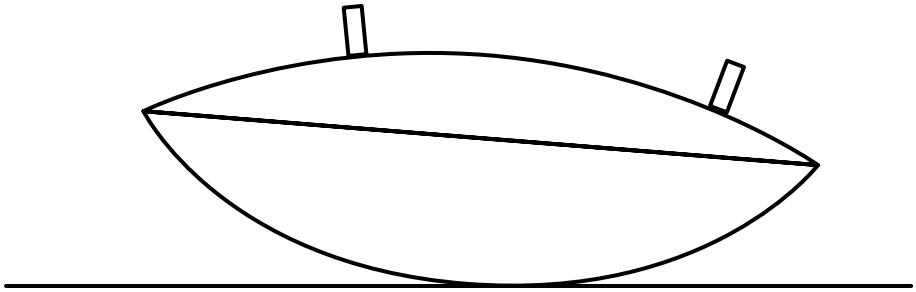
hueFO

A multi-user control interface for the Philips HUE.



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Contents

Acknowledgment

We would like to thank Michael Cruz Restrepo for his guidance throughout this project.

1. Introduction

Imagine a room full of people in groups and people sitting individually. Everyone is doing something different, and therefore requires a different lighting setting. The Phillips HUE lighting system is a good way to give people choice over their lights, but the system only allows one person to control all the lights. But when everyone requires a different light setting, how do we decide who gets control, and what the setting is?

The hueFO aims to solve this challenge, by having an interface which is can be controlled by everybody in the room, and can thus create a compromised light setting. Each pin corresponds to a particular light in the room, and is placed on the surface of the hueFO thus turning that light the color temperature and brightness set on the hueFO. This gives a lot of flexibility over the lights to the users, and because the interface is physical rather than digital, all users in the room can have influence of the lights and contribute their desired setting.

However, the hueFO is a hybrid control system. It gives the majority of control to the user, but the system also controls particular aspects of the lit

Fig. 1.1 hueFO Prototype

Fig. 1.2 'Breakout' Room Model

environment in particular scenarios to trigger social interaction. Strategically placed microphones monitor sound levels in the room, and this information is used to momentarily change the color of lights in order to give users a warning about the presence of other users, or simply the brightness of the lights in order to regulate the sound levels in the room. Upon entering the room, the system can also trigger particular lights in order to encourage users to interact with each other instead of sitting separately. Some of these scenarios can be seen in Fig. 1.3.

The hueFO is not only a system where users have control over all aspects of the lights, but it is also a system where the lights are used to encourage and trigger social interaction users to communicate and socialize with each other.

The hueFO is meant to be a smart multi user interaction interface for Philips HUE lights, by giving control to all the users, rather than restricting control to an individual user. The system simultaneously also encourages users to interact with each other, thus enforcing the relaxed purpose of the context for the hueFO, the Breakout Room.

Fig. 1.3 System Control of Lights

Fig. 1.4 hueFO Prototype

2. Objective

The goal of this project was to design a multi-user control interface for the Philips HUE lighting system, within the context of the 'Breakout' room. The Breakout room is a space within the current LTSM theme space in Laplace, TU/e, which is used as a break room, and casual meeting place. The space is regularly used by students, and often for different tasks at the same time.

One of the main aspects of this project was to design an interaction and control interface that is multi-user and allow many users to control the Philips HUE, instead of only one person controlling it.

The Philips Hue is a revolutionary way to enjoy the lighting systems in your house. A standard Philips Hue installation is not too different from a regular lamp, apart from the light bulb consisting of multi-color RGB LED lamps instead of a single color bulb. This allows the user to have access to 16 million colors[1], which can be controlled by a mobile application on any smartphone.

The main problem with the controls of this system is that it feels very clunky. Since the system is entirely controlled through an app, it's very hard to find any intuitive interaction. The controls for color are small, difficult to position on the color gradient, and there are many screens to jump between in order to get full control of the HUE lamps.

This problem gets even worse when multiple people try to access the lamps at the same time. The network is not only pretty weak, but there is no real solution for multiple inputs at the same time from multiple users.

