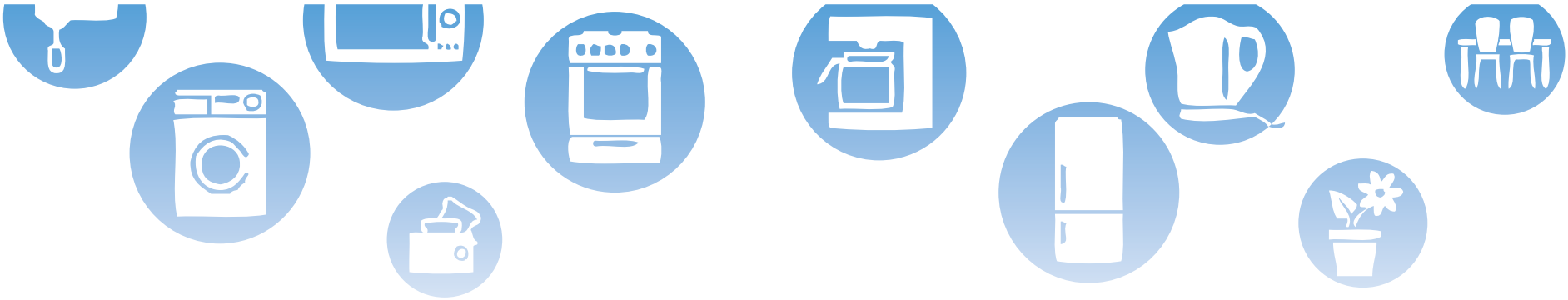
The Doormate: Supporting people in decreasing their electricity consumption

Don Willems

Department of Industrial Design

Eindhoven University of Technology



Introduction

With a growing awareness and care for the human footprint, the way people influence the wellbeing of the planet, the need for energy efficient living becomes higher. An area where this occurs is the home environment, where people use a big part of their personal energy consumption.
Not only that changes the way we live our lives, technological advancement will too; with the ever increasing possibilities to enhance products with computational power, more products are able to act 'intelligent'. This, combined with the faster and more stable wireless connections can create a Smart Home.
The combination of the two leads to the interesting topic of supporting inhabitants in lowering and/or monitoring their energy consumption using the capabilities of the Smart Home. This report will inform you about the efforts to create a concept and the concept itself that responds to this opportunity.
The first chapters concisely describe subjects important to this project. The findings and conclusions will be combined in the section after that, featuring the ideas and decisions that led to the concept. Finally the concept and all its facets, followed by an evaluation and future recommendations, is presented.

SOFIA, Internet of Things and the Smart Home

This project is created in the context of the SOFIA project, Smart Objects For Intelligent Applications. The mission of SOFIA is to encourage new innovation by opening up information that currently remains unavailable within various embedded system. This means that they aim to connect the physical world with information world, creating new user interaction and interface concepts from which the users can benefit. The connections between smart devices are made using Smart-M3 middleware. SOFIA fits into the envisioned Internet of Things.

The internet of Things

The internet of things is often referred to as a network of RFID tagged everyday objects. In this network data on location and time of objects you possess can be used to for example personalize services on your way to work. In the context of this project the internet of things is much more. It is a network of smart objects which each have (from very limited to extensive) computational power. A term closer to this description is ubiquitous computing. Ubiquitous computing is coined by Marc Weiser, who calls it the third generation of computing; "our highest ideal is to make a computer so embedded, so fitting, so natural, that we use it without even thinking about it". In the ubiquitous computing world connections between devices and combinations of gathered data will create a large amount of new interaction possibilities.

Smart Home

In the home environment, this network of devices is called the Smart Home; the home ubiquitous computing environment, where a lot of objects can produce, send and even process data.
The smart home 'stage' used as a starting point for the ideas and concepts in this project can be described as follows: Electrical appliances each have a similar computational capability. They can sense the amount of electricity they consume, how frequent they are used, for how long they are used and at which intensity. This information is then send to a central device that makes smart combinations of the incoming data streams.
It is important to note that the focus is not on the actual connections and data transfer possibilities between devices, but rather on new user interaction possibilities created by those possibilities. Technological potential is mostly taken for granted in that area.

Information and Attention

With all this new data the already overwhelming amount of available data will become even bigger. The over-indulgence of this information is called information obesity.
"It's like an ever-growing information buffet – and we're there for the 'all you can eat' meal. At the same time, with an overload of information available to us, our tools for finding, consuming and filtering this information have remained constant in their ability to assist us in making sense of the data. The result is an increasingly complex information environment – one in which we must constantly work to filter the myriad points of data presented to us." (G. Miller, 2009).
Attention might soon be the new 'currency'. As the online world expands and all information is available for free, attention of the user is where the real value is. For the project this means that the information should be presented when useful, but should also always remain easily to ignore.

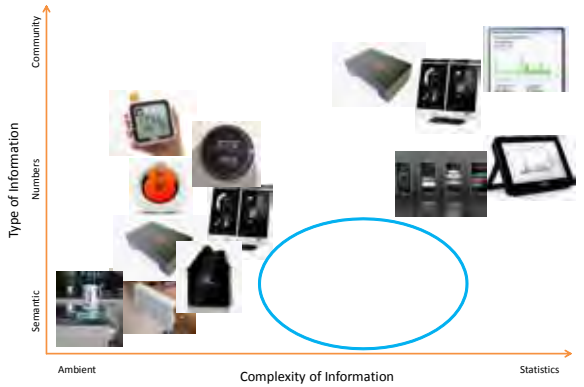
Energy consumption

The opportunities described in this project are found in the combination of the Smart Home and new user interactions related to energy consumption. The energy comsumption part of this opportunity is elaborated on here.

Electricity

Of the resources consumed in the home, electricity was chosen as focus. Energy is not only the most used resource, it is also closely connected to the Smart Home as almost all appliances run on it. Another benefit is that it is quite easy to measure and it can be measure at multiple points in the house or even at every appliance. More about the use of data on electricity consumption can be found in the Ideas section.

On the topic of appliance use, the home of the future and maintenance I talked with Kees Sanders of Trudo, a large housing corporation in Eindhoven. He pointed out that many people are having trouble coping with maintaining the increasing amount of appliances. Regular maintenance can increase efficiency of that device, and thus less electricity consumption. On top of that is understanding all the new technological appliances and innovations hard for certain groups.



Existing products and concepts

Faruqui et al. (2010) evaluated 12 In-Home Display pilot programs and found that the average saving was 7 percent. Although a lot of products are available, almost no one owns one. Meyers et al. (2010) conclude that "a lack of consumer awareness of the technologies, high costs due to lack of economics of scale, and difficult user interfaces are currently the major hurdles toward adoption."

The field of home electricity meters is explored by both evaluating existing products as well as concepts found on the internet. By placing the found products and concepts in graphs, gaps became apparent. These gaps formed the first direction this project took. As can be seen in left graph the amount of effort needed to use the device seems related to complexity of the information. Users would benefit from clearly presented specific information for them.

By helping the user finding the right information for them, they put in low effort yet get rich information. It also becomes clear from the right graph that more in-depth information that is presented in a meaningful way, rather than on one hand very abstract awareness and on the other hand numbers and graphs has potential as an innovative solution. With the added data available through the Smart Home, this solution is within reach.

