Home Energy Reduction: Simulation Game

SYNAISTHISI Project
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Goals:

- Raise energy awareness – Expose participants to 'what-if' scenarios
- Consumer engagement
- Apply decision support techniques
- Evaluate incentive types
- Balance demand according to renewable sources production

Overview:

Managing energy consumption and production is a challenging problem and proactive balancing between the amount of electricity produced and consumed is needed. The future electricity systems providing such capabilities are called smart grids. In this demo, we examine mechanisms that give incentives to consumers to efficiently reschedule their demand, thus balancing the overall energy production and consumption. Viewing the smart grid as a multi-agent system, each agent represents a consumer; this agent takes into account its user's preferences and proposes an optimal energy consumption plan via a gamified GUI, which comes in two versions, one promoting economic incentives, and the other social in the form of 'green' coins. Apart from raising energy awareness and exposing the application of agent based approaches inside smart homes, we also aim to evaluate the efficiency of the agent's proposals, that is which consuming tasks are more acceptable for shifting, and which incentive type is more capable to induce participation and effectiveness in demand side management (DSM) schemes.

So, you are asked to *assume that you are in your home*, and that at some time of the day the agent consults you for your residence's future (e.g. next-day) consumption rescheduling. You must consider your own preferences and decide whether to shift specific tasks at different hours of the day, where renewable production is higher, i.e. accept or reject the agent's proposals for a period of 10 days, when provided with the one incentive type, and for the same period when provided with the other one. Finally, you are also asked to fill in a questionnaire regarding your experience.

Gameplay:

-Login: At the beginning you will be given specific credentials for your login. Please make sure that you inserted them **correctly**. Then press 'Login' and wait for the game master to start the game rounds.

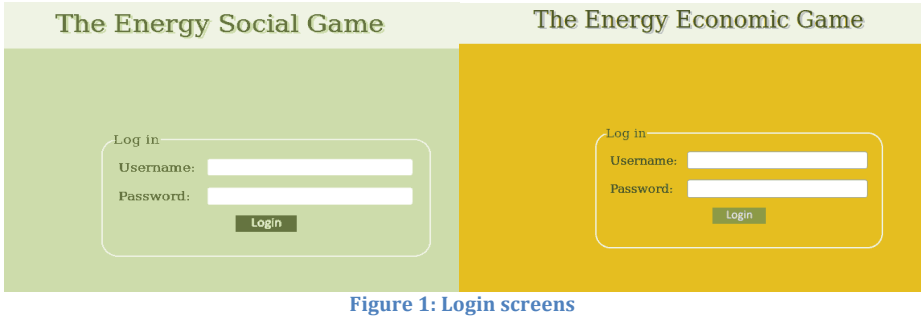

Figure 1: Login screens

-Game Controls: The components that can be controlled are of two kinds. The first type includes checkboxes, allowing to select or deselect a rescheduling suggestion, and the other comes in a form of a slidebar, which allows to set different temperature points for your home's thermostat. For the two different incentive types, the game controls are exactly the same.

Figure 2: Game controls positions.

1) Checkboxes:
   a) '**All**': Select all shifting suggestions for the day at once.
   For each suggestion:
      i) '**Accept**': Accept the particular suggestion.
      ii) '**Always Accept**': Automatically accept shifting of the current appliance's consumption for the next days.
2) Slidebar:
   a) '**Temperature preference**': Slide between user set temperature, and agent's proposed thermostat position.

-Game Feedback: Within each GUI version we include multiple coordinated views along with aspects of both pragmatic and aesthetic information visualization to ensure we are informing users, persuading them to follow incentivized actions, and allowing them to effectively and intuitively make selections and provide feedback to the system. Though the general visualizations in the social and economic interfaces are the same, there are small context-driven differences within each of the visualizations selected to highlight the most relevant information to each game.

