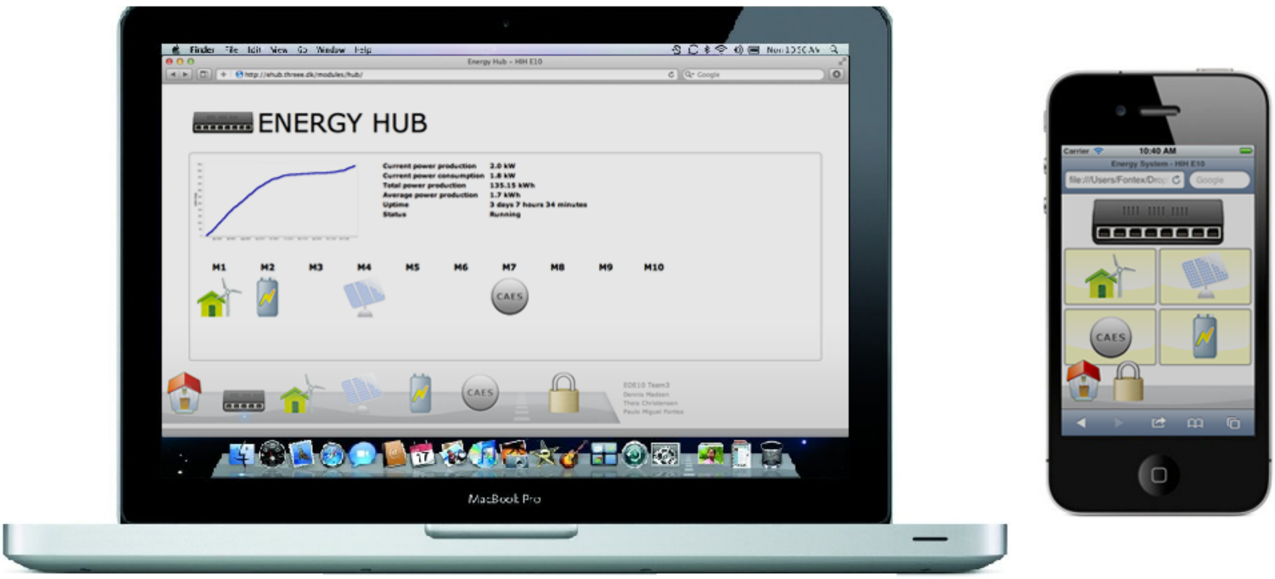
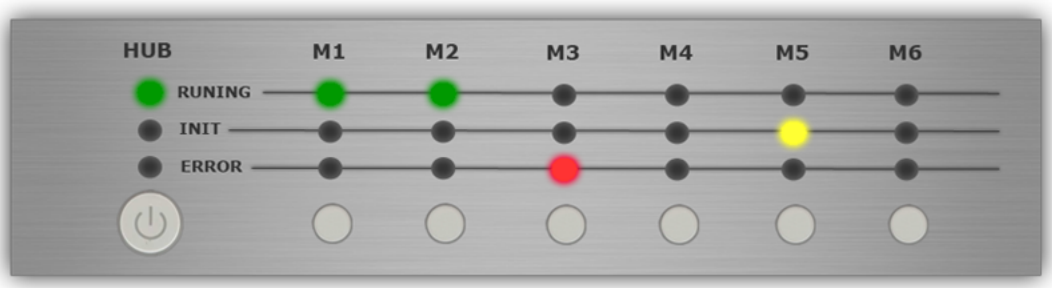
IDE1 - Interaction Design

Project - Energy Hub

Counselor: Henning Slavensky





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Chapter 1

Introduction

1.1 Interaction Design - Paulo

Interaction design is the process of understanding and satisfying needs and desires of a user or group that will use a product (goal-oriented design). In the design process, interaction sessions are held with the user, to get feedback on an early stage in the development process, or actively assist in the design process (Participatory Design). When creating a goal-oriented design for a certain user or a target group, goals are set to understand and clarify the needs of the user or target group (Usability Goals). These goals will also give a basis for testing the final product, to validate if the user or group goals have been fulfilled.

A web interface and a physical interface were developed. A participatory design method for the physical interface and a prototype of the web interface was developed, with focus on the user needs.

This report will describe the design process in the development of the Energy Hub prototype as an academic project. The experience gained in the development of a prototype, meetings with the users and the use of different methods to design the interfaces will be described. A short description of the Energy Hub project will give an overall understanding and expected achievements.

Recorded sessions can be found at: *http://e10.ede.hih.au.dk/index.php/Videos*

1.2 Problem Statement - Theis

The PRO3 project is divided into sub projects that each team is working on. Energy hub is our project, the problem statement for the device is as follows (taken from the teachers wiki).

- *The system controller monitors all connected devices.*
- *A connected device can either consume or produce power.*
- *All devices must have a standardized interface, both HW/SW/Mech.*
- *The controller must decide what happens with energy flows to and from all connected devices, in an optimum manner.*
- *The hub must be able to recognize all connected devices.*

A new request was to make interaction with the hub through a web page, as well on the energy hub. The user interface for this purpose is to be developed with the methods provided in the EIDE1 course.

1.3 Task Description - Theis

The hub is the central part of the overall system, all the modules are connected to this unit. The hub has to react when different events occurs in the overall system. This could be when a device starts producing energy, then the hub has to find out what to do with the extra energy. For example a: consumer module starts using energy, or starts consuming more energy in a short period.

