RESEARCH

Demo Abstract: enCOMPASS, demonstrating the impact of gamification and persuasive visualizations for energy saving

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Abstract

In this demo we present the enCOMPASS energy awareness app. The app is designed to turn the raw data of smart meter and sensors, installed at the premises of the consumers, into tools for behavioral change and customer relationship management. Sensed data are presented to the user in multiple visualizations, exploited to disaggregate consumption into end-uses, estimate user activity and comfort levels, and ultimately deliver contextual and personalized energy saving recommendations.

Keywords: energy saving; energy efficiency; gamification; persuasive technology

Introduction

Energy is a limited resource, most of the current methods to generate it have a direct impact in the environment, therefore it should be used efficiently to minimize the negative effects. To effectively create awareness in energy consumers they need to be presented with a relatable measure of the impact of their consumption habits and be informed about the alternatives they have so they can have long-lasting behavioural changes. Combining Internet of Things technologies like smart-meters and persuasive technologies has been increasingly research as they are powerful tools for providing user with feedback about their consumption and engage them into energy saving activities, but in order to create an effective behavioural change platform it should be designed around the users' needs and comfort, and provide recommendations tailored for the user and his context. enCOMPASS was created to address energy efficiency and awareness from a user-centered perspective considering user profile and levels of comfort. The demo will involve the attendees in enCOMPASS awareness application features and the rationale behind its gamification and visualization designs.

Related Work

The deployment of smart meters in an increasing number of households has boosted research on methodologies for inducing behavioural change based on energy consumption feedback systems. Studies suggest that incorporating different types of feedback with motivational techniques and energy saving advices improve the impact of the systems[1]. It must also be designed to consider different types of customers and to be presented at the right moment and provide actionable suggestions, tailored to a given user and context[2].

Several energy saving applications embedded in users' environment have been proposed [3], [4], using consumption feedback visualizations and gamified social interactions to motivate the adoption energy-efficient attitudes. The focus of the applications are different some are data-oriented (e.g. bar charts of consumption [5]), some are connected to the real consumption context (e.g. floor plans [5]), others metaphorical (e.g. traffic lights [5]), or playful and ambient[6]. Saving tips and recommendations are common strategies to motivate energy saving like in [7], sometimes provided in a contextualized manner but rarely shown in direct relation to the actual consumption. enCOMPASS aims at closing the gap between the consumption feedback visualization, the provided recommendations and the user comfort by providing tailored recommendations considering user consumption habits and preferred comfort settings.

The enCOMPASS Project

enCOMPASS is EU funded project under the Horizon 2020 programme, which aims at implementing and validating an integrated socio-technical approach to behavioural change for energy saving by developing innovative tools to make energy consumption data available and understandable for different type of users like residential consumers, school pupils and public building employees, empowering them to collaborate in order to achieve energy savings and manage their energy needs in efficient, cost-effective and comfort-preserving ways [8].

Using smart meters and sensors, which include temperature, humidity and luminance, the project integrates the user consumption and indoor climate with user-centered visualisations in a gamified mobile app. The enCOMPASS Awareness Application is designed to improve engagement and to provide users with general and personalized energy saving tips. The gamification aspects of the platform focus on 3 main areas: "Energy Saving", "Learning" and "Profiling".

The "Energy Saving" area focuses on the actual energy saved by users, they are encouraged to set a saving goal every month and monitor their progress periodically. The comparative baseline for the goals is the total energy consumed on the same month of the previous year, such information has been collected and provided to the platform by the utility companies participating in the pilots. The "Goal" section shows an energy saving metaphor of a battery, as displayed in Fig.1a, where users can keep track of their consumption and progress towards reaching their goal. On this screen, users can also set their energy saving goal and see the disaggregated energy consumption by device. The default energy goal is set to 20% reduction with respect to the baseline, the users can choose a custom goal in a range from 10% to 30%.

Gamification in this area is focused on the competition, users that reached the saving goal receive points depending on their target goal and the top 2 ranked users receive prizes from the utility companies. Also, users receive achievements(badges) when certain saving levels are reached. User can monitor their achievement progress in the "Achievement" section along with its position on the monthly and the overall leaderboards.

