Design Project 2: INA

Josefine Funnekotter
Eindhoven University of Technology
Den Dolech 2
5600MB Eindhoven, NL
j.o.funnekotter@student.tue.nl

Jules Huisman
Eindhoven University of Technology
Den Dolech 2
5600MB Eindhoven, NL
j.huisman@student.tue.nl

Demi Jansen
Eindhoven University of Technology
Den Dolech 2
5600MB Eindhoven, NL
d.v.jansen@student.tue.nl

Abstract
In this pictorial we visualize the process of our second design project in the squad Seamless Interaction Design for Everyday Life. We collaborated with De Meeuw, a company that works on modular housing. In the context of energy saving, we designed a product that switches between the user's focus and periphery. Through three iterations we came up with INA, a board and a module which represent the energy usage in your home.

Authors Keywords
Seamless Interaction for Everyday Life; Peripheral Interaction; Energy saving.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

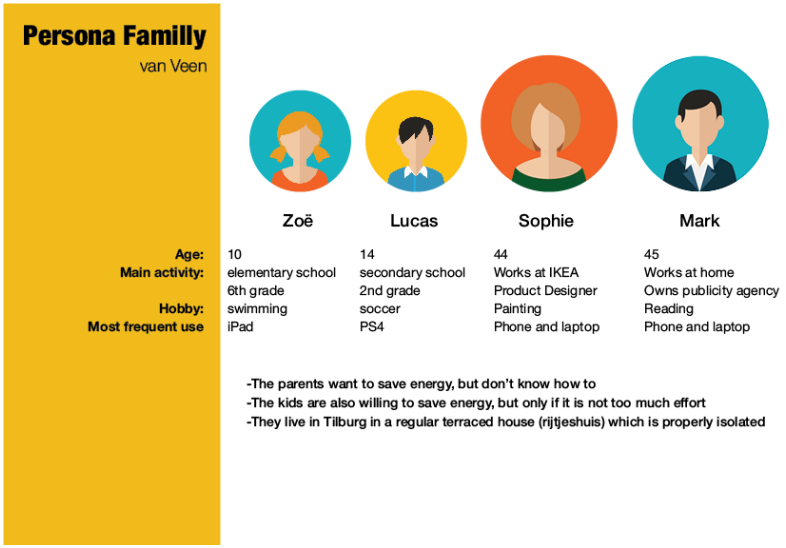
Introduction
We chose for the context of energy saving because we learned that people find it hard to grasp energy. This topic is relevant for De Meeuw as well, because they innovate in the field of future housing, where energy usage plays an important role.
In our process, each iteration consisted of an ideation, design and prototyping phase. We used research and feedback for decision making throughout our project. The first iteration was focussed on exploring different ideas and concepts. In the second iteration we narrowed down from three concepts to one. In the last iteration we fine tuned the design and created a final prototype: INA. By creating a better understanding of a user's daily electricity consumption INA stimulates people to consume less energy, without being intrusive.

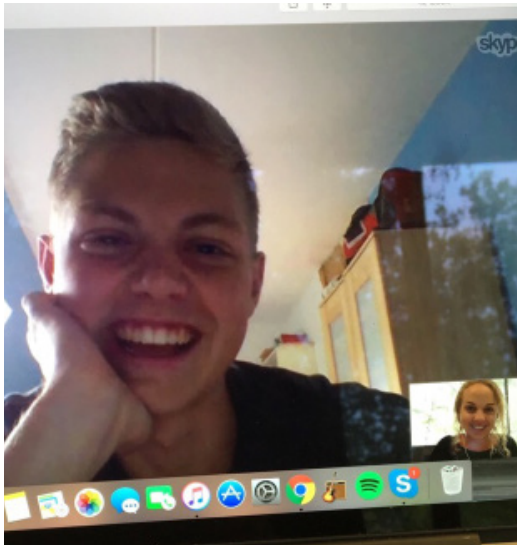
Iteration one
At the start of the design project we chose the design context: Energy saving. We created a persona family to design for, so we had a more specific context to start with.