In any context of use, not only within the TU/e Breakout room, it is immensely difficult for more than one user to control Philips HUE lights through the mobile application. Therefore, there is need for a more intuitive, multi-user interface.

Fig. 2.1 Philips HUE Mobile App

1 Philips, Technical Specifications, http://www.philips.nl/c-p/8718291241737/hue-persoonlijke-draadloze-verlichting/specificaties, 2015

3. Design

This section describes the overall process that was followed in designing the hueFO, from initial ideas to concept development.
In addition, we describe the main design challenges that we faced during this project, and how we solved them.

3.1 Idea Generation

The ideas outlined below show the main, promising ideas that we developed in the first few weeks of the project. They do not portray our entire brainstorming process, but simply the best ideas that resulted from it.

At the kick-off for the project, we started with a 'Quick and Dirty Prototyping' workshop where the aim was to create objects using rough and reusable materials.

We each created one object. Most interesting, were the 'spider' and 'torch.' The spider represents a balanced object. Each foot would represent an input for the user, once you change its position (height), it will lose balance and fall over (resemblance to our final concept*). This way, users would need to work together to mutually agree on a light setting.
The torch concept made use of pieces of coloured paper which are put piece in the torch, the colour of the lighting would change to that specific colour. Different colours can be added by different users t change the lights. In this way the emphasis on multi-user input was strong. We wanted a physical object as an input for a non-physical output (light).

After a lot of brainstorming we had several interfaces which we thought showed promise. The cylindrical disk prototype which made use of disks that you could place on the right or the left side of the central object, and by turning them, you could adjust the brightness of the lamps. In this way the users could set their own light preferences. The problem with this and several of our other ideas was that they average the inputs of the users. This means that no user gets the light condition he/she wants and therefore there is no agreement over the final light conditions.

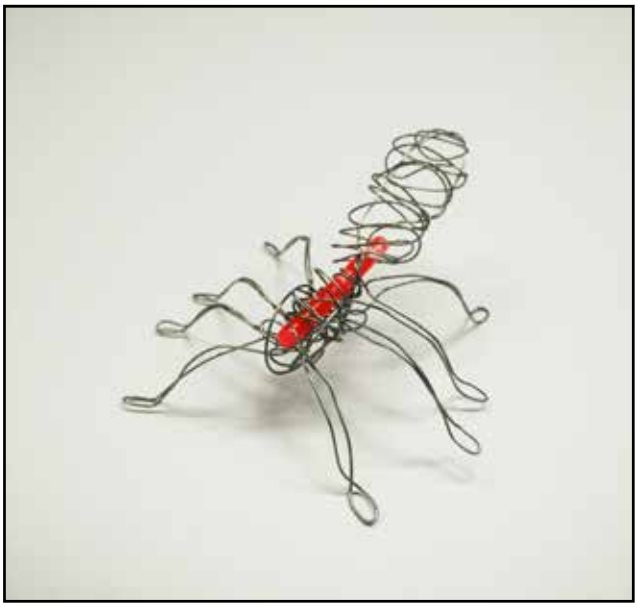

Fig. 3.1 'Spider'

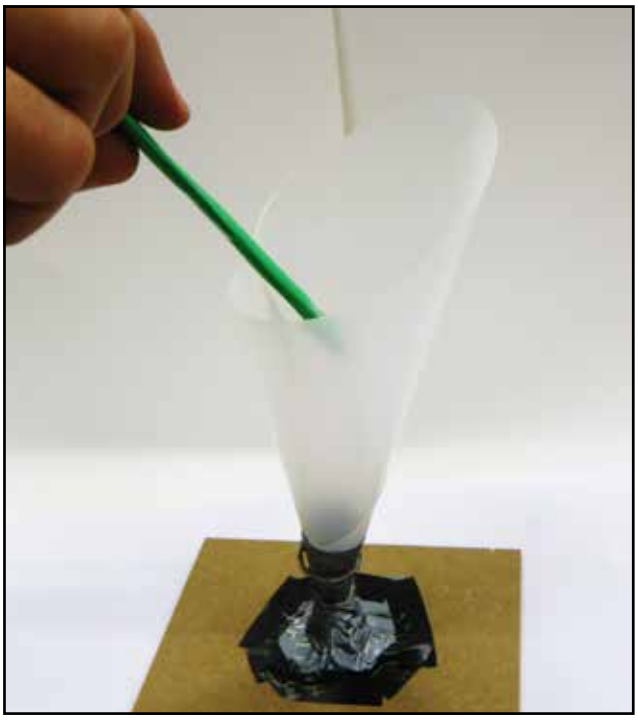

Fig. 3.2 'Torch'