During the first half of the project the following Mission Statement and Value proposition, respectively, were formed:

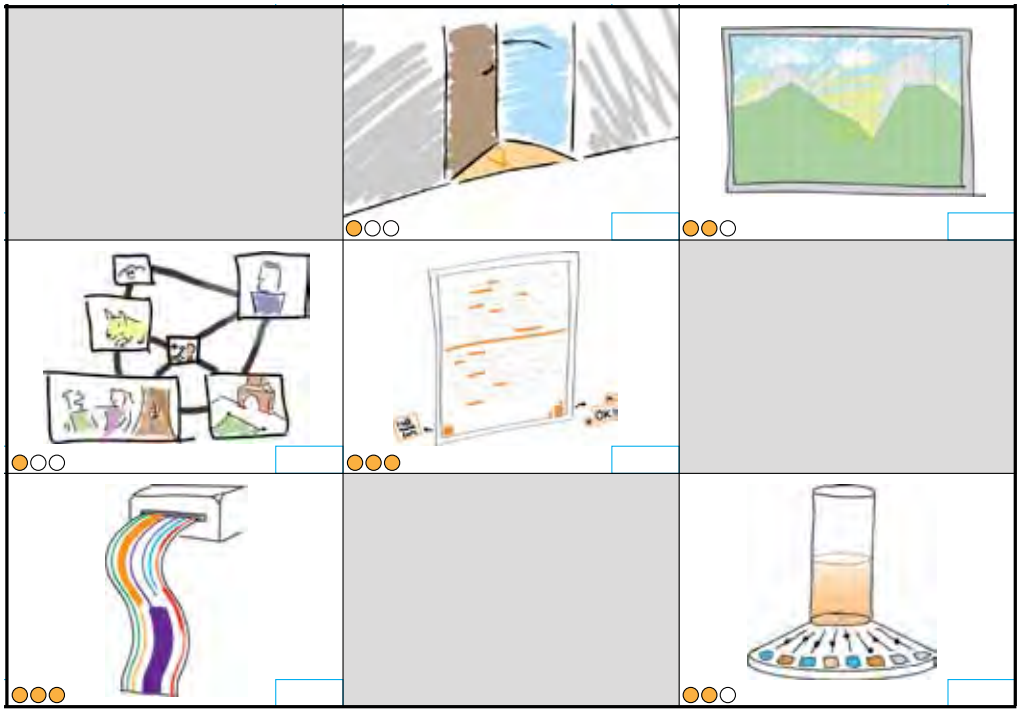
"Enabling the user to make conscious choices about energy consumption by making In-depth semantic in-house information available by providing the opportunity for personal planning, goals and coaching." and "Get support in saving money and reducing your environmental footprint by changing your energy consumption behavior."

User desires

From 12 questionnaire respondents' several desires came forward that also became apparent in the previous subchapters.

Electricity appeared to be the most valuable resource to have insight into. Amount of sunlight and air freshness also score high as interesting 'consumables'. The participants believed that coaching, a direct overview and continuous awareness are the most helpful forms of information communication. Comparing their own consumption with others as not desirable. Almost all participants indicated that they would like the device to blend in as an everyday object.

Practical information such as showing the washing machine is ready was also mentioned. The next chapter shows how the previously stated findings are implemented in ideas.



Ideas

This chapter starts by describing 6 ideas presented at the interim presentations. After evaluation, two of them are considered in more depth.

6 ideas

Before explaining the ideas, the factors from which they followed will be clarified.
The factors – Communication Type (columns), Electricity Information (rows) and System Communication (dots in cells) – come from research described in the previous chapters.

Communication type

Awareness: Both from literature on "Information Decoration" and "Information Aesthetics" and questionnaires awareness appears to be an important aspect in communicating electricity usage information. The resident is subtly shown what is happening in the house. This subtle information only comes to the attention when attention is paid to. The home owner knows how to interpret the information and how to act upon it. Visitors however will only see a beautiful product. This makes the product public and out in the open, yet only communicating private information to the main user.

Coaching: From analyzing the current products both coaching and planning aspects were missing yet very interesting for future users. In order to fill this gap in the market and fulfill the demand ideas are formed for these options. Coaching brings certain electricity event to the users' attention, but also presents a solution. By giving more in-depth information directly to the home the user will be able to apply it. Darby (2006, p.17) concluded "... sometimes people need help in interpreting their feedback and in deciding what courses of action to take..." when evaluating the effectiveness of feedback on energy consumption.

Planning: The planning option will allow the user to create his or her own planning and set own goals. The actual electricity consumption will be the direct feedback. By comparing the planning with the realistic usage the user can adjust his/her behaviour.

Electricity information

There are multiple possibilities to show the electricity consumption in a house. Most existing products show usage for one socket or the whole house. With the 'Internet of Things' on the horizon and the Smart-M3 middleware of the SOFIA project more is possible.

Electricity per Location: For users it can be very insightful to compare electricity consumption of rooms. This will allow for comparison between for example the kitchen and the bathroom or between rooms of residents; this can lead to exchanging tips and influencing behaviour.

Electricity Events: As information is abundant, another continuous feed of information might not be advantageous, giving valuable highlights is. These highlights can be recurring events of leaving the lights on in the kitchen without activity there or leaving products on stand-by after use.

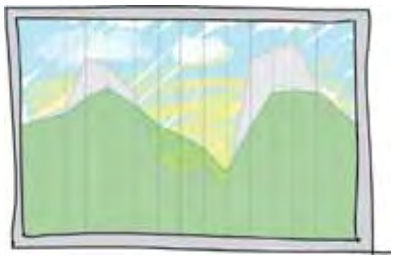
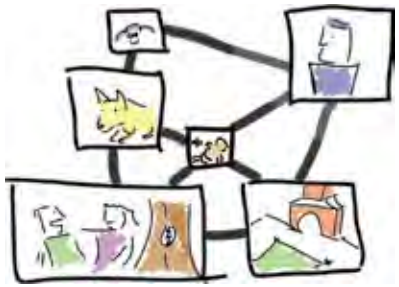
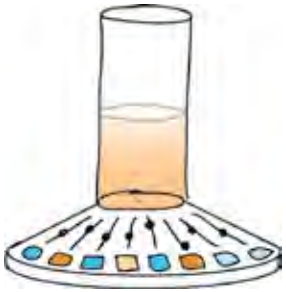
Electricity per Activity: Being able to compare electricity consumption of different activities will not only give the user a good idea of the impact of the activities but also reflects their own behaviour. Additionally is it possible to make smart connections between activities giving the user new insights.

System communication

1-way communication: Data is sent by the appliances and gathered at a central point. The data is used to communicate to the user.

1-way communication with interaction: The gathered data is used to allow the user to interact with it, for example adjusting a planning to it.

2-way communication: The device does not only communicate the gathered data to the user, but the device is also able to control the connected appliance, possibly based on user input.

	Awareness	Alert / Coaching	Planning / Goals
Energy per Location		 ●○○	 ●●○
Energy Events	 ●○○	 ●●●	
Energy per Activity or Device	 ●●●		 ●●○

●○○ 1-way communication

●●○ 1-way communication with input

●●● 2-way communication/control

Idea 1 – Doormat

This doormat shows the resident what happens at the moment when he or she leaves his/her home. Devices communicate their behavior to a strip on the door. That strip leaves a mark on the carpet by pressing down stamps on it, the threads that are stroked to the other side by the open swinging door show the current electricity consumption as a percentage or in a icon. When the mat shows a light bulb icon or shows that electricity is still being used although you are leaving for vacation for example, the user can step on the mat to turn off the lights.

Idea 2 – Painting Planning

In this idea users can set goals and reflect on them using a 'painting'. The painting has a background and two semi-transparent layers in front of it. One is controlled by the device, the other is set by the user. The layers are made out of elastic fabric connected to a string in the middle, this string is manipulated by vertical strings representing hours of a day. The device-controlled layer, gray in this drawing, shows the daily usage over time, for example: low at night, peaking in the morning, dropping during the day and spiking again around 6 to 9 when people are cooking and doing household tasks. The user can react on that by setting a goal for themselves using the green layer in the front. They can manipulate the fabric by pulling the strings. As they set the layer, for instance to balance the day more and use the washing machine on off peak times, they are able to compare it with what actually happened.

Idea 3 – Photoframe Awareness

The photo frame is a common object in every house. In this case the people in the frames also serve as references to certain rooms in the house. In these rooms 'electricity events' can occur and this frames makes the user, and only the main user, aware of this. By subtly pushing the picture connected to the room where the event occurs further away. The alerted user can now find out how to improve his/her behavior in that room.