Our task is to develop a switch that controls all the modules and react on the above events. Due to the fact, that all modules are connected to the hub, then the interaction in this system is machine to machine communication. The human to machine interaction in the system is only taking place on the energy hub and on the created energy web interface. The hub interaction is only for the owner to use, while the web site is for everyone to use, this gives some additional requirements for the user interface. On the web site it is possible to see the status of the hub, the modules and how much energy is being produced and consumed in the system.

1.4 Stakeholder Analysis - Paulo

Stakeholder Analysis is an important tool for developers, as the different involvement of all persons in the project and on the final product is clarified. This is done by identifying persons or groups which are relevant and their level of influence on the project.

Project coordinators:
Morten Opprud
Klaus Kolle

Customers/Users:
Jan Nielsen - Customer (Primary User)
High school students (Secondary Users)
Rene A. S. Josefsen (Web interface customer)

Suppliers:
Jens Mortensen
Per Lysgaard

Theory Advisors:
Henning Slavensky
Ulrich Bjerre
Kristian Lomholdt
Per Lysgaard

	Has decision power	**Has no decision power**
Directly involved stakeholder	Klaus Kolle Morten Opprud Jan Nielsen	Rene A. S. Josefsen
Not directly involved stakeholders	Per Lysgaard	Jens Mortensen High School Students

Figure 1.1: Stakeholder Analysis table

Klaus Kolle and Morten Opprud, are the project coordinators/managers, they have decision power over the final product and are directly involved with the development. As academic project, they are the ones that have to be satisfied with the final product. As project managers they guide the developers trough all the phases of the development process.

Jan Nielsen is the customer, the primary user of the system so he has the decision power over the final product and is enrol in all the development and design process.

Rene A. S. Josefsen is our web-interface customer, has no decision power in the overall system, but is direct involve in the design of the system interface.

In a production project, Jan and Rene satisfaction as clients, would be very important. In this project their feedback is used as requirements for the final product.

High School Students have no decision power over the final interface since they are the secondary users of the system. They will be one of the final users to test the system.

Jens Mortensen is the component supplier, is not directly involved in the project and has no decision power over the final product.

Per Lysgaard is not directly involved in the development of the system, but has the final decision of the budget for the system.

Chapter 2

Design

The hub can be interacted with in two different ways; on the physical hub or through the website under the energy hub page. In this chapter the different ideas over the design will be explained.

2.1 Design Methods - Dennis

Finding the right design for the hub have been really educational, as two different interfaces have to be designed, this give the possibility of trying different design methods. As the hub is only going to be operated by the customer for the system, it was natural to involve him in the design phase. The participatory design session with the customer is explained in detail in the next chapter.
As the system is meant as a show off system, the design of the website is on an experimental level, where pieces from a known operating system has been implemented on a web interface. The reason not to include users in the design phase of the website has been to come up with a new and innovative design. Whereas most people will stick to something they know if they are supposed to design, for instance a webpage. After the first sketches, both the customer to the system and the web-customer has been contact to give feedback on the drawings. Later on a usability test was made with the two customers before the creation of the real page. The usability tests is described in detail in the next chapter.

Based on meetings with the two customers, usability goals and user experience goals have been found, to make the final product as close to what they wanted. Experience goals are subjective, which can differ from one person to another based on an opinion or emotion, whereas usability goals are more measurable and not coloured by the persons opinion.

2.1.1 Usability goals - Dennis

Based on the meetings, numbers are given to different usability goals due to their priority. The below sections will be given numbers on a scale from 1 to 10 (were 10 is very important and 1 is less important)

- 10 safe to use (safety)
- 8 easy to learn (learnability)
- 8 easy to remember how to use (memorability)
- 6 effective to use (effectiveness)
- 5 efficient to use (efficiency/performance)
- 2 have good utility (utility)

Safety Most important is the safety factor as the user of the system (Jan) should be able to show the system for high-school students and other users, without hurting fiddle-fingers. Therefore everything dangerous such as: high voltage connections and sharp edges should be held inside the module boxes. Non-technically experienced persons should also be able to connect devices to the system, without thinking about safety risks.

Learnability: As the system is meant to be operated by a non-technically persons, learning the system have to be fast and operating the system, therefore the interface will be very intuitive. Also visitors should be able to do simple tasks on the system, such as turn a device on or off.

Memorability: Mainly the system is supposed to run by it self without any interaction. But when the system is going to be operated, or the system is showed for visitors, the instructed person(s) is able to do so without any preparation time.

Effectiveness: The effectiveness of the system is not the most important factor, but still quite important as the talk is about a green system, which must be affordable for the user to implement the system. When investing in a green system, it will have information about estimated lifetime and buy time (the time it takes the system to 'buy home itself'). If the buy time is to long, maybe longer than the lifetime, the price for having such a system will be way to high. The goal is that visitors can see the advantage in buying a green system (environmental and money friendly), so it might affect them to be more environmental friendly.

Efficiency/Performance: The performance in the system is not critical when considering it from the users perspective. It doesn't matter if it takes a few seconds before the system responds the user. But for safety reasons it have to operate very fast between the modules so no parts is harmed due to long response time. But nothing that has directly connection to the user interaction.

Utility: The possibility of changing parameters in the system should be kept as low as possible to easy the interaction with the system. If the user have too many ways of setting up the system it can easily confuse more than necessary. Therefore only the most important elements that the user should be able to change are implemented, rest of the settings are hidden utilities (only to be set up by the developers during tests).