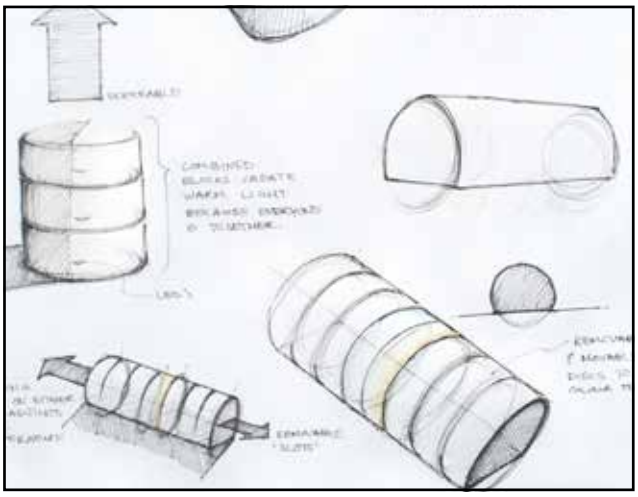

Fig. 3.3 'Disk'

3.2 hueFO Concept Development

The ideation phase led to several ideas, but none of them truly fulfilled the requirements we had set for the control interface (see chapter 5.2). The ideas that followed, were much more focused on achieving these guidelines. This lead to the initial idea of the hueFO, and below we outline its development.

We settled for an object that would function with the use of one central hub and multiple smaller objects that can be put on the surface of the central object to manipulate the light. This concept is based on visual transparency. Because it is a physical object, the users instantly see what the others want. This is something we strived for, as the current controls for the Philips hue are pretty poor at providing this.

To help expand this concept we made sketches, and soon found that the object would look best if it was a rounded shape. We decided to pursue an ellipsoid shape out of two distinct parts, a top and a bottom. We found that the bottom part would have to be bigger to create a balanced design. After some iterations of these sketches we decided to make a 3D model out of MDF.

We also made wooden pins, shaped like a cylinder to control the interface. We noticed that with this MDF model, it was hard to get it to lean properly. It's possible that if we had used heavier pins, it would work, but since these pins were already a good weight according to us, we did not want to change this. In the end we decided to alter the model, we replaced the top part with StyroDur instead of MDF. This is the model we presented in the Mid-Term Demo Day. This model did not have a coloured top yet, as the purpose of this model was to get the general impression of the concept, and to experiment with the interaction it afforded.

Something we considered is to mount a moveable weight in the inside of the object that moves to the side where there are more pins, to aid the object in tilting to the favoured side, but we decided to drop this idea because we thought it would be too complex for us to handle properly.

Instead, we decided to make the main object lighter. To do this, we made plastic moulds of the MDF models we had made earlier in the Vertigo building. Since this is a technique none of us had utilised before it took a few tries to get it right. We wanted the