Idea 4 – Mirror Choices

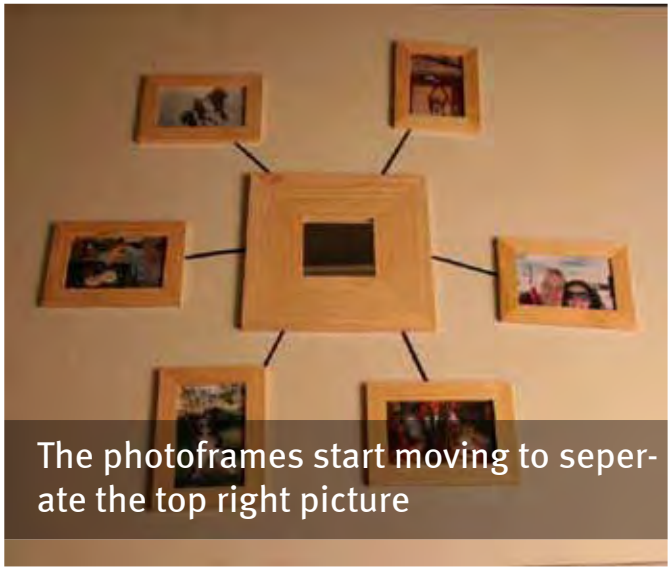
In contrary to most other ideas this one presents very detailed information. In its idle mode, it is a regular mirror; however, when an 'energy event' occurs the mirror will tell what is happening and how it can be solved. Behind the mirror there is a matrix of words with LEDs behind them, when a LED lights up behind a word cut-out, that word will show through the mirror. Doing this for multiple words will form sentences that explain both the event and the answer to that event. The user then chooses whether the device is allowed to deal with the event, e.g. switching off the lights in an unoccupied room, or that he or she will take care of it him or herself.

Idea 5 – Consumption Printer

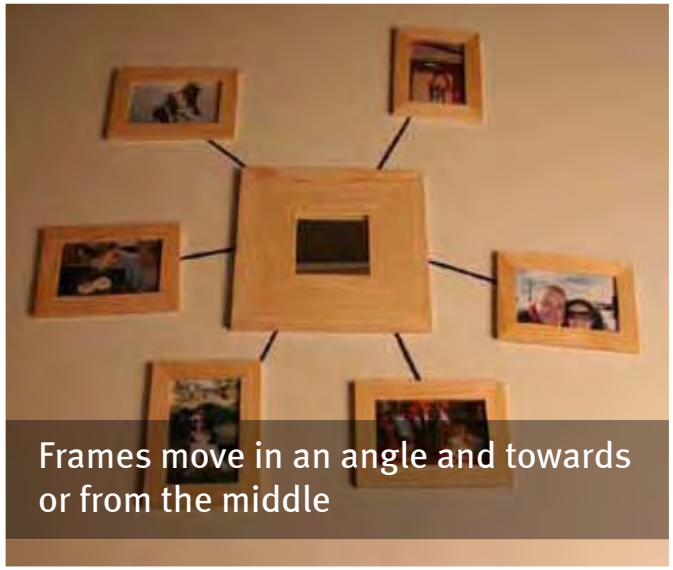
This printer shows the users behaviour by printing the energy consumption of separate activities. Each activity has its own colour and width, which is dependent on the percentage of the total use. As the print becomes too long, the user will want to rip it off. This triggers an action related to the behaviour shown on that print. In case the user wasted a lot of energy by having a lot of devices on standby, the printer will shut off those devices. However, when behaviour improvement is detected, the user is rewarded. The reward could be a printed coupon from a sponsor (e.g. a company that wants to show they are environment conscious) that gives the user discount on some kind of product. The print speed depends on the total energy consumption. This will cause the print to get lengthy faster with high energy consumption, resulting on more required user interaction and (hopefully) behaviour improvement.

Idea 6 – Personal Planning

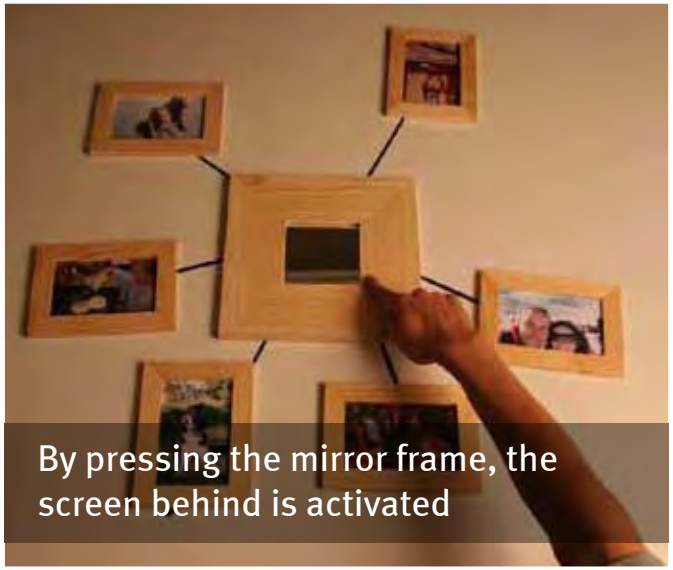
This idea asks the most effort from the user as he has to set how much he wants to use at the start of the day. Activities have their own slider on the device. Moving the slider up will cause liquid, representing energy, to flow into the main tube. The liquid in this main tube is comparable to the total energy use. When the user has set all the activities, the sliders will move back as the activities are performed and electricity is used. When watching TV, the livingroom entertainment slider will slide back and suck liquid from the main tube. As the day progresses it will become apparent to the user which activities used more or less electricity than planned and can anticipate on that the next day.



The photoframes start moving to seperate the top right picture

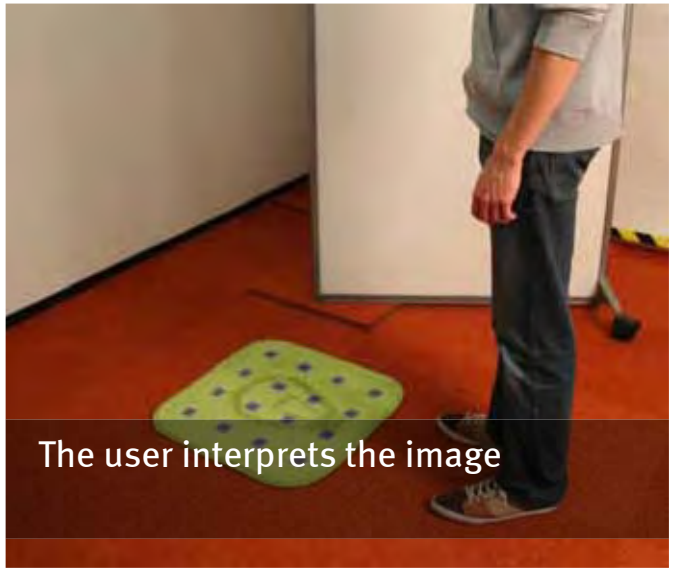


Frames move in an angle and towards or from the middle

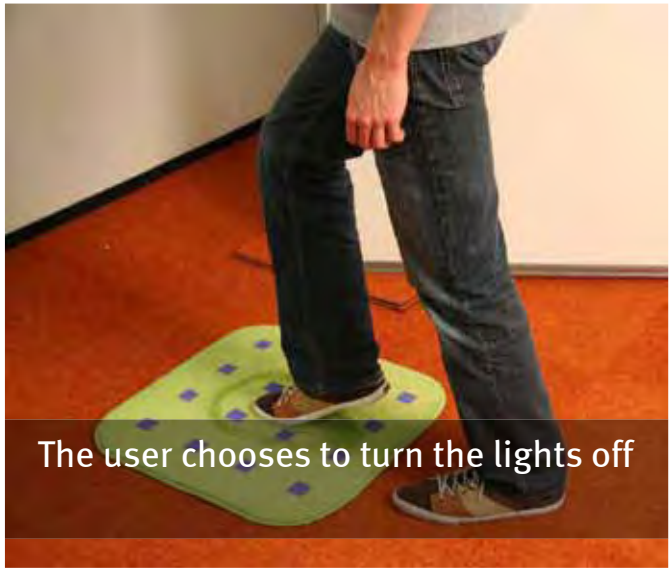


By pressing the mirror frame, the screen behind is activated

The door moves over the mat to leave an imprint



The user interprets the image



The user chooses to turn the lights off

2 ideas

Based on feedback by coach, clients and exhibition visitors the Doormat and a combination of the Mirror Choices and Photoframe Awareness were explored further. This was done with stop motion movies, animating the behaviour of the devices.