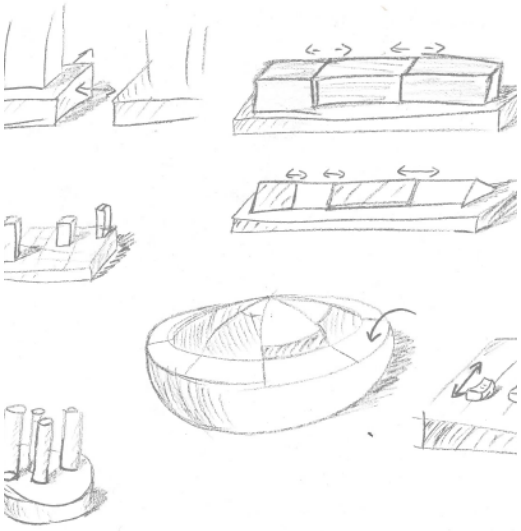
Apart from studying papers, we conducted two focus groups, an interview and two observations of families to research the user and the field of energy saving.

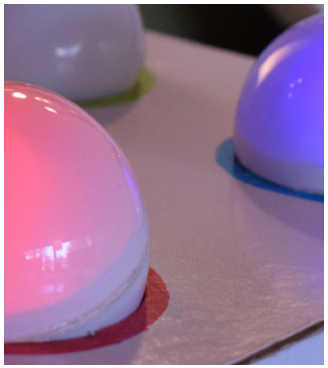
From the research we had two main conclusions. First of all, it is difficult for people to grasp what energy is, because they cannot visualize it. Secondly, people feel like they waste energy on products that consume electricity, but are not used. For example, leaving the lights on when leaving the room.

We used the research outcomes as a starting point for brainstorming explorative concepts. Through various brainstorm methods we came to the main direction: visualization and control of energy in a home. We split the direction in three prototypes which each represent a part of the main direction.









Spheres - Control energy waste of unused products

This board lights up all the rooms where electricity is being used. By turning the ball, the sockets in that room are "turned off". The user can control their energy usage over different spaces without being physically present.

Hourglass - Visualization of total energy usage in a house

The goal of this concept was to challenge the user to consume less energy than the day before. At the start of the day, the amount of sand in the upper represent yesterday's energy consumption. The sand in the hourglass drips down relative to the current energy consumption, so at the end of the day you can see if you saved energy compared to yesterday.

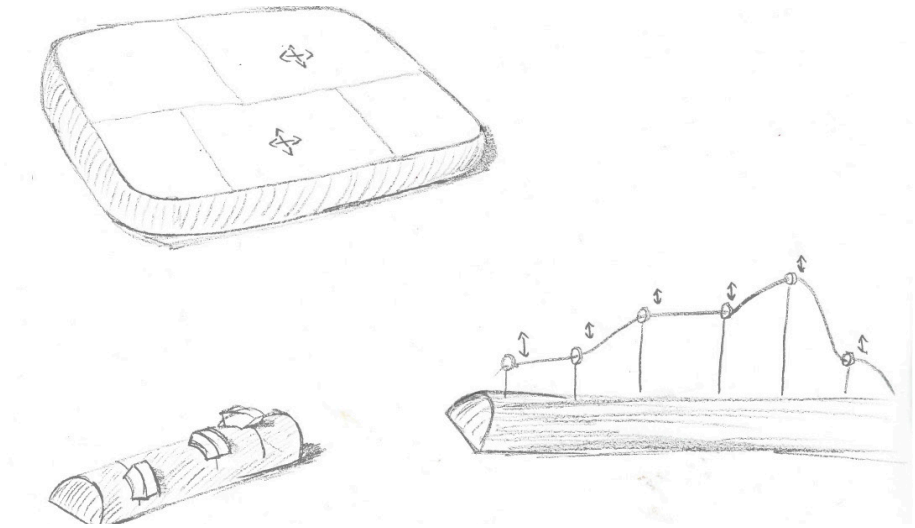
Bars - Visualization of energy usage per room