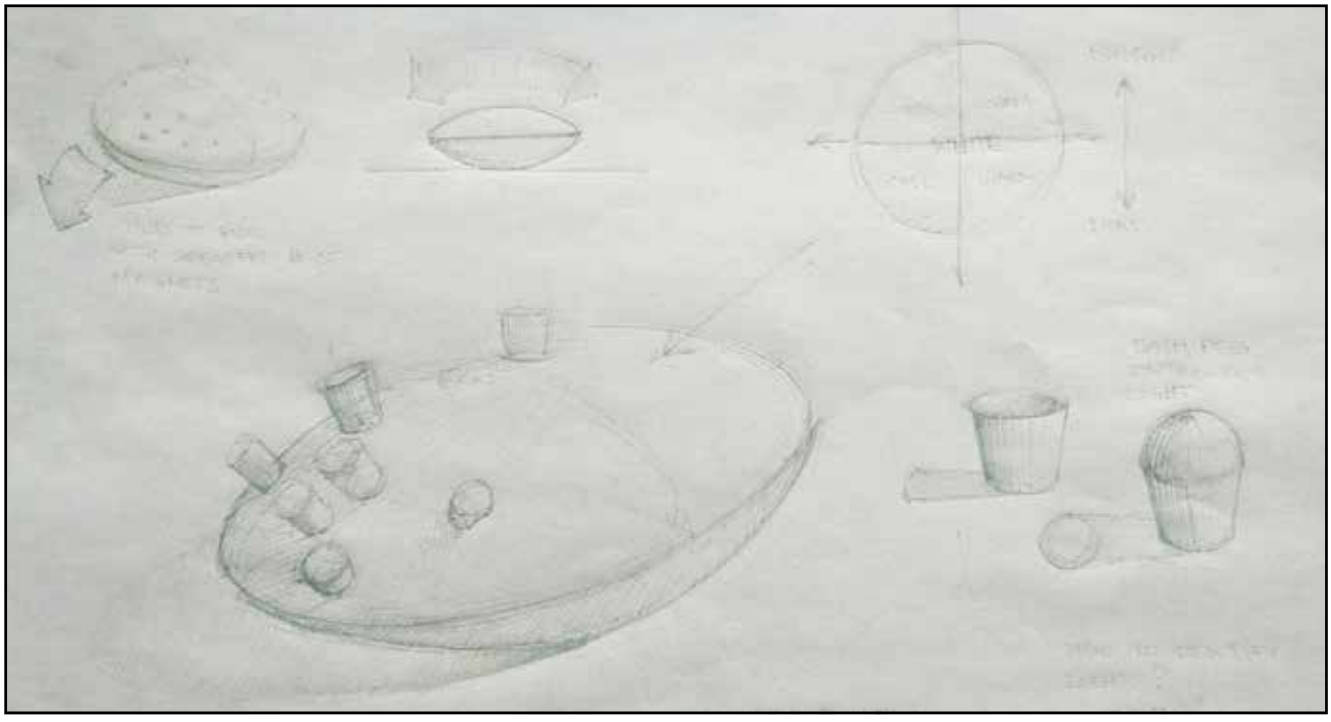

Fig. 3.4 Early hueFO Sketch

Fig. 3.5 Early hueFO Model

top part to have a colour temperature gradient and the bottom to be a neutral white colour.
While spray painting the temperature gradient on the inside of the top part, we figured out a way to get the pins to stick to the ellipsoid; we wanted to use magnets. After some layers of spray paint we used some layers of black, magnetic paint, which faded the colours. This made us redo the process, which in the end gave us a better prototype.

