultural Probes. Further details can be found in [11]. As depicted in Figure 2, the children disguised as special agents who had missions to save enchanted people and recover kW stolen by a devil wizard. Children between 8 and 12 years old received a 'digital package' (mobile app) with instructions to perform the following *CP tasks*:

- *Become an psychologist and analyse your own family (including yourself) using electrical appliances, indicate their mood and explain your thoughts.* User's mood information can be obtained through this task.
- *Become an electrician and mark the electrical appliances you have in each room and who uses them each day for a*



Figure 2. Main elements of the energy-related narrative.

week. Make your own reflection answering the questions you'll find in the last page. Thanks to this task we can learn about the electrical appliances owned by families, their main users, their distribution in the house and the frequency of use.

- *Become Sherlock Holmes for a while and discover.* Ask your parents what Smart Grid and green behavior are and write their answer. Do your parents think they have a green behavior? Why? This task evaluates parents interest and knowledge about the Smart Grid and green behavior.
- *Become a journalist and interview each member of your family.* This task can be used to gather data about families' needs of information about their use of electric energy, and preferences and predisposition to change habits.

With the gamification of the CP we hope to achieve that participants complete an elevated number of tasks defined in the CP by incrementing the participation and, therefore, the main goal was to obtain the maximum data. The gamified CP consisted of 4 consecutive levels. We consider that the participant finishes the CP (end the game) when she unlocks and completes the fourth level. At the end of the duration of the CP the player who recovers more kW from the wizard (the first in the ranking) is the absolute winner of the game.

The participant performs a different role in each level. The game starts with the child taking the role of a special agent. As an agent, the child will have to accept a set of missions (one per level) implicating to disguise as different characters. On the first level, players have to perform the role of a psychologist and gather emotions (moods) about each member of the family when using an electrical appliance. They obtain points (kW) for each association made and they need to do at least one drawing for each member to complete the mission and unlock the next level, if more are done, they have the possibility to receive the psychologist's badge.

On the second level, players get the mission of being an electrician. They should indicate the rooms and the electrical appliances in a digital map of their house (see Figure 3). Then, during one week participants fill the map selecting appliances and who has used them. Daily notifications will recall the mission to participants, who will recover kW from the wizard (and save people from spell) for each completed day (see Figure 3). Those players who complete the entire week will earn an electrician's badge. 3 completed days will be enough to unlock the third level.

Sherlock Holmes is the role played in the following level. Players have to investigate the knowledge that family members have about green behaviour. They will ask their relatives to fill a questionnaire. The more interviewed members, the more kW gained. To unlock fourth level it is necessary to interview a minimum of two persons. Moreover, if players observe at least one family member's behaviour during the day and indicate through a list what activities are green/no-green they gain a detective's badge (Figure 3).

The last level requires the player to act like a journalist. The mission consists in interviewing each member of the family in order to know their preferences of useful information about their daily use of energy. The more interviewed members, the more points gained. To complete the level and finish the game, players have to interview at least two relatives. If at least an additional relative (grandmother) is interviewed, players achieve the journalist's badge.

The CP app works on mobile devices, this way, the tracking can be done more efficiently and it can be easier for children using the app to introduce the data, as well as for the developers to gather these data.

#### USER DATA TRAILS

In this project, we were first concerned on collecting quantitative data such as the completion rate and the time spent on each CP task/mission. The goal was to compare the two conditions, gamified vs non-gamified.

On the other hand, and more importantly, we collected data trails from users by means of CP tasks/missions. Therefore, emotional and energy-related habits were sensible data to be anonymized. We also gathered qualitative data by means of pre and post-experience questionnaires, i.e children's opinions on their experience, how much they had enjoyed the CP activities and their perception before and after performing the CP of their own and their family's level of awareness of energy related issues. These data was also anonymized by removing users identification.

A limitation, in terms of privacy, of our work is that data can be vulnerable to de-anonymisation. We think that the efforts directed to improving the usability of security and privacy technologies [3] will help to incorporate encryption models in privacy-preserving applications like our CP.

#### CONCLUSIONS

This paper analyses data gathered from a digital cultural probes as conscious data trails. CP design and deployment was guided by the CAAR (Consent, Anonymous, Availability, Revert) framework. The CP purpose was to inform and inspire the design of an application to provide family members with information about the Smart Grid, their use of electricity, and recommendations to change appliances and habits. CP participants were children who developed missions (tasks) to gather information about families' relation to energy consume and usage. We also aimed to raise both own and family members awareness on energy related issues.

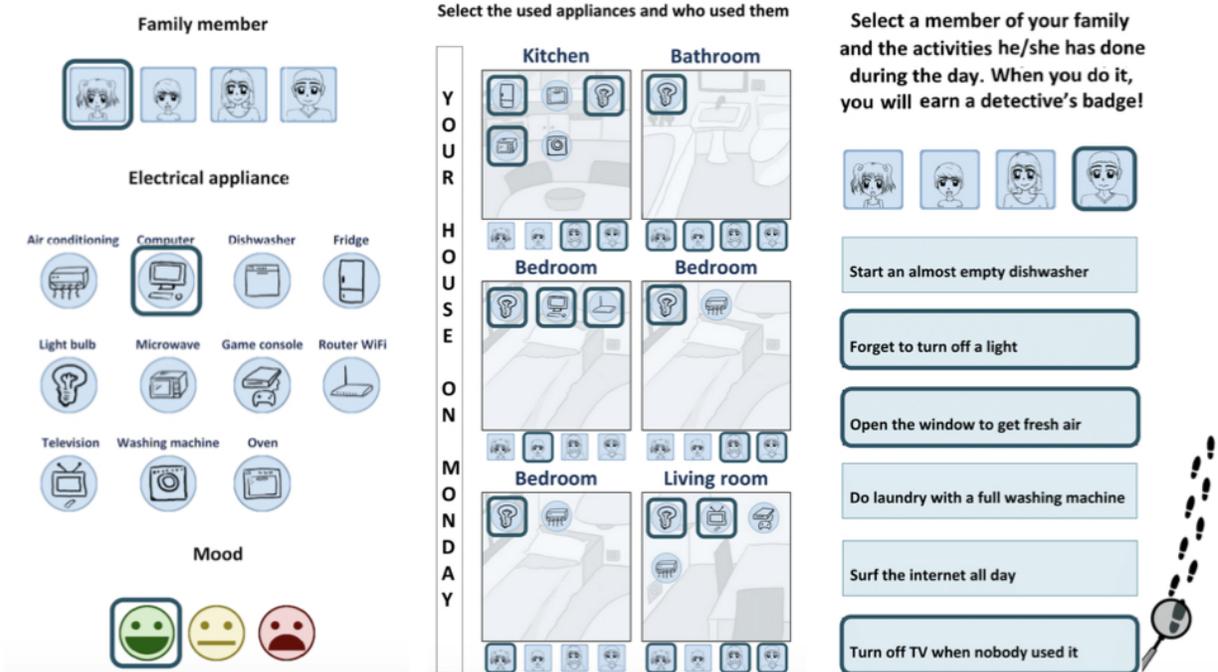


Figure 3. Wireframe design of CP tasks. From left to right, psychologist mission, electrician mission and detective mission. The final design can be found in[11]

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