2.1.2 User experience goals - Dennis

The user should not find this system specially emotional or fun as the system might be seen as frivolous if it is overdone. However, to keep the interest of the visitors (primarily high school students), the system should be entertaining to a certain level. Down below the different user experience goals found interesting for the hub are listed in order (most important at the top):

1. Rewarding
2. Helpful
3. Entertaining
4. Motivating
5. Enjoyable
6. Fun

The goal is to give visitors a better understanding of the term 'Green Energy'. They should feel they have become rewarded on the area after having interacted with the system. The system should be helpful, to easy the process of doing things, like seeing the production historic, connected modules etc. The represented values have non-technically expressions to make it more entertaining and to not make the user lose motivation. Even though the user have to learn something by using the system, the system is also supposed be enjoyable and fun to use.

2.2 Metaphors - Paulo

Metaphors are used in many domains such as: philosophy, cognitive science and poetics. It is a human feature of giving a name for something new, using the name from something known. When a person encounters something which is new, they try to fit it in the already acquired knowledge.

As example: Microsoft users who is using 'Microsoft Office Word', when they are using a different word processing program with a different name, they will still call it 'Word'. This is one of many examples of how human mind works.

The discussed metaphors are:

- Energy Splitter
- Energy Router
- Energy Switch
- Energy Divider
- Multiple wall socket
- Network Switch
- Network Router
- Router

The metaphor 'Network Switch' was selected, since it is the one that most assimilates with the energy hub. This is represented graphically in the web interface as the fowling icon:

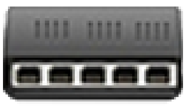


Figure 2.1: Energy Hub metaphor representation 'Network Switch'

Chapter 3

User sessions

3.1 Prototypes - Theis

In order to get information from the users about how the user interface should be like, six sessions were made with different purposes and users. For the user sessions four prototypes were made, the prototypes are as follow.

3.1.1 Hub low fidelity

The low fidelity hub prototype is used in the participatory design session. The prototype is a box with an aluminium sheet as front, this should act like the hub, then pictures of different types of components were printed out, such as bottoms, LEDs and screens. This makes it easy to rearrange the design, just by moving the pictures around the front sheet. This is a low fidelity prototype, because it do not do anything functional, it is to show how the design could turn out.

Figure 3.1: Picture of the hub LF after session

3.1.2 Hub high fidelity

The high fidelity hub prototype was made before the participatory design session, and this was how his needs were defined. The prototype is also used in the participatory design. It were made with the same box as the low fidelity hub prototype, where an mbed[1] were used to control the LEDs and bottoms in the front sheet. This is a high fidelity prototype, because it can show how the hub will react on different actions, it gives the user the same experience as a fully operational hub would with this user interface.

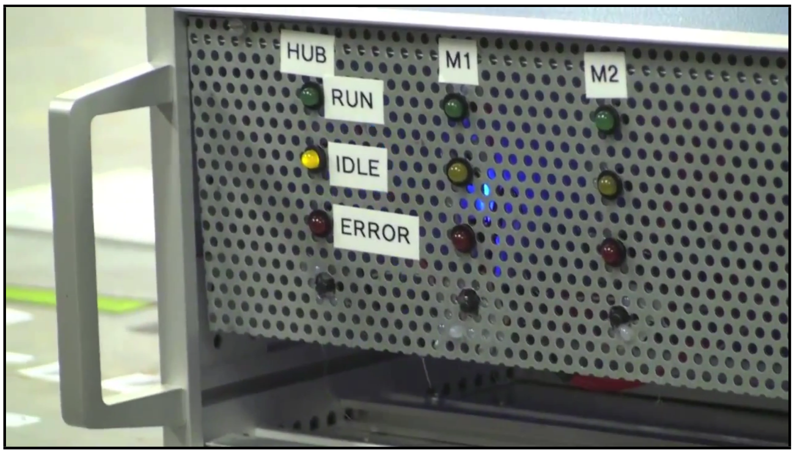


Figure 3.2: Picture of the hub HF

3.1.3 Power point mid fidelity

The power point prototype is used in the first usability test. It is an interactive power point with slides to show the different web pages, it is said that this is a mid fidelity prototype, it gives the user a good experience as the final page would do, but it does not have any dynamic data, it is all static so that it is just to see how the interaction with the site works.

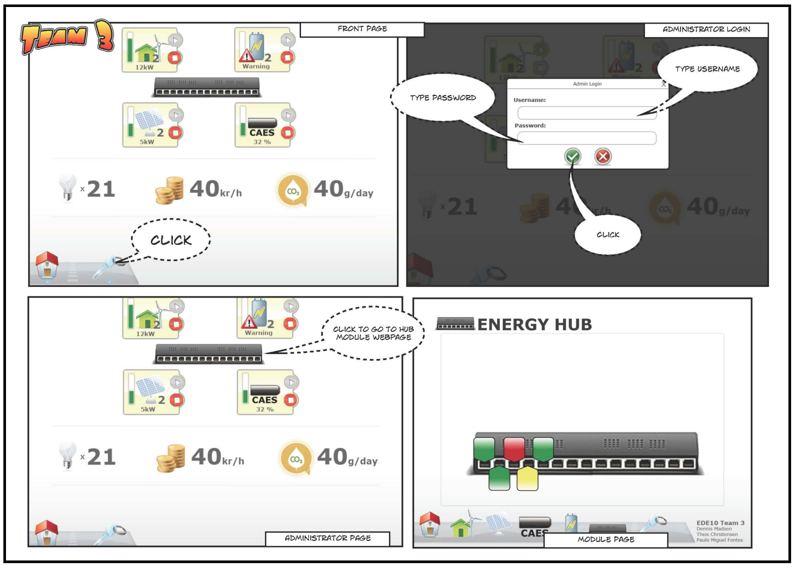


Figure 3.3: Picture of the power point slides

[1]Prototyping Microcontroller: http://mbed.org/

3.1.4 HTML web page mid fidelity

The HTML page prototype is used in the second usability test. In EWEB1 course a web page was developed, the purpose of the site is to give an idea of how the final web page would look like and work but without any data reading and logging, it is a static web page. It is defined to be mid fidelity like the power point because the functionality is almost the same.