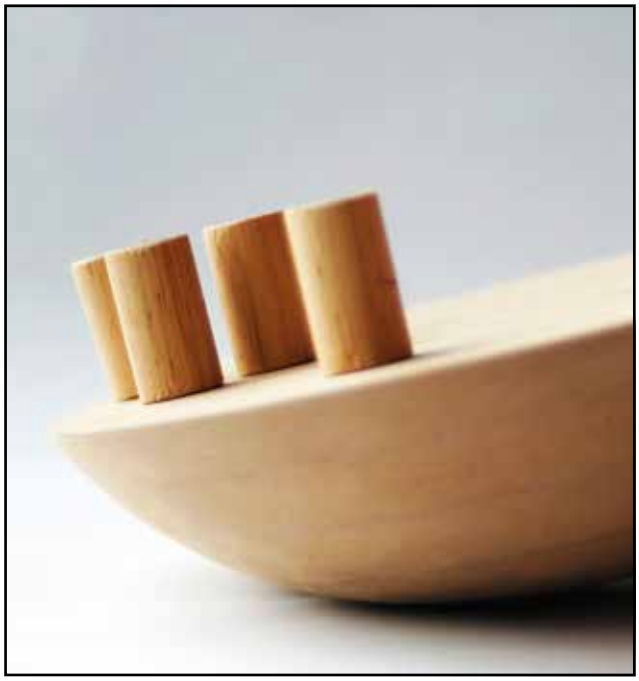

Fig. 3.6 Early hueFO Model

Fig. 3.7 Final hueFO Prototype

3.3 Design Problems and Solutions

Representation of Pins

Perhaps the biggest design challenge that we faced during this project was how to make users aware of which pin corresponds to which light in the room. It was important for us to find out what would be the best way to create a representation that the users would understand.
Initially, we considered representing the lights in the shape of the pins. By creating pins that looked like the lights themselves, it would be immediately obvious which pin would control a specific light. This solution was far from ideal for a number of reasons. Firstly, it would completely ruin the simplistic visual style that we were creating for the hueFO, but more importantly, we did not want to transform the device into a miniature model of the Breakout room, and by creating pins in the form of lamps, all users would create this unwanted representation.

Another approach that we took, was simply having an icon or colour on each pin, that was repeated on the corresponding lamp. We tested this solution with users, by colouring the pins, and putting corresponding colors on the lamps. During the user test however, we noticed that users paid no attention to the colours, and instead figured out the representation through trial and error, which when they were interviewed said it was faster and easier. With this in mind, we experimented with creating a slow pulsing whenever a pin was lifted from the surface of the hueFO in order to show the users which light that pin will control. In addition, trail and error gave a sense of playfulness and experimentation which the users found more exciting than having labels on the pins themselves.

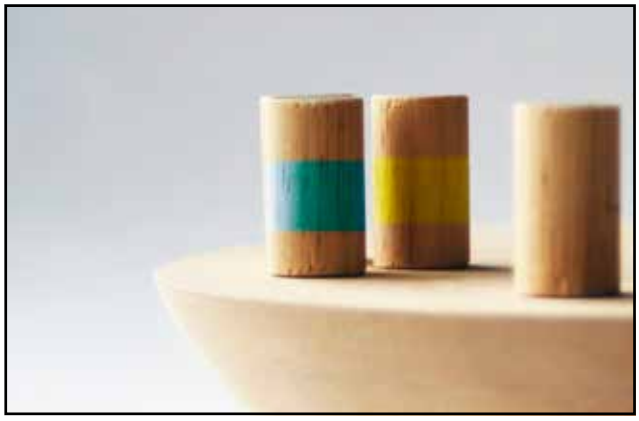

Fig. 3.8 hueFO Pin Labeling

System Intervention

Having hybrid control with the hueFO allows the system to be able to influence the lights in certain situations in order to create a certain moment of interaction between users in the room.

We faced a major difficulty during this project where we did not want the influence of the system to be very strong, because we did not want users to feel controlled and suppressed by the system. In the beginning of the project, we focused on finding out how people interact with each other when they enter a room and from that we tried to see how the system can enhance those experiences or facilitate them when they are not so strong.

In order to keep the influence of the system as minimal and discrete as possible, we decided that it will only have influence over the lights in a few very specific scenarios. These scenarios are mainly when there is a change in social dynamics in the room, for example when someone enters.

In addition, we designed the changes that the system makes to the lights to be subtle and smooth transitions in as many cases as possible. By having smooth and subtle transitions, users will not feel that a certain change is being forced upon them, and in some scenarios, they may not even consciously notice the changes.

Multi-user Inputs and Outputs

At the start of this project, we considered multiple ways of dealing with multi-user inputs for the lighting settings. Generally, we felt there were three ways of dealing with multi-user inputs.

1. Averaging of inputs
2. Ignoring inputs through ranking
3. Compromising between inputs

An obvious and easy solution to dealing with multi-user inputs is averaging all of the inputs. Initially, this seems to be the fairest way to accommodate everyone's wishes for a light setting. However, this method of creating an output has several major issues. Firstly, averaging everyone's input settings results in a final setting which no one is happy with, since nobody is getting the setting that they initially wanted. Secondly, when dealing with light, averaging colors or color temperatures does not result in a new color, but it results in white light. Therefore, if the output was made to be an average of the inputs, the majority of the time the output will likely be white light, and this would not satisfy the users' needs.