User can also choose to inspect their consumption details at different levels of granularity; or visualize the impact of their consumption through visuals metaphors, to
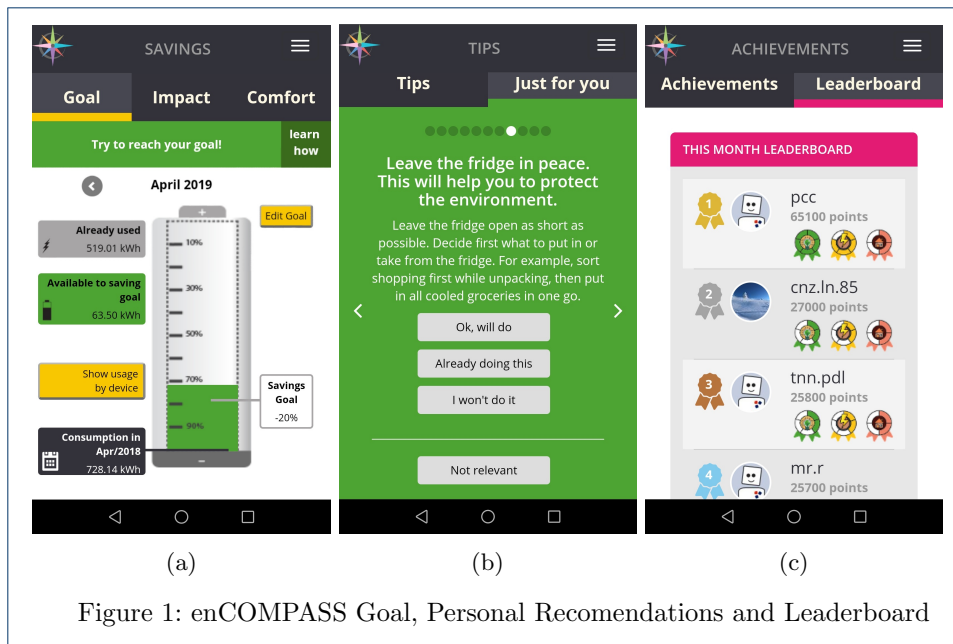
Figure 1: enCOMPASS Goal, Personal Recomendations and Leaderboard

help users relate energy savings to things which are important to them, the "Impact" section presents the impact of achieved energy savings using three different metaphors: monetary (Fig.2a), environmental(Fig.2b) and hedonic(Fig.2c). Monetary and environmental impact visualizations show the cumulative savings that the users have achieved translated into money and CO_2 values, respectively; whereas the hedonic impact visualization shows the points that the users have achieved for saving energy.
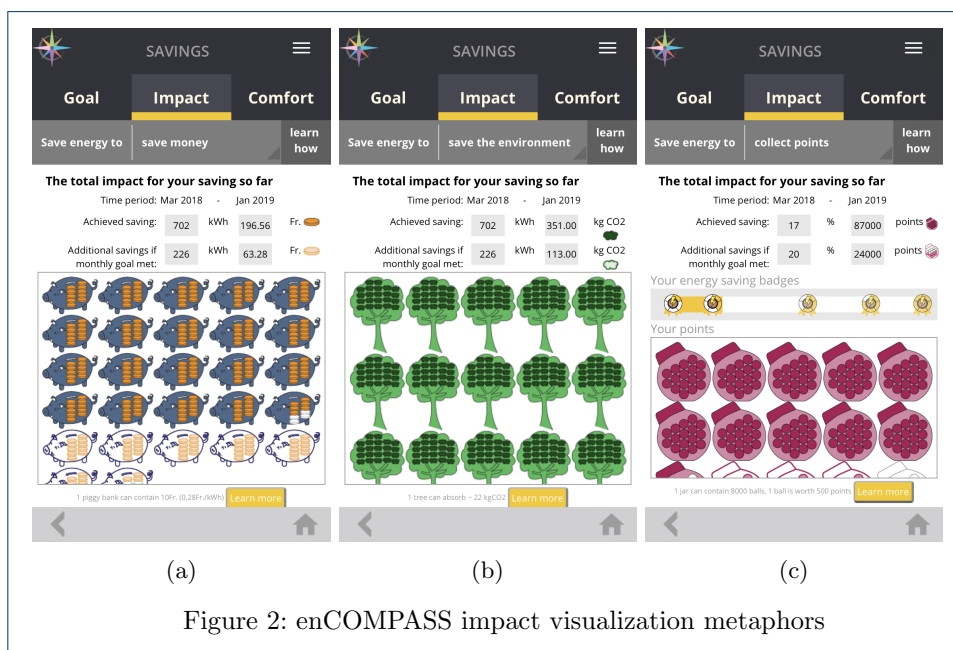

Figure 2: enCOMPASS impact visualization metaphors

The second area is the "Learning" area that focuses on energy efficiency education, through the "Tips" section users receive generic energy saving tips and

personal recommendations (Fig.1b). Personal recommendations are generated by a machine learning algorithm that uses energy consumption, sensor data, and user profile information to select suitable tips. The gamification of this area consists of awarding points to the user for every tip they read, extra points are awarded if the user provides feedback about the accuracy of the tip. The points of this area add up to the total score for the competition, and award achievements when certain levels of points are reached.

The profiling thematic area aims at collecting user profile information that can be used for tuning the recommendations and the comfort inference. A "Household Profile" section collects information about user's household configuration like the orientation of the windows, the more information the users provide the more points they get, another section of the application shows the user the indoor climate information collected from the sensors, the user gets points by providing feedback about the comfort perception in the current conditions.

Conclusions

The enCOMPASS platform has been deployed to 3 pilot sites in Switzerland, Germany and Greece, each pilot consists of around 100 participating households and at least one public building and one school. The intervention period, which duration is 12 months, is currently ongoing. The evaluation of the platform impact will consist on measuring the energy consumption reduction during the intervention period. The first analysis results suggest a 10 to 12 % consumption reduction for the residential consumers that participate in the project in comparison with the control group. A complete analysis will be done after the intervention period is completed, to understand the overall effect of the platform in households, public buildings and schools.

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