The Photoframe/Mirror combination strong points:

- Public yet private: The user can derive awareness information from the placement of the photoframes while the visitor will not notice it;
- Two levels of depth: Awareness and In-depth tips. These tips are activated by pressing the frame of the mirror.

The Doormat strong points:

- The Doormat fits very well in the home environment;
- The point of interaction is interesting as it will be in the flow of daily life;
- The device will probably be cheaper.

After evaluation the Doormat was chosen to develop further. The first adjustment was to incorporate the two levels of depth of the other idea. How this is applied together with the ability to communicate more complex tips can be read in the next chapter.

The Doormate

Supporting people in decreasing their electricity consumption

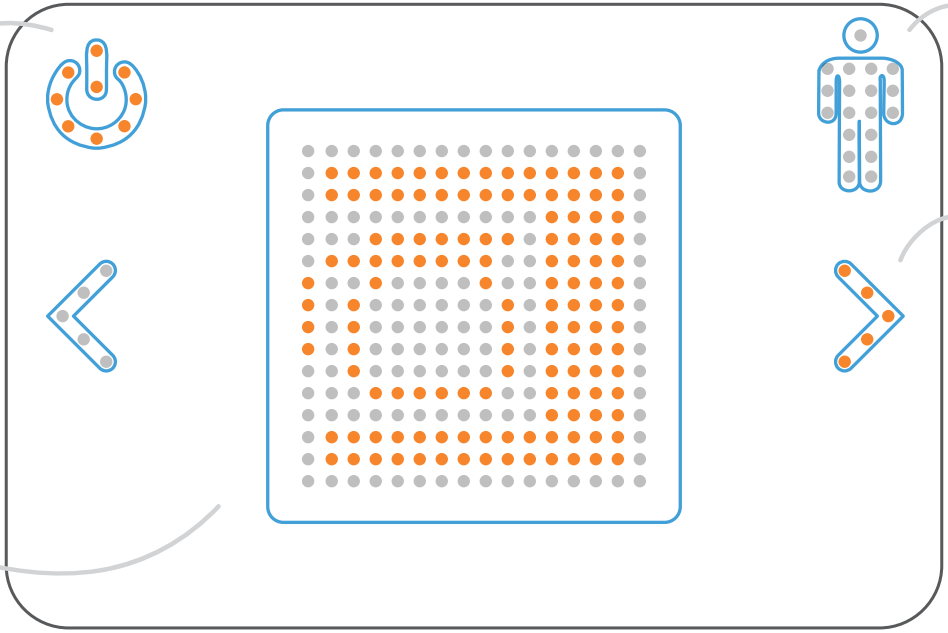
By combining gathered appliance usage data over the smart home network, information is created

Control Mode

Quick and easy energy saving by switching off appliances when leaving.

Display

Icons and animations are shown here. Underneath is a pressure sensor.



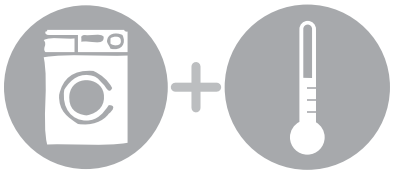
Coaching mode

Tailored coaching animations when arriving at home.

Arrows

Indicates more icons or animations are available. By pressing the arrow the next icon or animation is shown.

Data to Information



Combination

Combining data of multiple appliances to derive information.

Usage Data

By gathering data on time, frequency, duration and intensity of use, behaviour is deducted.

Maintenance

Certain appliances require scheduled maintenance.

Doormate

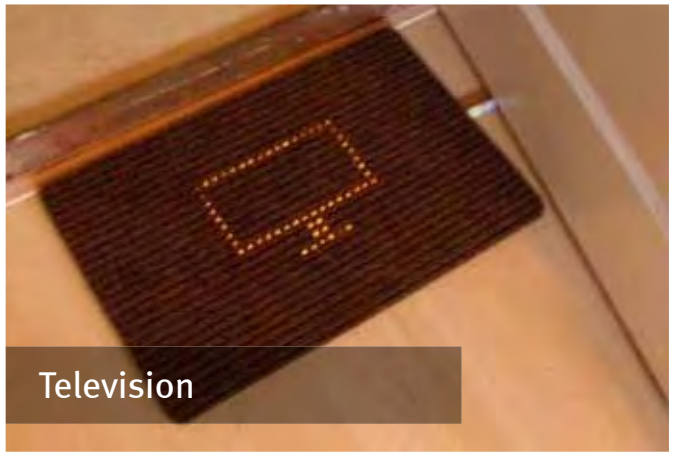
The Doormate is for wiping your feet and supporting lowering of electricity consumption. It does the latter by communicating information through an integrated LED display. It allows people to easily turn of devices when leaving the house as well as improving their energy consumption behavior by learning from tailored coaching when coming in. One could say the Doormate is addressing both the 'consumer' – making sure no money is wasted when not at home and the 'citizen' – contributing by environmental friendly behaviour - in people.

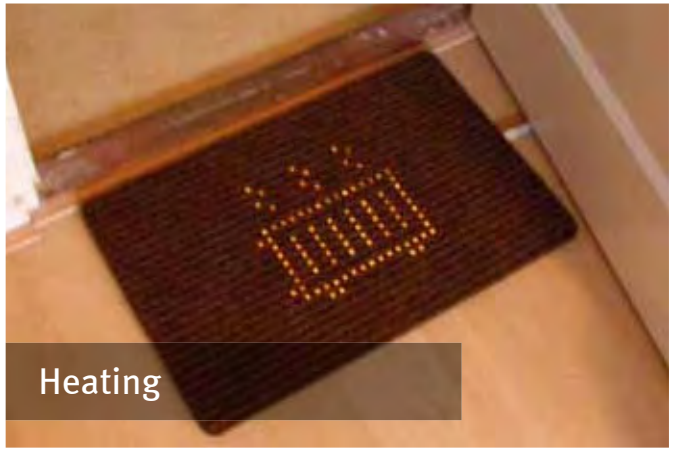
The doormat in particular is chosen as it fits into every home environment. People found it very important for the object to blend in. Another benefit is that the user can decide for his or herself whether to pay attention to the device or to keep walking. The user remains in control and chooses how to spend their attention.

The location of the doormat is excellent for the intended interaction. When leaving the house the user has quick and easy control over appliances that might be better to adjust or turn off.

As these actions are relatively simple and the time of contact is short, static images are used to communicate. To switch off the depicted device the user steps with one foot on the lit up power icon (top left) and with the other foot applies pressure on the display, as if putting out a cigarette. If more devices are available to be switched off, the arrow(s) will light up and can be used to scroll through the icons.

When entering the house the user can spend a brief moment to learn (or get a cue to remember) how certain behaviour can be changed to be more energy efficient. This is the moment before the user will be going to use the appliances in the home. As the contact time between product and user is longer, animations are used to explain the (sometimes) complex coaching tips. If the user does not understand the animation, he or she can get more information on his/her Smartphone or laptop by both pressing the lit up coaching icon (top right) as well as the display. In the case of the coaching state the user is able to 'flip' through tips if more are advised.