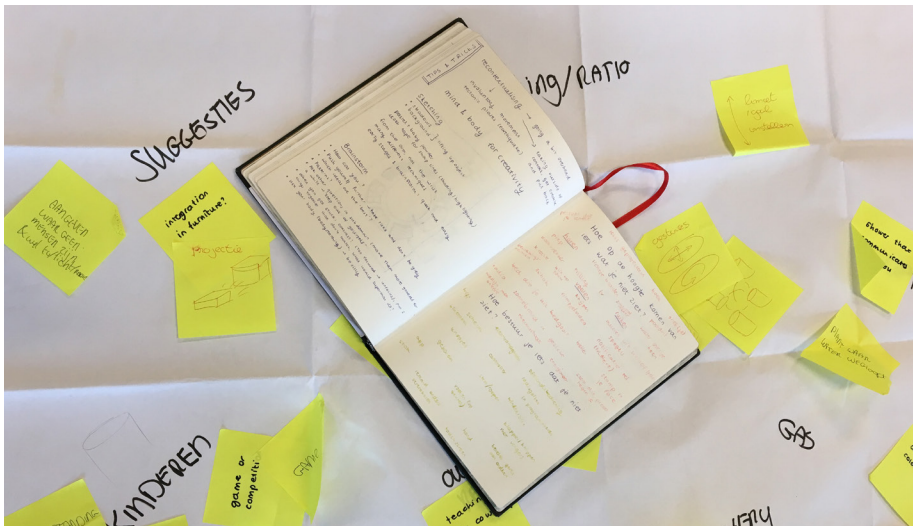
Each bar represents a room in the house. The height of a bar stands for the current amount of kW used in that specific room. This way, we make the rooms' energy usage comparable to each other.

Iteration 2

With the feedback that we received on our three exploration ideas, we concluded the stronger and weaker aspects of the designs. The visualization of energy usage by movement, was something we wanted to keep. The hourglass was considered aesthetically pleasing, but too abstract. The spheres were too similar to normal switches. We preferred the bars, but we had to consider the amount of space it would take in, in people's households.

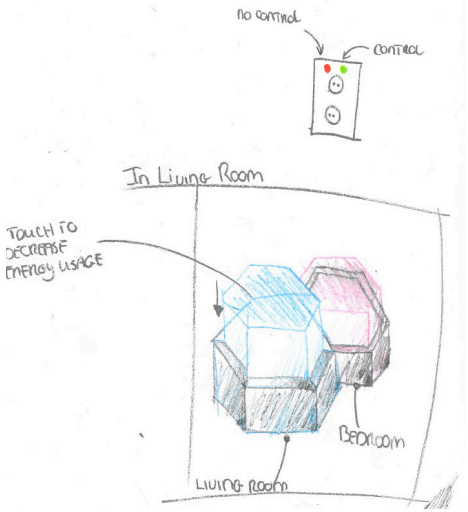
Using this knowledge, we started making sketches. We wanted to visualize energy usage and provide control. We created various ideas with different shapes, sizes and methods.

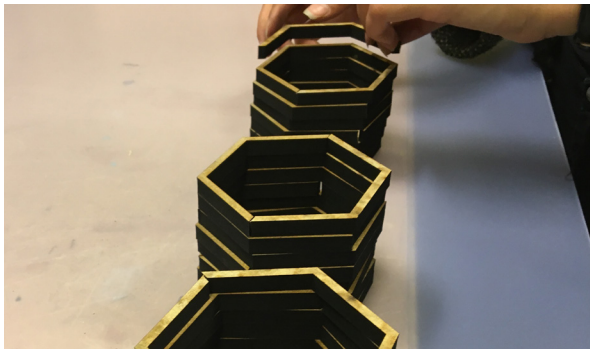


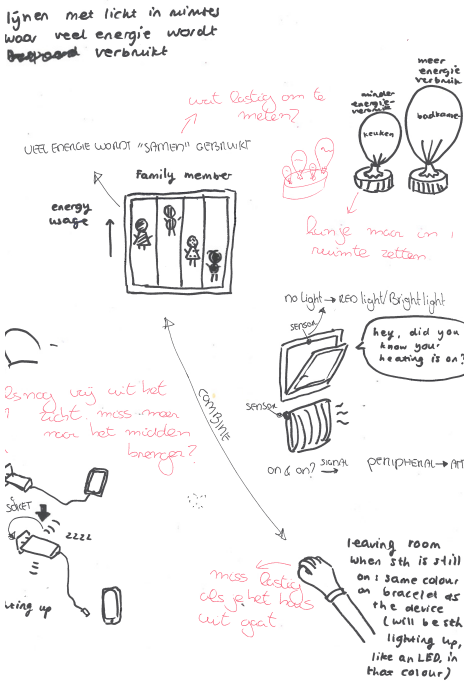


The idea we continued with, was one with hexagonical modules. Each room would have a main module, which would visualize the energy usage in that room. Moving up meant an increase, moving down meant a decrease. It would turn red if there was an uncommon increase in usage.