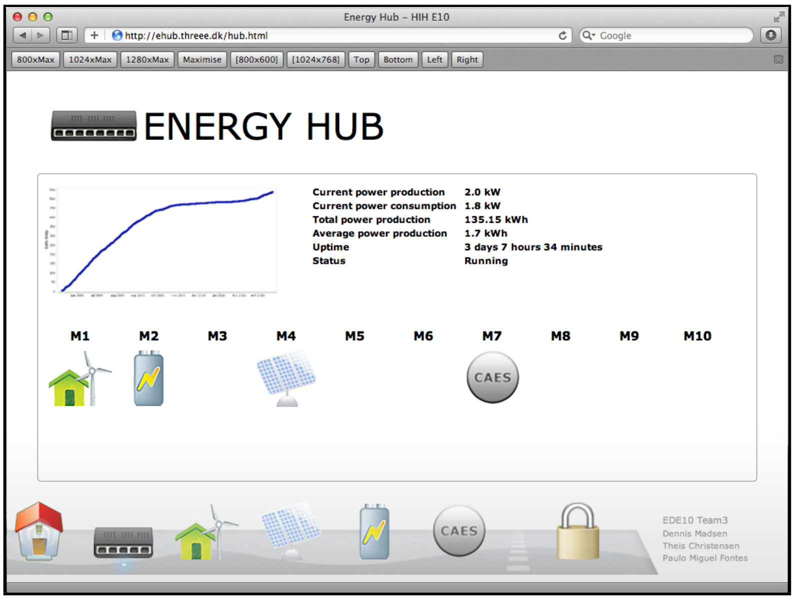


Figure 3.4: Picture of the hub web page

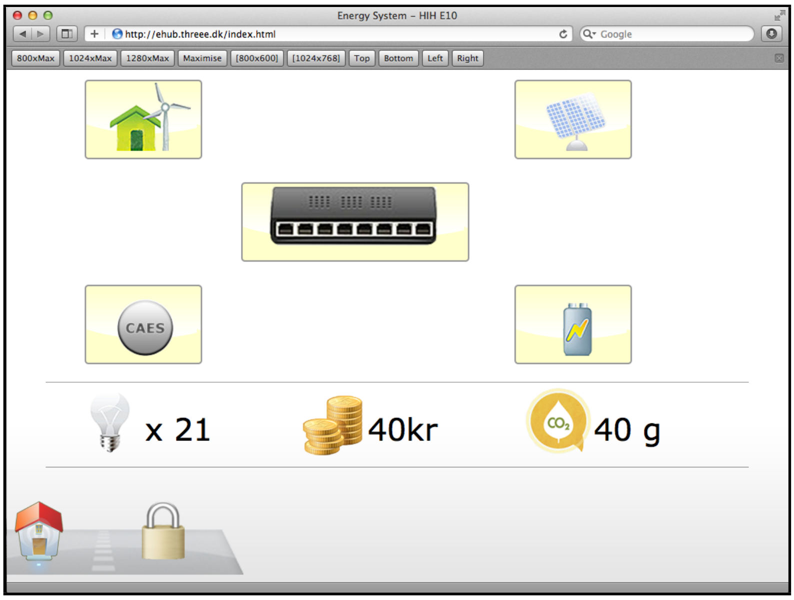


Figure 3.5: Picture of the index web page

3.2 Participatory Design - Dennis

As explained earlier, the hub module is divided into two sections, the web interface and the physical interface on the hub. The goal of the participatory design session with the customer Jan was to clarify the level of interaction he wants on the hub module, but also where he wants the different things to be placed. A video of the session can be found on the wiki page (find link in the introduction section). Before the session, pictures of small buttons, LED's, screens, connecters etc. were printed out to easy to process of placing components on the front panel. Jans job was now, with some guidance instructions, to place the components he wanted on the hub and where he wanted them. The design ended up with a clean design containing:

- 1 Power button, to turn on the hub. The button should have built in LED.
- 1 emergency button (powers off everything).
- 1 on/off switch for each module (position switch).
- 2 indication LED for each module (green on = module is powered on. Red on = module is powered off).
- A 230VAC plug is placed on the front to connect: light, phone-chargers or similar.

To get access to the front panel of the hub, a locker have to be opened with a key, to protect fiddle-fingers. The emergency button is of cause operational all the time and the locker doesn't need to be opened to use the system. When finishing his idea about the front panel of the hub, Jan was introduced to another solution, which worked as a prototype of the finish product. Jan was asked to go through some tasks:

- Turn on the hub.
- Connect a module.
- Turn on the connected module.
- Identify an error on a module.
- Repair the module.
- Shut down the system.