Television


Heating


Animation about dryer

The Doormate gathers data from the Smart Appliances in the home. The data consists out of variables as simple as time of use, frequency of use, intensity of the appliance during use and duration of use. By combining this data and evaluating changes, information on improving usage behaviour can follow. The six example situations that are also implemented in the prototype are elaborated on here:

Icons, shown when leaving the house:

- *Light bulb*; switch of the lighting that is on.
- *Television*; switch of the television
- *Heating;* lowering the thermostat to the preset temperature when no one is in.If presence sensors are installed these could be used to determine whether or not to show these icons when someone leaves the house.

Animations of 12 images in 5 seconds, shown when entering the house:

- *Coffee;* the animation shows how a coffeepot is taken of the heater of the coffee-maker and coffee is poured into a thermos flask, pointing out it is better to keep it warm there.
- *Dryer;* a dryer and washing machine are shown under the sun. An arrow goes from the washing machine to the dryer and is crossed out. The screen pans to the right and the laundry goes on the clothesline. The intention is to express that it is best to let laundry dry outside when it does not rain and is of sufficient temperature.
- *Dishwasher;* A dishwasher opens up and the contents are shown. Only the bottom half is filled with dishes. The next frames show that it is better to fill up the dishwasher completely before turning it on. This advice is based on the frequency of use in relation to the number of residents.

Other data that can be used to create coaching tips are energy label of appliances, insulation of house and maintenance moments and actions. The energy label can render behaviour adjustments practically useless in some situations. The insulation has a very large influence on the total energy consumption of households. Sanders pointed out it is likely that a lot of houses will be using electric heating, which is why housing insulation will be an important topic for the Doormate. Sanders also indicated that maintenance of the increasing amount of appliances is hard to oversee, but sensible to keep up with. For this purpose the Doormate can also handle upkeep messages from appliances to communicate to residents when entering the house.

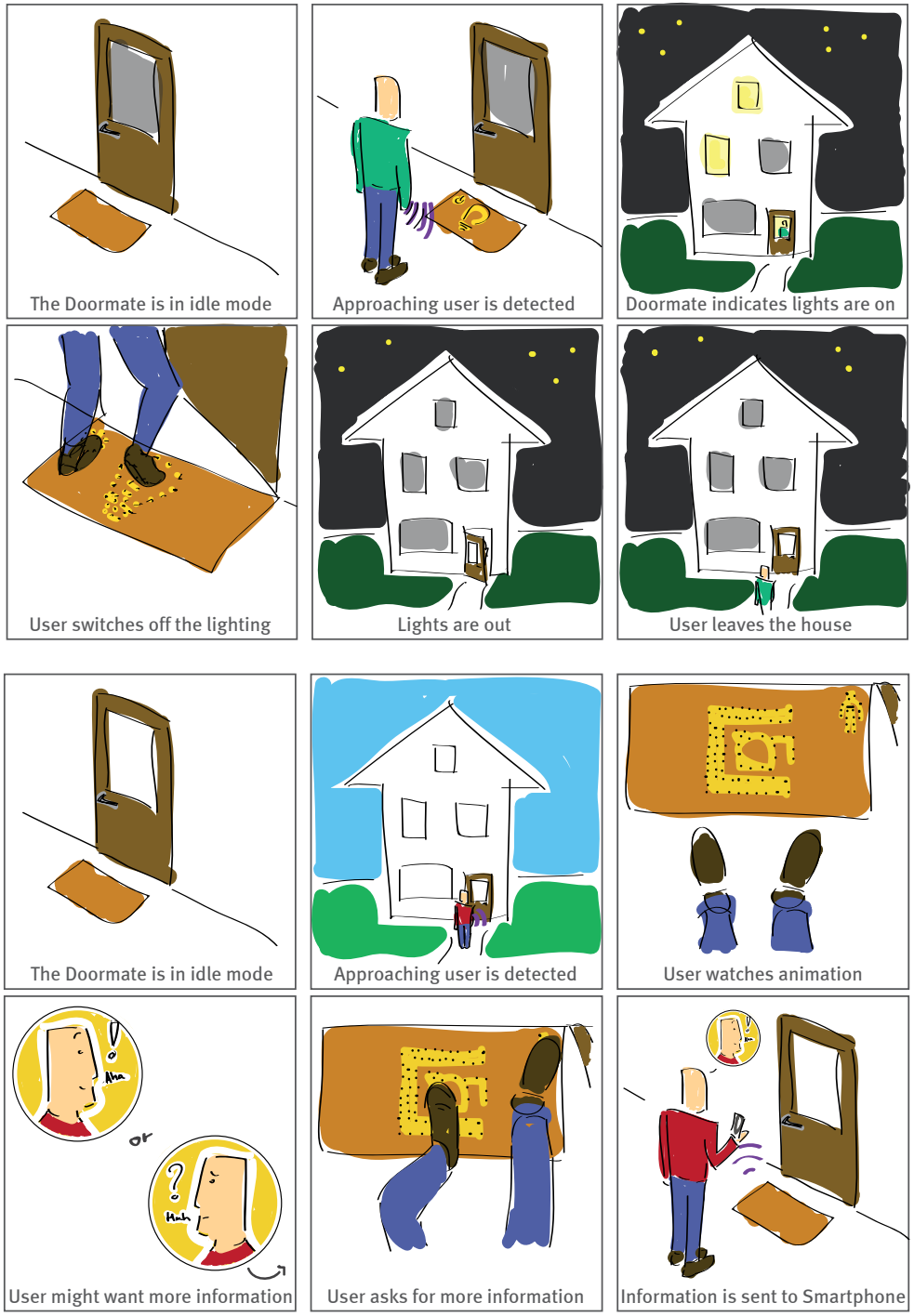
In some cases the user might want personal coaching when in the house, for example when passing by the doormat in the hallway. In this case the tips can be activated on pressing the upper left corner.

Software

Complementary software is not in the scope of the project. However, it is important to note that software, for the laptop or Smartphone, could add to the system. Preferences can be given, for example that the user does not want to get coaching on computer use. Detailed load graphs can also be shown. Ueno et al. (2006) received responses, in their research on effectiveness of energy-consumption information systems, that participants were especially interested in the daily-load curve, a detailed graph on their daily consumption.

Scenario

The top scenario shows how a user forgot to switch of the lights and is reminded by the Doormate. He then decides to switch them of using the Doormate. The bottom scenario shows how a person who is coming home is detected and, while he is taking of his coat, is shown an animation on how to be more electricity efficient. If he does not understand it immediately, he can press the Doormate to recieve more information on his Smartphone.



Variations

As the concept is designed for and envisioned Smart Home, this section explains how some factors can be adjusted based on the situation at that time; Now, Envisioned Situation and Beyond.

Object communication:

- *Now:* as virtually all appliances in the home are not 'smart' yet, the best solution would be to place 'Smart Plugs' that take care of gathering the data on appliance use. The information is then send by these plugs to the Doormate.
- *Envisioned Situation:* The appliance themselves are able to gather data and send it to the Doormate.
- *Beyond:* As even more objects in the home become smart, more elaborate coaching can be designed. This also creates more possibilities to include more functionality to the 'leaving the house'-state of the Doormate; for example automatically closing windows or an alert for the user who forgot to feed his or her cat.

Personalization

- *Now:* What would be easily incorporated now is the ability to sense presence. The Doormate could have a movement sensor on the sides to see someone approaching. This would however make the visuals apparent to anybody approaching the Doormate.
- *Envisioned Situation:* In the SOFIA line of thought it is very sensible to link the behaviour of the Doormate to the proximity of Smartphones. This makes sure the Doormate is only activated when authorized people approach.
- *Beyond:* Taking the ability to recognize people (or at least their Smartphones) further, all appliances could take that information into account. The Doormate could use this to create personal coaching tips for residents.