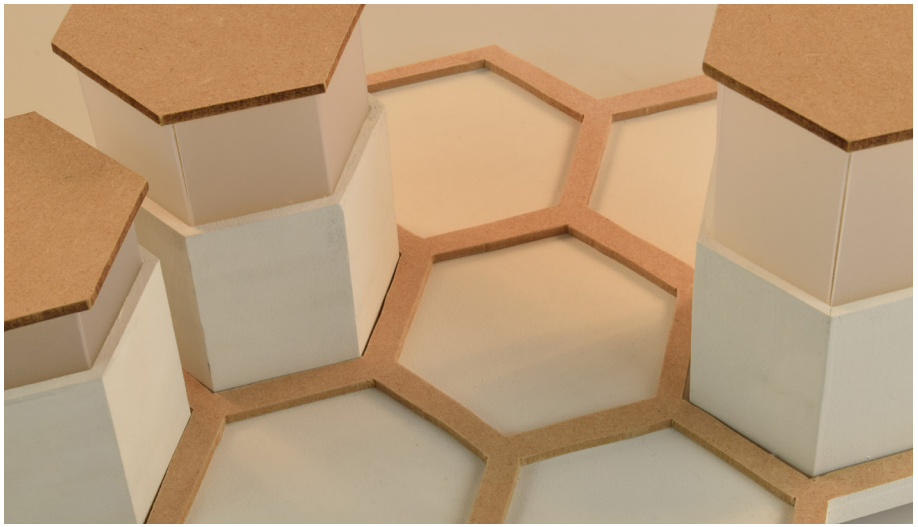
If you would want this information about another room, you could add an extra hexagon to the main module, which would represent the room you wanted extra information about. This was the reason for the hexagonical shape - it made it easy to add modules and it is aesthetically pleasing. At last, you could push the module down if you wanted to turn off the devices and lights in the room that matched the module.







There were too many options and components to this design, which made it a bit confusing.
Therefore, we let go of the control aspect and only focused on the visualization; the hexagon moving up and down, and a red light fading in.
We also stepped away the idea of hexagons in each room, and made one platform, on which they could be positioned. In this concept, there would be one central point in a household, where the energy usage of the house was visualized.