The general impression from Jan was positive, but some of the functions on the interface were unnecessary as he will primarily use a PC to check the status of the different devices (on the web interface). The placement and method of connecting new devices was fine and the same with turning on and off the hub. Instead of the pushbuttons on the prototype, as mentioned, he wanted position switches. The indication of every module was fine, but unnecessary indicators should be removed.

3.3 First usability tests - Theis

In the first usability test, the power point was used as a demonstration prototype of the web page. There was two sessions, one with Rene and one with Jan as the web customer and the full system customer. A camera was used to record the actions on the screen, and another to record the face expressions. In the sessions Rene and Jan had the opportunity to explore the interface with the power point prototype. The goal of this test was most of all to show the design, and then get some reactions and feedback. There was no specific tasks that the users should do, so this was not completely a usability test. Both Rene and Jan were positively surprised, but they had also a lots of changes they would like to have on the final page.

Rene would like:

- Identify modules - Give an ID for each modules so they can be identified easily

- Warnings - Optimise warning status for a more intuitive experience (maybe change background of the icon)
- Graphs - Make the graphs full screen when click on
- Permissions - User without log in should be allow to see everything but not change it
- Status - Make vertical bar more intuitive, add colour scheme to it (red, yellow, green)
- Update - The data should update every 5 to 10 seconds

Jan would like:

- Font size - Make bigger data text
- Explanation for graphs - Make a small explanation for what the graphs shows
- Graphs - Make the graphs full screen when click on
- Energy for storage device - Show the energy for storage modules for comparing with other modules
- Start/Stop - The start and stop function for the modules did not work intuitive for him
- Not exciting - The page was a bit boring

In the development of the final web page, with all the PHP and dynamic integration, all suggestion from the two sessions will be considered. Identifying the modules will be taken care of with the PHP, so when you click the wind turbine and there is more than one of them, every module will be shown with there ID so the user easily can figure out what module he wants to look at.
The warnings should be more visible, Rene suggested to maybe change the background color of the module when there is an error. This observation got supported very well in the session with Jan, he did not notice that there was an error on one of the batteries, warnings will be made more visible on the final page, and maybe use the suggestion from Rene with the background color.
Both Jan and Rene wanted to make the graphs full screen when they click on them, this will also be implemented in the final page, maybe with a page where the user can change settings for the graphs and see explanation for what the graph shows.
The permissions for users without log in, is already implemented in the HTML page, so it is possible to see everything on the page without having to log in, but for the possibility to change things you have to log in, this will be made on the final page.
They both wanted more data on the modules, and comparison options between the modules, and the specification of the modules, this will be implemented on the final page, when it is possible to get all data through PHP implementation.
Rene wanted the data to update every 5 to 10 seconds, this would be waste of resources if no one is looking at the web interface, to optimize this, the web interface would check if anyone is using the page, if someone is using it the data will be updated from the log every 5 - 10 seconds.
Jan said that the font was a bit small, this will be helped so it is easy to change the text size on the page.
Jan also said that the page was not exciting, and suggested to use more colors. Probably it is because the page is static. On the final page there will be used java scripting to make effect and animation on the page, this will help on the excitement for the web site.
Jan did not think our start and stop bottoms was intuitive, because of the colors and there was no clearly status indication of the single module, this will be made with a status box for each module clearly showing the status of the module.
Feedback was given on the design from the two sessions, and the plan is to implement all of them in a way so it will fulfil the feedback from Rene and Jan. There were only small changes they though would help the user experience. This is why it is a good idea with user sessions. A better understanding of the user needs and certain suggestion to changes that will hopefully make the interface better. It also makes it easy to implement because the exact needs are known.

3.4 Second usability tests - Paulo

In this usability test, persons with different interests and knowledges were selected. Different feedback can be acquired from such tests, such as: user experience and how persons with different backgrounds interact with the interface.

Two different categories where selected to this usability test:

- 1 Person directly involved on the project.
- 4 Persons with no involvement, or overview over the project.

The evaluation will be made on the performance, accuracy and emotional response while the user is interacting with the system, the sessions were recorded for later analysis.

In the performance, the system will be evaluated in how much time and how many steps it takes before the user finishes simple tasks. Accuracy is determine by the number of mistakes the user does before finishing each task, in emotional response the users actions, thoughts about the system and what feelings they got when fulfilling all tasks will be considered.

5 simple tasks were asked for the users:

- Unlock the system.
- View photovoltaic average power production.
- See the current power production on the energy hub.
- Find the current status on the battery module.
- Lock the system.

3.4.1 Setting the Scene - Paulo

Setting up a usability test requires the creation of a real scenario (hi-fidelity prototype), in this case a real webpage. The user could navigate in the system and since everything was recorded, data can be extracted later on, without compromising any of the user thoughts when interacting with the web interface.

The aim of this usability test is to observe how users interact with the navigation in a realistic way, so developers can understand problematic areas in the design and be able to improve the interface.

This usability test was performed with students from AU-Herning, with and without any knowledge for the system. The use of a laptop with the web interface running on a web browser and the use of a mouse or trackpad. The sessions were recorded, with authorisation from the user, this was performed by the front camera and screen capture, in this manner the reactions from the users could be recorded while interacting with the system.