Power Supply

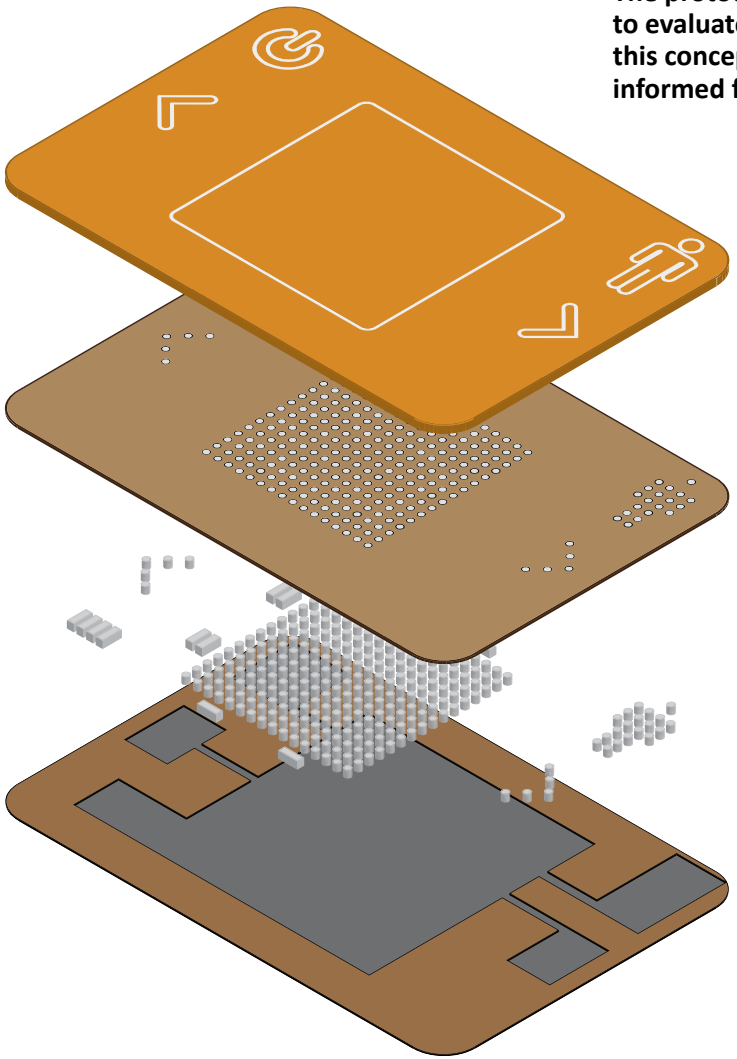
- *Now:* The easiest and most straightforward approach is to add a battery or an adapter to connect to the electricity grid.
- *Envisioned Situation:* Gaining energy from the movement of the door would be a great source. Users are able to apply relatively much force resulting in enough power for the LEDs. As they are only lit up when people pass through the door, the energy generation and consumption are in line.
- *Beyond:* Another possibility is to include piezoelectric components that generate energy as people stand on the Doormate, assuming the gain will be higher in the future.

Coaching model:

- *Now:* A pre-set program for a large amount of situation can be implemented in the Doormate. By using this set of situations the Doormate can match the current situation in the household to them to find suitable animations.
- *Envisioned Situation:* For certain coaching tips the Doormate uses other households with approximately the same lifestyle (number of residents, size of house, appliances, profession etc.) to see whether a certain appliance is used considerably more frequent, intense or over a longer duration. If that is the case, the Doormate can show the appropriate animation to point it out to the user.
- *Beyond:* An idea that requires more effort to implement is one based on Emergent Behaviour. Every household will be placed in a 3D space with the axes being: x, number of resident, size of house and climate; y, types of appliances; and z, the total energy consumption. The behaviour of a household will be compared with that of another that is in close proximity to the first household in the 3D space (with a higher chance to be lower on the z-axis than higher). From this comparison the Doormate will show the appliance that makes the biggest difference in energy consumption between households. The social aspect, in the sense of 'as they can do it, we can do it too', comes into play in this variation of the concept.

Prototype

The prototype contains the display that is described in the concept. The model was mainly used to evaluate peoples understanding of the icons and animations and for them to envision how this concept could support them in daily life. While imagining they will be able to give better informed feedback.



Composition

The prototype is build up out of four layers as can be seen in the picture on the right, from bottom to top: a supporting anti-slip bottom, electronics, protective positioning layer and the doormat cover. The first layer and third layer function as protection as well as positioning of the second layer. The electronics contains the 16x16 LED display.

Since the top layer will wear, it functions as a replaceable cover. This way the more expensive three bottom layers do not have to be repurchased. This also allows for a more flexible adjustment to personal style, as the cover can come in a different colours and patterns.

The model is not far for a production model. In order to take it a step further all electronics should be integrated in the doormat (LED indicators, pressure sensors and IC's) and a PCB should be designed in order to make it smaller and more durable. An important addition is a watertight third layer, just under the replaceable cover, to protect the electronics.

The building process is shown on the next two pages.

Electronics

Without going into too much detail the set-up of the electronics is based around 74HC595 shift register IC's controlled by an Arduino. The images are created by scanning through the rows consequently, so fast the eye does not notice, and switch on the appropriate columns. This also means that, for a 16x16 LED matrix the brightness will be 1/16th as bright as normal, as they are on for 1/16th of the time. To overcome this, the display is split up in two 16x8 matrices. Four shift registers to open transistors on the anode side of the LEDs and two to switch two ULN2803a IC's that source the current coming from the cathode side of the LEDs. The images and program are loaded onto the Arduino.

Test

Preliminary tests were done with seven participants. They were introduced to the model and asked to image how the Doormate would fit into their lives. The prototype was used to test three aspects: visibility and general understanding, animation and icon interpretation, and preference in initial coaching display.

The initial response was that it first of all looked very nice. The effect of the light coming from a doormat, which is generally a very uninteresting and low value object, surprised them and gave the mat more value.

All participants were enthusiastic about the control functionality, as they all recognized the situation where they forgot to turn off appliances. The behaviour improvement animations would be really appreciated and applied for six of the participants. The seventh did not want to adjust his behaviour based on what a doormat tells him.

For the six participants that were looking forward to the coaching animations the main benefits were:

- Clear, direct tips brought to them without putting in effort;
- Personalized coaching that is always applicable to their behaviour;
- They imagined the point of interaction very suited for this interaction.

Some participants indicated that they would like information when they were not entering the house. This can be achieved by pressing the coaching icon (top right corner). In this case, the point of interaction is not sensible to them.

Icon and animation understanding:

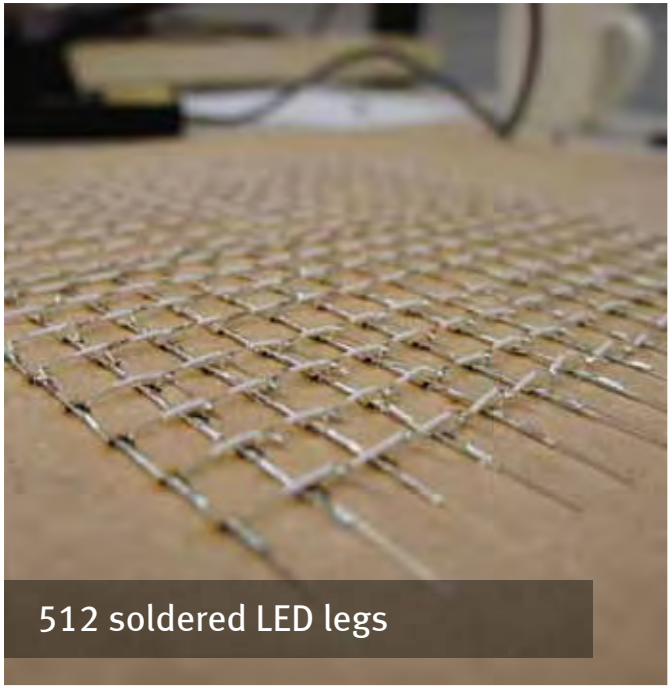
(1 = Not understood, 2 = Help needed, 3 = Hesitation giving one answer, 4 = Needed a second look, 5 = immediately understood)