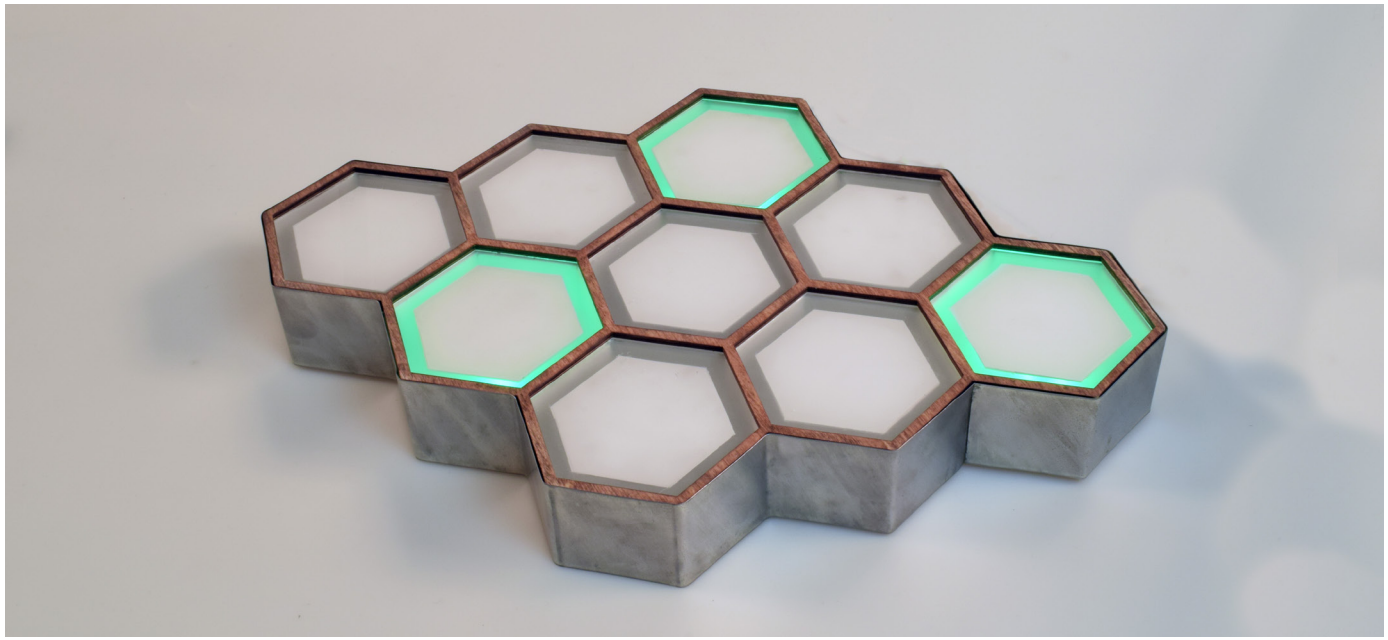


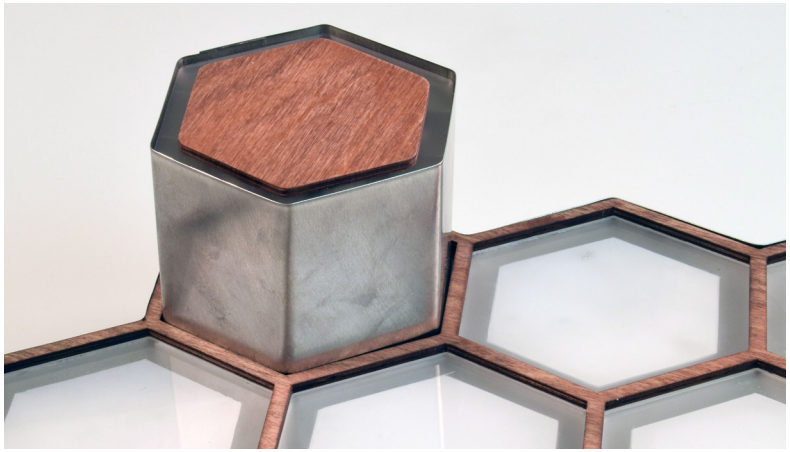
At the mid-term Demo Day, we presented our three explorations and the design that we had, after narrowing down to one concept. The prototype we created, was made out of MDF and plastic. This way, we could explain our concept more easily.

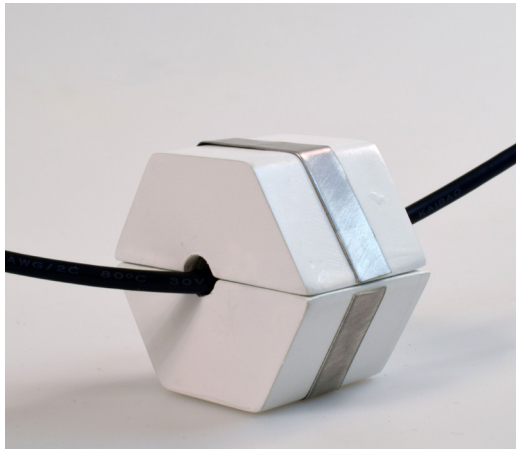
Because we did the presentation at De Meeuw, it was important to emphasize the value of our design for their company. With the modules we came up with, De Meeuw could store data about where and when people use or waste the most energy. This information could be useful for builing their modular houses.

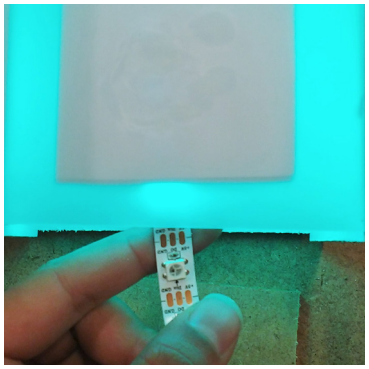
Iteration three
The last iteration, the prototyping phase, started with freezing the concept we made in the second iteration. When freezing the concept, we decided to put the functionality in the board instead of the modules, and bring down the number of modules to one. In the end, we had a board that showed the energy usage, using colors, and a module that allowed the user to look twelve hours back in the past.