Creating a ranking was an option we briefly considered as a solution for this problem, however, we felt that it restricted too many users. If priority over the control of lights was given to the first person in the room, then everyone else in the room would need to adapt to a light setting that they do not want. This is not a multi-user interface, and therefore was not a fitting solution for our design intentions.

One of the overriding guidelines which we tried to follow throughout this project was to get users to communicate with each other in order to get to a compromised light setting. For this reason we decided to give users control over each and every light, and to make a central, physical interface which everyone can access and manipulate and users can talk to each other in order to understand each other's needs and come to a light setting which is mutually agreed on.

Use of Color

The Philips HUE system allows users to make any color with the lights in their environment. However, with the hueFO, we decided that we were going to use only color temperature in the control interface, since we did not feel that the ability to use all colour had specific added value to our device.

Through the research which is explained later in this report, we learned that unlike color, which has a different emotional effect on everyone, color temperature has very similar emotional effects on people, and therefore the results are much more predictable and manageable.

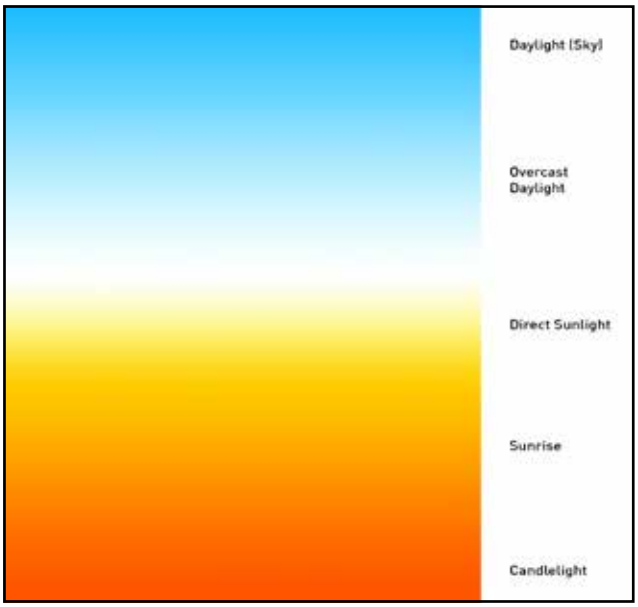

Fig. 3.9 Color Temperature Gradient

4. Technology

In this section of the report, we describe the issues and restriction we faced with the technology associated with our project. We also describe our technological goals and technical configuration for our prototype.

4.1 Issues & Restrictions

Due to the technological restrictions that we faced during this project, we were forced to make a much simpler prototype which we used as a 'proof of concept' in order to show that our concept was a viable solution to the problem. However, we spent a significant amount of time researching what kinds of technology would be included in an 'ideal' prototype and how it would work.

To be able to make this concept work properly we have looked into various types of technology. Our concept requires complex things, so after looking into technology briefly, we decided that the technology needs to fulfil these criteria:

1. It needs to be able to transmit data to the Arduino wirelessly.
2. It needs to have a gradient of values, it should not be limited to a fixed amount of settings.
3. It should be able to recognize multiple pins on the same surface.
4. It needs to be accurate at a small scale.

We concluded that we were going to need a micro-controller such as an Arduino. This fit in with our technical background, we had all worked with simple electronics in the past, and we all had some experience with the Arduino environment. In addition to this, we still needed something to sense the inputs.

Initially we had two possible solutions to the technical problems we had, but neither solved the problems well and allowed our system to perform the way we intend. These were:

1. NFC or RFID: Initially the use of NFC seemed logical as we could assign an NFC-tag for each pin, which can then be read by the hueFO to indicate which pin is at which color temperature on the surface. This would not work because NFC does not work well in a small space with many NFC tags. This phenomenon is known as tag collision[1].