3.4.2 Testing and results - Paulo

The results of the usability tests are shown below:

Task	Time	Steps	Mistakes
Unlock the system	20s	5	1
Photovoltaic avr. pwr. production	10s	1	0
Energy hub current production	7s	1	0
Current status battery module	6s	1	0
Lock the system	2s	1	0

Table 3.1: Person directly involved on the project. Usability Test #1

The first user, was a person directly involved on the green energy system. The system worked as expected for the user, he was able to complete the task easily and without any troubles, some functionalities should be improved/implemented:
- Unlocking the system, it requires a click on the 'OK' button to submit the credentials. May be useful to implement a key press 'enter' to submit the user and password, since this is how most users are used to work on the internet and different OS's.
- A small explanation of "Savings" icons on the front will be implemented, the user tried to click on them to get more information, without any success.

Task	Time	Steps	Mistakes
Unlock the system	20s	4	0
Photovoltaic avr. pwr. production	22s	1	1
Energy hub current production	16s	3	2
Current status battery module	7s	1	0
Lock the system	4s	1	0

Table 3.2: Persons with no involvement, or overview over the project. Usability Test #2

In this usability test, a person with no knowledge about energy or any overview of the project, was selected. This can be compared to the High School students that will see the system for the first time.

Some improvements from this test are:
- When the user was asked to see the solar panel (photovoltaic) average production, there were difficulties to associate the icon to the name of it.
- The user have many troubles to identify the energy hub icon in the bottom menu, this will be improved so the navigation in the system would be easier.

Task	Time	Steps	Mistakes
Unlock the system	22s	4	0
Photovoltaic avr. pwr. production	9s	1	0
Energy hub current production	16s	1	0
Current status battery module	5s	1	0
Lock the system	6s	1	0

Table 3.3: Persons with no involvement, or overview over the project. Usability Test #3

A person with no knowledge about energy or any overview over the project was selected. From this usability, the user have difficulty in finding the energy hub on the bottom menu, this can be a big issue in the navigation of the system.

Task	Time	Steps	Mistakes
Unlock the system	21s	4	0
Photovoltaic avr. pwr. production	11s	1	0
Energy hub current production	13s	1	0
Current status battery module	5s	1	0
Lock the system	4s	1	0

Table 3.4: Persons with no involvement, or overview over the project. Usability Test #4

In this usability test the association between the names and the icons is hard to understand for the user. This will be improved, since the user experience and navigation are being affected.

Task	Time	Steps	Mistakes
Unlock the system	38s	4	0
Photovoltaic avr. pwr. production	4s	1	0
Energy hub current production	41s	5	4
Current status battery module	4s	1	0
Lock the system	3s	1	0

Table 3.5: Persons with no involvement, or overview over the project. Usability Test #5

The user feels confused when asked to perform the first task, the amount of icons on the front screen makes it confusing, since the user does not now which ones are selectable. The energy hub icon is not associated with its name, making the user getting lost in the navigation, this could be avoid having a short name of the module on mouse over.

Figure 3.6: Apple solution

3.4.3 Usability Tests Analysis - Paulo

The performance and accuracy retrieved by the usability tests are show below:

Task	Performance	Accuracy
Unlock the system	24.2s	9
Photovoltaic avr. pwr. production	11.2s	9
Energy hub current production	18.6s	6
Current status battery module	5.4s	10
Lock the system	3.8s	10

Table 3.6: Accuracy (10 - High accuracy, 0- Low accuracy) and Performance (time average in seconds per task), data retrieved by the usability tests.

Task #1: to unlock the system the user has to type the user name and password on two text fields, this was performed without any difficulty and the time was similar in the first 4 tests, just one user had more difficulties to find the unlock icon, since it was confusing all the icons on the front page. The key 'enter', would be a good implementation since it is used by many users in the tests.

Task #2: when users were asked to see the solar panel (photovoltaic) average production, there were difficulties to associate the icon to the module name. A label with the name of the module will be useful to guide to the right module.

Task #3: this task was the most problematic for all the users without any knowledge about the energy system. In this task the accuracy drops to 6, this reflects the higher difficulty in this task for most of the users. This can be improved by writing labels with the name next to the icon of the module.

Task #4: there were no difficulties with this task, all users could easily associate the battery icon with his name. This was perfumed with 10 of accuracy.

Task #5: there were no difficulties with this task, it was performed by all users with success.

Usability tests at this initial phase of the project were the most useful feedback, since a navigation, as developers were easy to understand and follow, for users was confusing and sometimes even problematic.

Further improvements are going to be implemented to the web interface, so the users would be able to interact with the system easily and without any problems.

- Further implementation on navigation system:
  1. Implement a key press 'enter' to submit the credentials.
  2. A small explanation of "Savings" on front page will help the user experience.
  3. The amount of icons in the front screen makes it confusing since the user doesn't now which ones are selectable.
  4. A label with the name of the module will be implemented to guide the user.

Usability tests are going to be performed in next phases of the project, since the goal of the web interface is the user and the interaction with the system. In further usability tests, high school student may be invited, since they are focus group of users that will use the web interface.

3.5 Drama - Theis

A drama play is a good tool for engaging a user as co designer in a project. It is always useful to involve the user in development of the product, because they will be using the final product and can easily help with designing the product. This can be accomplished with a drama play, on this way the user is involved, it is easier for the user to understand how the technologies works, and how the product would work. It is also thoughtful for the designer because designers do not just develop a product, but also a new work station. The user knows the work practices, he can imagine how he would use it, and access changes. A drama play do not require big acting potential, it is a basic performance, to show the user how it works, and the designer how the user wants to use it. The goal of a drama session is not to entertain but to clarify how it all would be used.