We did not change the design of the board; we liked the design and it was clear to the users that the tiles represented different rooms. However, we did change the design and functionality of the module. To discover how people interpreted the use of the module, we did a quick user test. We asked people how they thought the module functioned and only explained that it was used for visualizing energy usage. This gave us useful information to continue our work, as you easily get quite stuck in your own ideas. After the user test, we decided to show the energy usage of the past twelve hours. This decision was mainly based on our knowledge and the results of the user test.

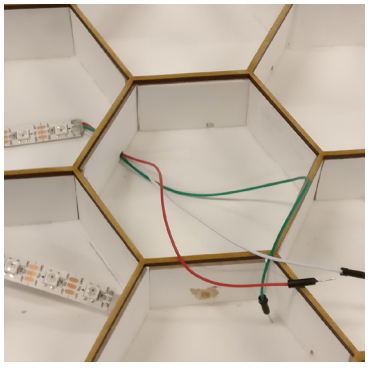


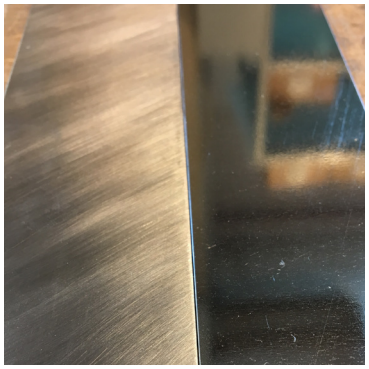




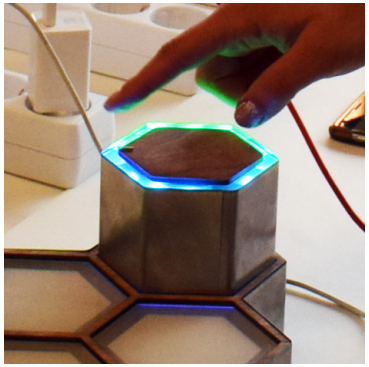


After we had the final design for the board and module, we started working out the construction and electronics. The top of the board needed to be precise to stop light leaking and prevent the board from becoming too bulky. We decided the best option was to laser cut the materials.

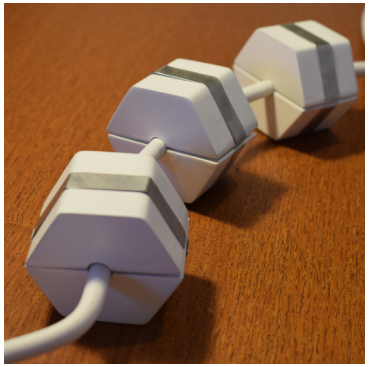




The inside of the board was made of MDF, as it is easy to work with. The outside was made of plywood and brushed sheet metal; this gave the product a fitting industrial look. After the outside was done, the electronics were installed.