1) Feedback views found in both versions:
   a) **Bar Chart/Line Graph** (Figure 3): Contains both pragmatic and aesthetic properties designed to inform the user while also persuading him to make "green" or "economic" decisions. It serves as a complementary visualization to the first three input mechanisms where you can better understand and explore the consequences of choosing a particular schedule. More specifically, the bar graphs show the average (the aggregated consumption divided by the number of households) of the predicted consumption for the next 24 hours, the green bars correspond to the average of consumed green energy and the gray bars correspond to the "dirty" energy. The **yellow** line projected over these bars shows the predicted consumption for the next 24 hours, before taking into account any shifting or heating reduction, and the **purple** line shows the predicted consumption after the changes caused by accepted suggestions. Furthermore, each point is marked with a different color to indicate the quality of the consumption at each hour. The **green** color indicates a good consumption pattern, **black** indicates an average consumption pattern and **red** indicates a poor consumption pattern. This visualization is pragmatic in the sense that it clearly communicates important technical information and aesthetic in the sense that the colors and design of the layout are chosen specifically to encourage you to follow a green rather than dirty scheme. Also, this visualization supports the decision making process, as the purple line showing predicted consumption is dynamically updated every time the you select different combinations of accepted suggestions. Thus, you can test a variety of combinations before making his final selection.

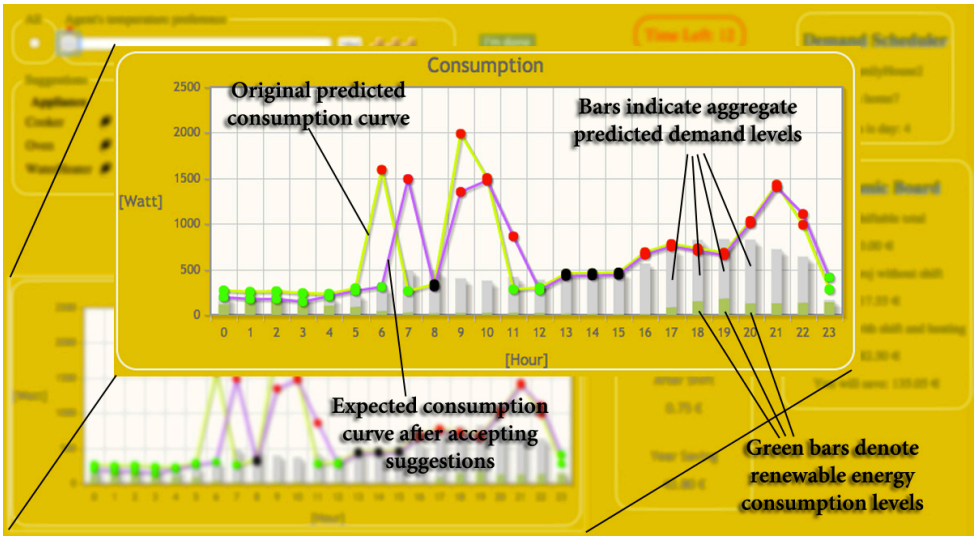

Figure 3: The Graph feedback component.

b) **Effectiveness information visualizations** (Figure 4): These visualizations provide summaries that give the user a better idea of where he stands within both, the current round, and entire game. In the upper-middle part of the window a stylized man carrying a money bag provides information about the effectiveness of accepted suggestions in the form of the number of earned green coins in the social game and money saved for the next day in the economic game. The box under the man with the coin describes the differences before and after shifts as well as the number of green coins or money he will save annually, provided that he always accepts the shifting suggestions.