3.5.1 The protocol - Dennis

All 'E-teachers' and the three web-costumers were invited to come by and witness a drama session, showing the data handling in the energy system. The session was made to clarify how the protocol in the system is going to work and find possible leaks in it.

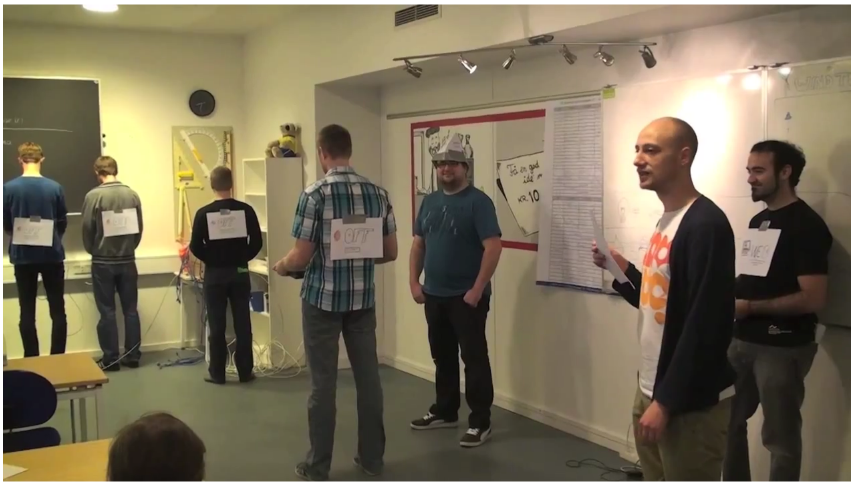
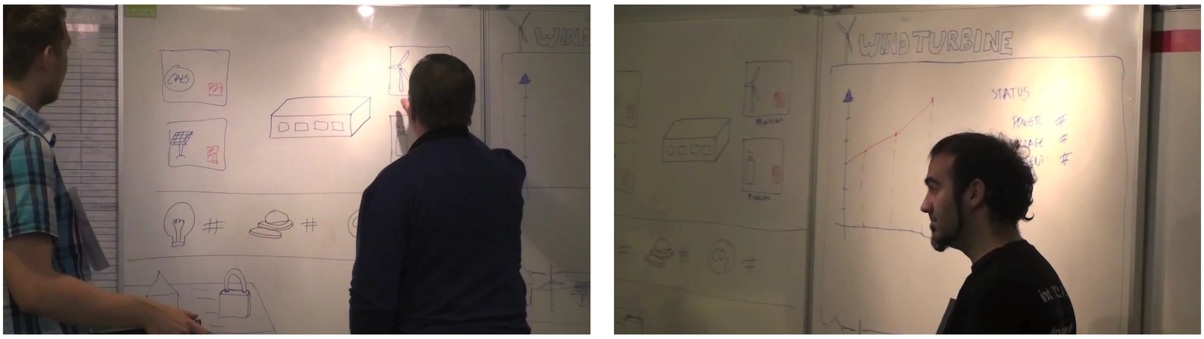


Figure 3.7: The drama session setup

The session was divided in three scenes:

- Scene 1:
  1. Power on the hub.
  2. Connect two modules to the hub.
  3. Power on the modules on the hub.
  4. Start the modules on the web-interface.
- Scene 2:
  1. Go to the wind-turbine page on the web-interface.
  2. Watch the graph being updated.
- Scene 3:
  1. Watch what is happening if two modules sends at the same time.

A random person was selected from the audience (teacher Klaus Kolle) who was then supposed to go through the above mentioned steps.

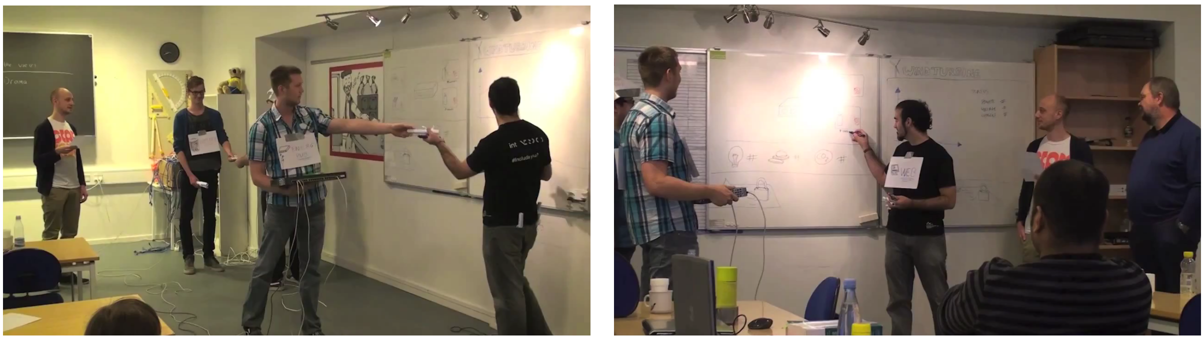


(a) Web interaction (b) Web interface

Figure 3.8: Person interacting with the web interface

A video from the drama session can be found on the wiki (find link in the introduction section).

After the session, the audience was asked to give feedback. A few mistakes were found in the protocol, such as: non-defined timeout period (the amount of data delivery tries before it is seen as an error), how often data is sent, acknowledge bit check on the ethernet connection to the server and an undefined size of the data sent from the modules.