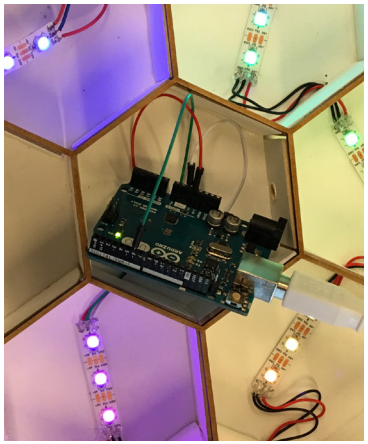


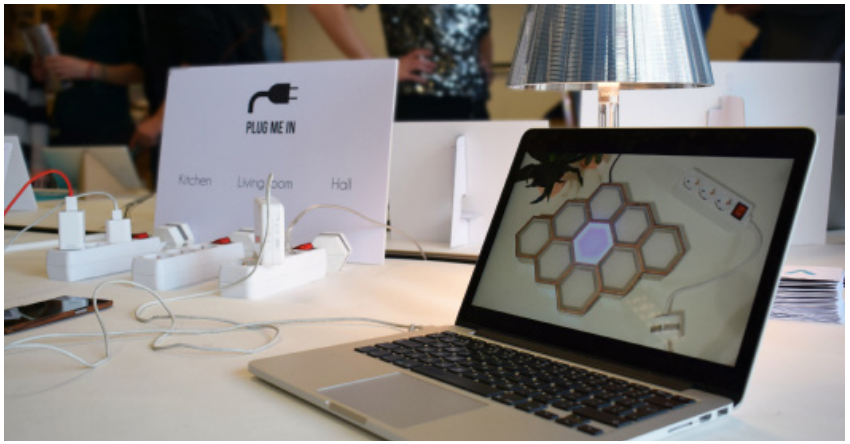
The construction of the module resembles the construction of the board. Brushed sheet metal on the outside and mdf and electronics on the inside. The size of the module was designed for the electronics that it housed; this resulted in an exact fit.



The design of the energy clips was conceptual and only represented the functionality that it would have if it had an actual energy meter.

The actual energy meter was housed in an outlet box. The box measured the current going through each outlet and sends the data to the board.





Most of the programming was done in parallel to the construction of the board. We split the programming tasks into different categories: the board, module, energy measurement and data transfer. When all the individual tasks were done, we combined them all to interact and communicate with each other. When all the electronics were installed we fine-tuned the code to make it suit our needs.
At the end we had a functional prototype that helped with communicating our ideas and concept. It also resulted in an interactive demo day representation.

Demo day
We made an interactive demo day set up. Apart from watching a short movie, people could plug in appliances in sockets, which represented different rooms. According to the amount of current that was added to a circuit, the color of the tile matching a certain room changed.

The module could be placed on the tiles and showed a sequence of lights which represented the energy usage of the past twelve hours in that room.

We made brochures with an explanation of how INA works and why it is valuable, accompanied with various pictures of the product.

Conclusion and discussion

We are all really pleased with the results we achieved this semester. However, there are still things we would like to do if we had more time.

First of all, we would have liked to conduct a final user test to confirm the design choices we made. The challenge with our product is that you have to user test it for a fairly long time, to get reliable results. In the business area, we only focussed on setting design opportunities for INA that are in line with the interests of De Meeuw. We also would have liked to set up a business model for our product to show companies the feasibility of the product. The fact that this was our second design project, helped us a lot in getting structure. Using various brainstorm techniques and making prototypes for every iteration, helped us to generate better ideas and communicate these clearly.

We were able to integrate each other's expertise in the project and we had room to develop our personal goals in the design process. Overall, everyone in the team was committed and eager to collaborate.

Acknowledgements

We express our gratitude to Bart Hengeveld, Saskia Bakker, Isabella Boloz, Berry Eggen and Koen Beljaard for their weekly feedback and instructions in the squad of Seamless Interaction Design for Everyday Life.
Secondly, we want to thank De Meeuw for their hospitality, feedback and enthusiasm.
Furthermore, we are thankful for all the people who were willing to take part in our research, feedback sessions and user tests.
We would also like to thank the department of Industrial Design at the TU/e for providing the design project that we worked on.

References

1. ACM. How to Classify Works Using ACM's Computing ClassAntimo Barbato, Luca Borsani, Antonio Capone, Stefano Melzi (2009). Home Energy Saving through a User Profiling System based on Wireless Sensors.
2. Marco Jahn, Marc Jentsch, Christian R. Prause, Ferry Pramudianto, Amro Al-Akkad, Ren´e Reiners (2010). The Energy Aware Smart Home.
3. Piccolo, Lara; Baranauskas, Ceca; Fernez, Miriam; Alani, Harith and De Liddo, Anna (2014). Energy consumption awareness in the workplace: technical artefacts and practices. In: XIII Brazilian Symposium on Human Factors in Computer Systems, 27-31 October 2014, Foz do Igua Brazil.
4. G. Wood, M. Newborough (2002). Dynamic energy-consumption indicators for domestic appliances: environment, behaviour and design.
5. Anton Gustafsson, Magnus Gyllenswärd (2005). The Power-Aware Cord: Energy Awareness through Ambient Information Display, April 2-7 | Portland, Oregon, USA
6. Stephen S. Intille (2002). Designing a Home of the Future.