2. Capacitance Sensors: We explored using capacitance sensors to locate the position of the pins. It seemed possible to create a grid with capacitance sensors which could be activated when a pin is placed on it. The problem here however was that a capacitance sensor can only detect one pin on its surface. If two pins are placed on one sensor, then one of the pins will not be activated. In addition, such a sensor will not be able to detect the position of the pin placed on it, only that it is touching.

3. A different technology we have also considered is using a grid of TRS connectors, also known as jack cables. These would provide a stable connection to the pins, and they can recognize up to four different input signals. While we recognized the positives in this type of technology, the very limited amount of recognition put us off, and made us decide to not pursue this technology any further.

Finally we came to the conclusion that we needed a simpler system. Since we have already made the colour gradient on the surface of the top, it would be unnecessary to recreate it with some other technology. Therefore we opted with camera technology which is described in the next sub-chapter.

1 Technovelgy.com, http://www.technovelgy.com/ct/Technology-Article.asp?ArtNum=57, 5/6/15

4.2 Technological Project Goals

Despite the fact that we faced difficult technological restrictions, we did research into how it would be possible to make such a system work in the way we intend it to.
The principle behind this method stems from optical styluses used in some drawing tablets. A tiny camera in the tip of the stylus uses references on a surface to pin point its position.

Implementing a similar camera on the bottom of each pin of the hueFO, the camera can simply read the color of the gradient at the point which its is placed. Inside each pin is also a small microprocessor and a bluetooth transmitter. When the camera reads the color, it is sent through the bluetooth transmitter to the Arduino microprocessor inside the hueFO body. The microprocessor inside the pin also sends the lamp number that the pin corresponds to. This way, the Arduino receives data about which pin is being moved, which lamp that corresponds to, and which color it should be.

This data is then transmitted via WIFI from the hueFO to the Philips Bridge, and from there to the Philips HUE lamps themselves. This part of the system is already implemented with the standard Philips HUE lights, and therefore is not directly part of the hueFO. An illustration of the flow of data can be seen in Fig 4.X below.