	Icons			Animations		
	Light bulb	Television	Heating	Dishwasher	Coffee	Dryer
1	5	5	5	4	4	4
2	5	5	3	4	5	2
3	5	5	4	4	5	5
4	5	5	5	2	5	5
5	5	5	5	2	5	2
6	5	5	3	2	2	2
7	5	5	5	4	5	5
Average	5	5	4,3	3,1	4,4	3,6

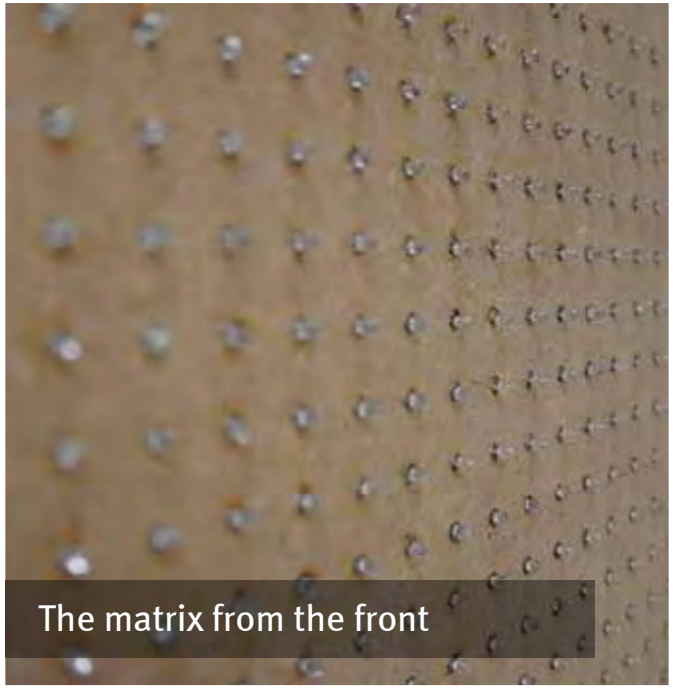
The results show that the Icons as well as the coffee animation is well understood. The other two example animations were harder to understand immediately. Younger participants understood the animations with more ease.

It was proposed by F. Beute (author of "Can Ambient Persuasive Technology Persuade Unconsciously? Using Subliminal Feedback to Influence Energy Consumption Ratings of Household Appliances")that people might not want to see the coaching immediately, but only after asking for it. She proposed to show people either a smiley face to indicate how well they were doing or a graph that showed them the use over the previous day. Three participants were consulted in this part of the test, their responses corresponded to each other:

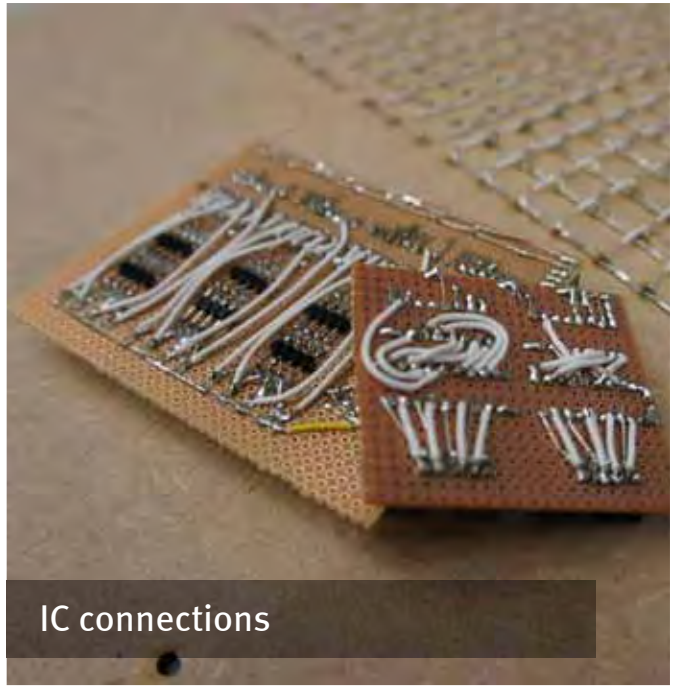
- Graphs were interesting, but they would rather look at them at another moment and location and in more detail.
- Positive feedback was pleasant and stimulating to see, but they did not see the added value. They would rather be informed directly at the doorstep then first having to ask for it.