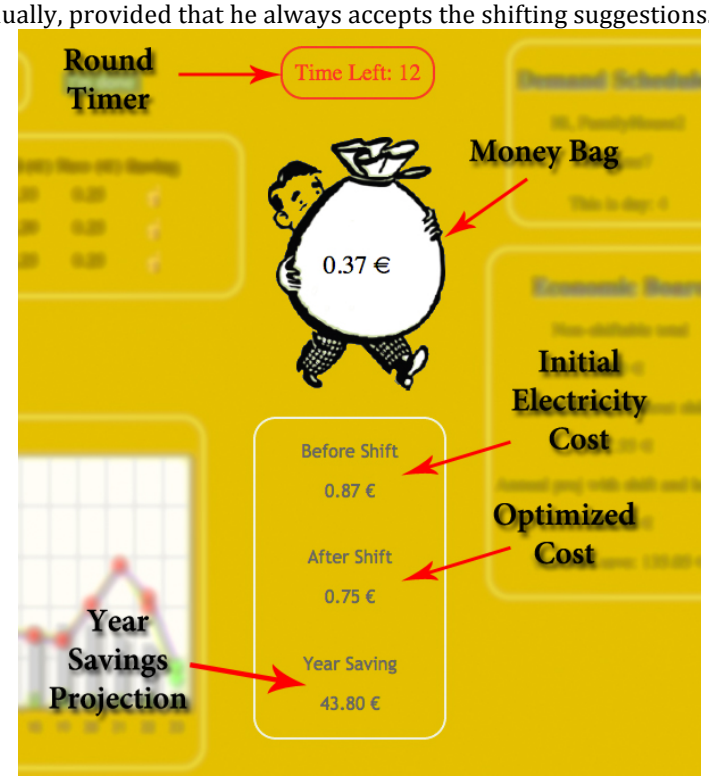

Figure 4: Effectiveness visualizations.

2) Feedback views which differentiate among versions:
   a) **Economic version specific** (Figure 5): Here, projections for the year are shown, including the cost of non-shiftable appliances, the total projected cost for the year, the total projected cost after shifting (including heating demand reductions) and the total projected savings.

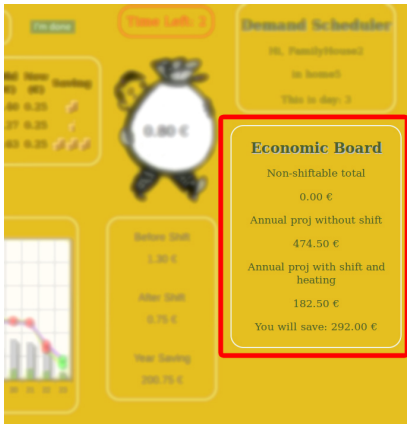

Figure 5: Economic interface specific information.

b) **Social version specific** (Figure 6): To engage the user and motivate him or her to be "greener", a leaderboard is shown in the right column of the interface. In this way the user is able to compare his consumption with that of his friends' consumptions, using the earned green coins as the means of comparison.

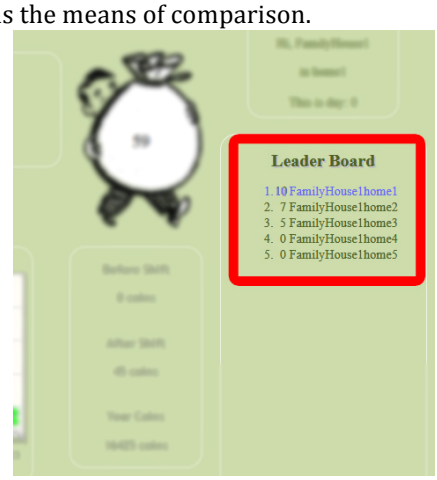

Figure 6: Social interface specific leaderboard.

c) **Different incentive types:** The main difference between the two GUI versions lies in the type of the incentive promoted. More specifically, in the *economic* version the agent presents the benefits of the consumption rescheduling in terms of actual monetary gains. This way, each accepted suggestion is followed by the presentation of the actual amount in euros that the consumer gains, e.g. via a reduced electricity bill.

When using the *social* version on the other hand, the impact of rescheduling is represented by virtual 'green' coins. Here, the participant gains more coins according to the amount of green energy used, namely the less electricity from bulk resources used, the more gain in virtual coins is achieved.

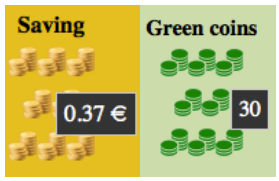

Figure 7: Savings in euros (economic version, left) and gains in green coins (social version, right).

Contest Flow:

1. Play the first version
2. Play the second version
3. Fill in the questionnaire
4. Share your thoughts and experience