(a) Data sent from hub to web (b) Web updated

Figure 3.9: Data sent to web interface

As all 7 groups in the EDE10 class are part of one system, it was obvious to have one drama session with participants from all groups. The session turned out surprisingly well, especially because of the attendance from the Web-customers and the teachers who where able to see how the system works on an early stage of the developing the protocol that had not been thought about. These inputs will hopefully decrease the amount of protocol versions it takes to reach the final one.

Chapter 4

Process description

This chapter describes the design process of both the physical and the web interface. A brief description of all the steps taken from scratch until a final prototype for the user.

4.1 Physical Interface - Paulo

In a user centred interaction design, the needs and desires of the user that is going to interact with the system are important information for a user focus design process.

Meeting with the user at first clarifies the project, and the developers can be introduced to the user desires and needs in a physical interface. After the meeting, the input from the user is analysed, and having the user needs in mind, a hi-fidelity physical interface is build using rapid prototype tools, such as the mBed, prototype housing and low cost components. With the use of a participatory design, the user is able to design, with the developers help, the physical interface that meet his needs. This was a great design tool to use, since the design made by the user was completely different from the prototyped.

Participatory design don't only allow the design product to be exactly the user needs, but it can 'save' time in the product design. In this case a prototype was build that developers expected to be the user needs, but simple to interact interface was expected by the user.

Physical components such as switch, lcd, LEDs, etc. were printed and cut, this allowed the user to arranged different components on the front panel of a prototype housing. Developers were asking information from the user and helping with the design process. In the end a low-fidelity physical interface was generated and discussed with the user.

Further in this project, using the feedback from the participatory design, a hi-fidelity prototype of the physical interface is going to be build using the rapid prototype tools, so a usability test can be performed with the only user of the physical interface.

4.2 Web Interface - Paulo

In the web interface, developers have different types of target users, and clients who desires and needs differ due to them different background and expectations.

With a overall concept of the Energy Hub project in mind, a meeting with Rene was arranged, so his requirements could be clear. The feedback from this meeting was analysed and a web page layout was created having on focus the user requirements and the target user group. The design was inspired from Apple products, as they give a good user experience and are easy understandable.

Since this would be a web interface used by all the teams, a preview was presented to the teams and different changes were performed on the layout design, until a final design was accepted from all teams.

A mid-fidelity prototype was made using powerpoint and linking slides. This would give the user a overview of the navigation and system information.

Two feedback session were arranged with the user and client, their feedback was used to perform changes on the layout so it could meet their expectations and needs.

In general the web-client (Rene) liked the interface layout for its easy interaction and user experience, but the data was confusing, this will be improved according to the feedback acquired.

For the user (Jan) the colors used were boring and the interaction with the system was not intuitive. This feedback will be taken be kept in mind when improving the system, since Jan is the first user of the system.

Usability test were performed on different users with no involvement or overview of the project, this feedback is going to be a great help to improve the system, since High School students with no overview of the projects are the secondary users of the system.

Further in this project, all the feedback will be evaluated and a hi-fidelity prototype of the fully functional interface will be developed and usability tests are going to be perform on the web interface.

4.3 Overall Understanding of the System - Paulo

To give an overall understanding of the system communication and how it will work, a drama session was performed, where students from the class were the system modules, hub and web server.

The drama session gave a overview of the system, it was useful to understand faults in the system, so they can be further corrected and the system communication improved.

3 different scenes were created and performed:

- Scene 1: Hub and modules connection and startup.
- Scene 2: Communication Hub<->Modules, Hub<->Webserver.
- Scene 3: Data collision and handling.

In each of this scenes a real live communication and system functionalities were performed. Further corrections will be performed on the system according to the feedback acquired in this drama session.

Chapter 5

Conclusion

Written by All

A participatory design is most useful when developing a interface for only one user, since this user desires and toughs can be completely different from others. This method decreases the time of design, since the developers do not have to develop several prototypes until it meets the user needs. Instead the user is a co-designer, integrated as a developer and asked to design him self the layout/interface that is going to be implemented.

Usability tests are a useful and powerful tool in interaction design. A must in all projects that involves an user or an user-group. This gives a great feedback on what is not intuitive as expected. Different types of user knowledges have to be selected to have the most reliable feedback, keeping always in mind the target group or user that is going to interact with the system.

Before this introduction course to Interaction Design, our team was a little sceptic about it. The first thought was that it would be time consuming and would slow down the development of our system, without giving any useful feedback.

By doing the exercises proposed in the course, interaction design became a great tool on user focus development, since it eliminated the faults and misunderstandings between what was understood as user needs and what really was needed.

Interaction design was very useful to the project in this early phase. At first the development of a high fidelity prototype of the hubs physical interface was created. With this high fidelity prototype, we thought it would be easier to get the acceptance from the user, however this was not the case. As explained in the report, a participatory design session was scheduled, and we experienced, that it can be very hard to define the user needs.

The entire design process has been useful and it have been possible to develop a static web interface for the hub. Tests have shown improvements to be made and with the help of a participatory design session, a layout of the physical interface with the exact user needs was created for further development.

Chapter 6

Appendix

6.1 Videos

Participatory Design, Drama session and usability tests can be found on the cd as well as on the wiki: http://e10.ede.hih.au.dk/index.php/Videos

6.2 Project Description

http://teachers.ede.hih.au.dk/index.php/EPRO_3_%26_4_-_Renewable_Energy_Systems

6.3 Literature

Interaction Design Beyond Human Computer Interaction