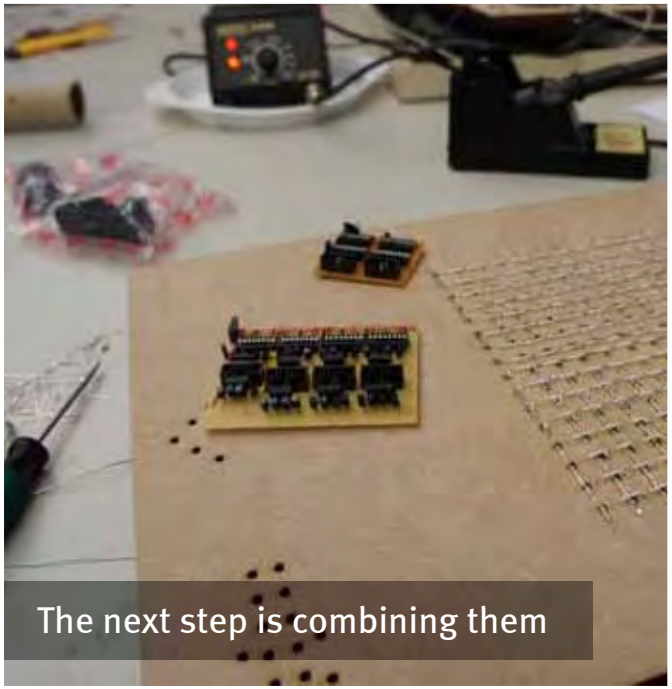
512 soldered LED legs



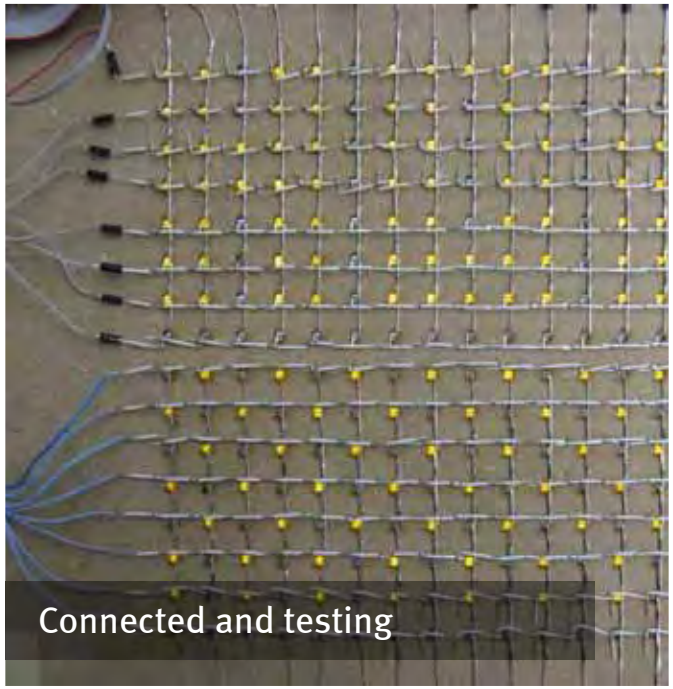
The matrix from the front



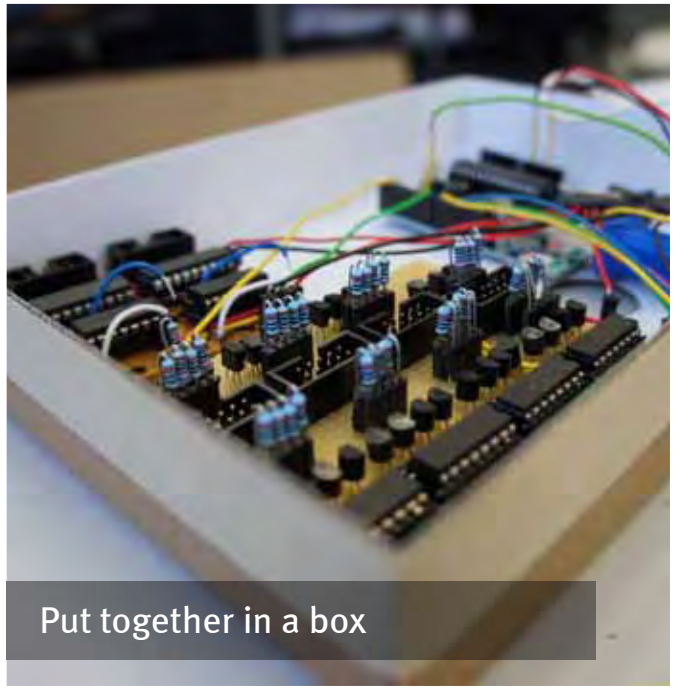
IC connections



The next step is combining them

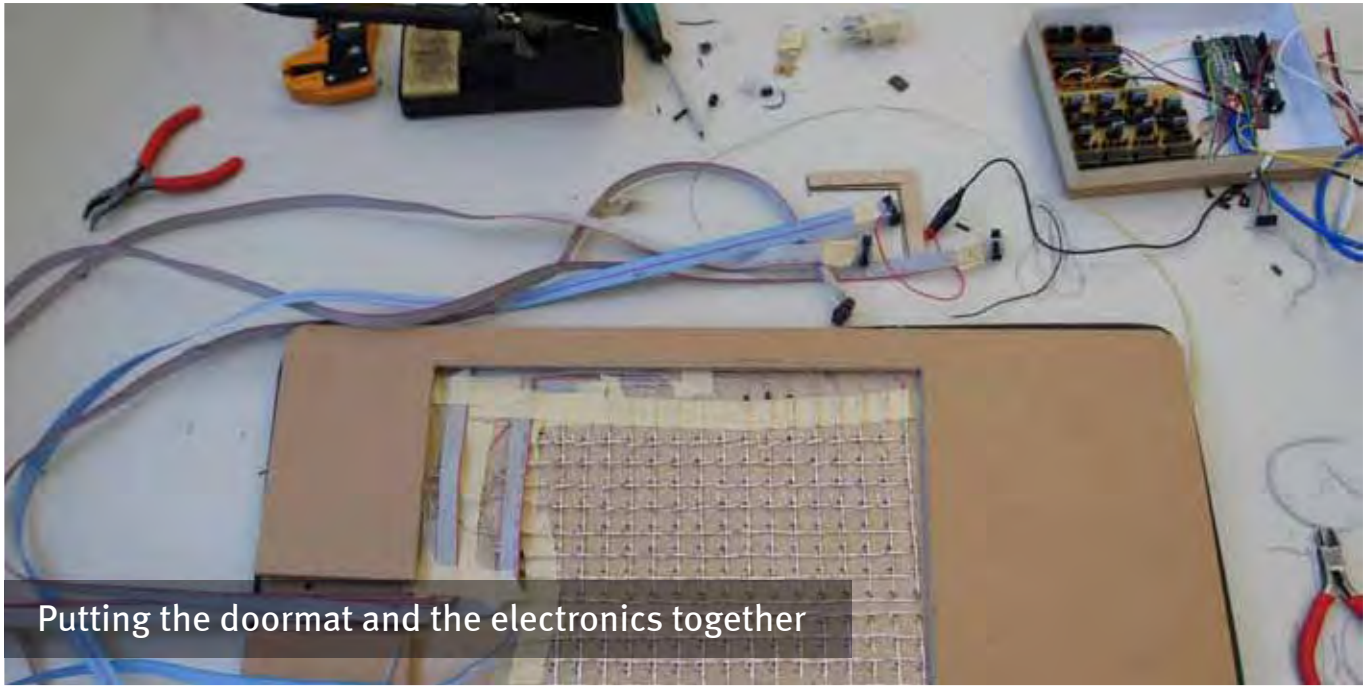


Connected and testing



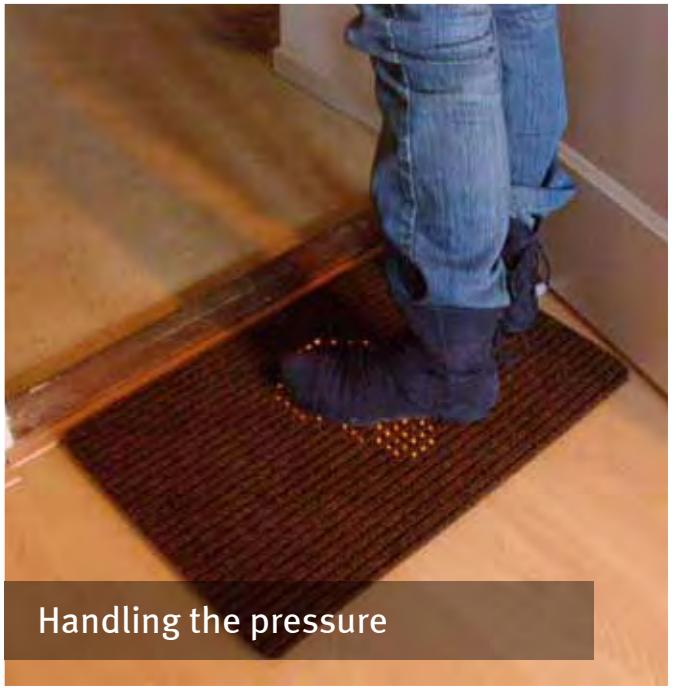
Put together in a box

Holes punched in the mat



Putting the doormat and the electronics together

The Doormate in its natural habitat



Handling the pressure

Evaluation & Future

The results and reactions on the Doormate are promising. People recognize the benefits and see themselves using the Doormate over a longer period of time. Further testing is needed to improve several aspects of the Doormate:

Interaction: Although people recognize the interaction is easy, it would be good to test how people will actually work with the foot controls.

Icons and animations: Only a few depictions are presented in the model. More extensive experimentation and testing should be done to come to the best images.

Longer period of use test: To see the real benefit of the Doormate is has to be tested over a longer period of time. Will the user still pay attention to the product after a week? Do they see the Doormate as an authority on electricity use and their behaviour? It could also become apparent that people are not pleased for the Doormate to tell them to do certain things they intentionally chose to do in a certain way (Heijs, 2006).

Not only the field of electricity consumption is interesting for the Doormate. It can applied in multiple other settings. For example to accommodate social messaging or to retrieve information from social media or to display personalized news or meeting times from the users agenda. In bars or restaurants it can be used to welcome people, make them aware of the specials or point them to their friends when they come in.

References

Ueno, T., Sano, F., Saeki, O. And Tsuji, K. (2006). Effectiveness of an energy-consumption information system on energy savings in residential houses based on monitored data. Applied Energy 83, 166-183.

Faruqui, A., Sergici, S. and Sharif, A. (2010). The impact of informational feedback on energy consumption – A survey of the experimental evidence. Energy 35, 1598 – 1608.

Meyers, R., Williams, E. and Matthews, S. (2010). Scoping the potential of monitoring and control technologies to reduce energy use in homes. Energy and Buildings 42, 563-569.

Darby, S. (2006, april). The effectiveness of feedback on energy consumption.

Miller, G. (2009, October 11). Our changing information diet. Message posted to http://knowledgeissocial.com