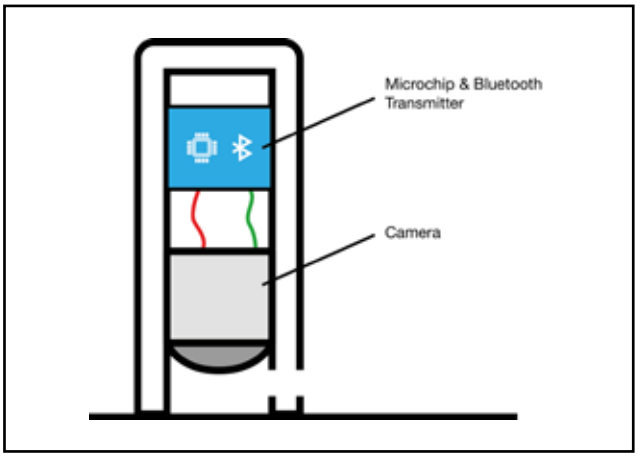

Fig. 4.1 Pin Internal Diagram

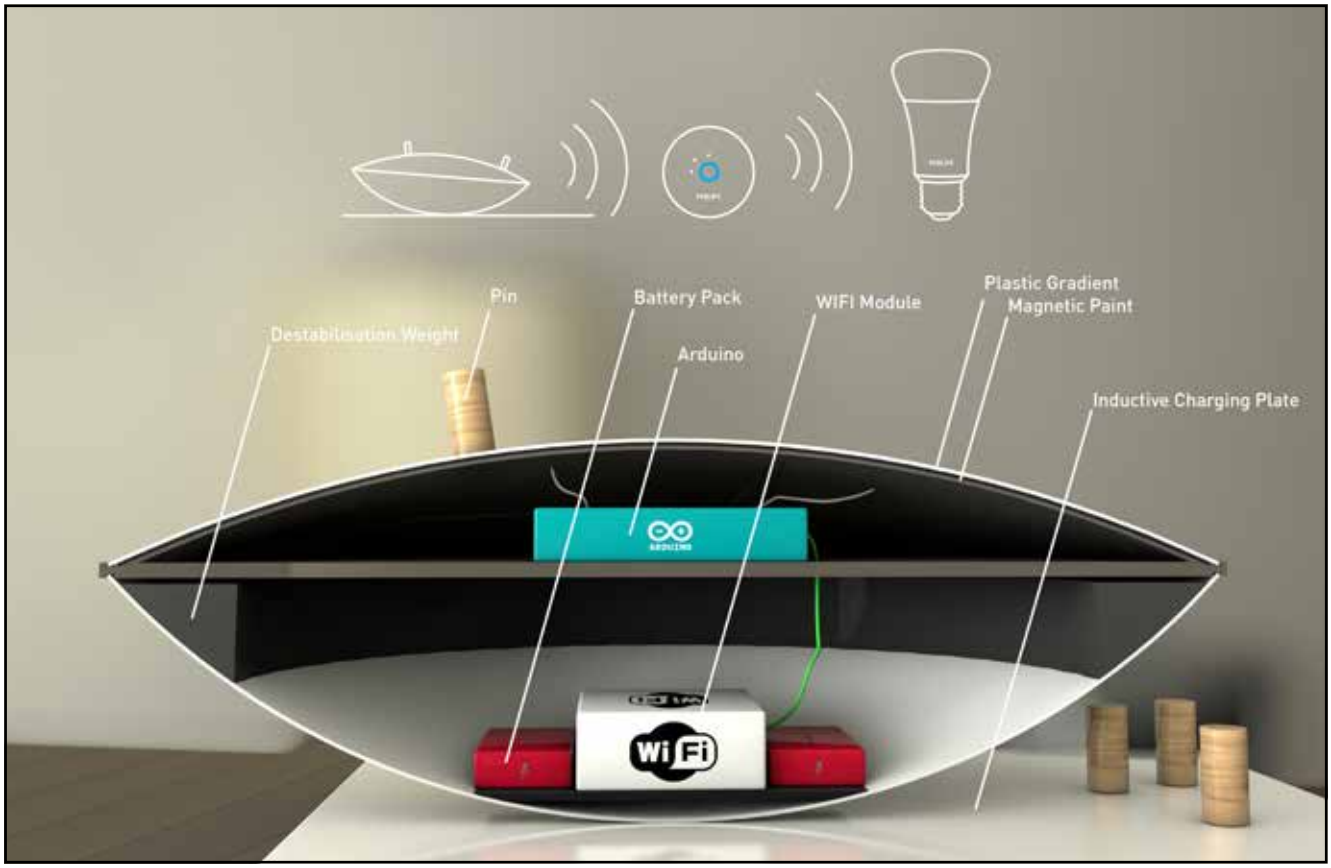

Fig. 4.2 hueFO Internal Visualization

4.3 Technical Configuration

Since we had a good vision on how the interface would look, we started to focus on the system itself. We decided to split the system into two parts. The user input and the system part. The user input is the physical interface itself, which is described in detail in chapter one.

To create our concept as a final prototype, we need several electrical components:

1. Arduino (the programmable controller)
2. Microphone modules (to detect sound levels)
3. Wifi module (for communication to the Philips hue device)
4. Micro camera's (for the pins identifying the light condition on the hueFO surface)
5. Wireless charging plate (for charging the hueFO's battery)

Since time is limited for this project, we were not able to include all of these devices in our prototype, but you can read more about this in chapter 4.2.

The following is short description of the operation of the hueFO 'proof of concept' prototype.

When the light of a certain lamp in the room needs to be changed, the user needs to find the right pin (the amount of lamps in the room is the same as the amount of pins on the hueFO). When they take off a pin, the corresponding lamp will flash one time and then turn off. Based on the position on the gradient of the hueFO, the light will change to exactly the same values (warm-cold, bright-dimmed etc).

In order to make a working model, we needed to simplify the number of possible light settings. We divided the surface in to five color spots. Each color was activated by a switch which was positioned in each spot.

On the bottom of each pin, there is a magnet which would stick to the switches, and closes the switch to complete a circuit. When the circuit is completed, the Arduino pins to which the switches are connected will receive a 5 volts, otherwise they will receive 0 volts. The setup used is shown in Fig. 4.X.

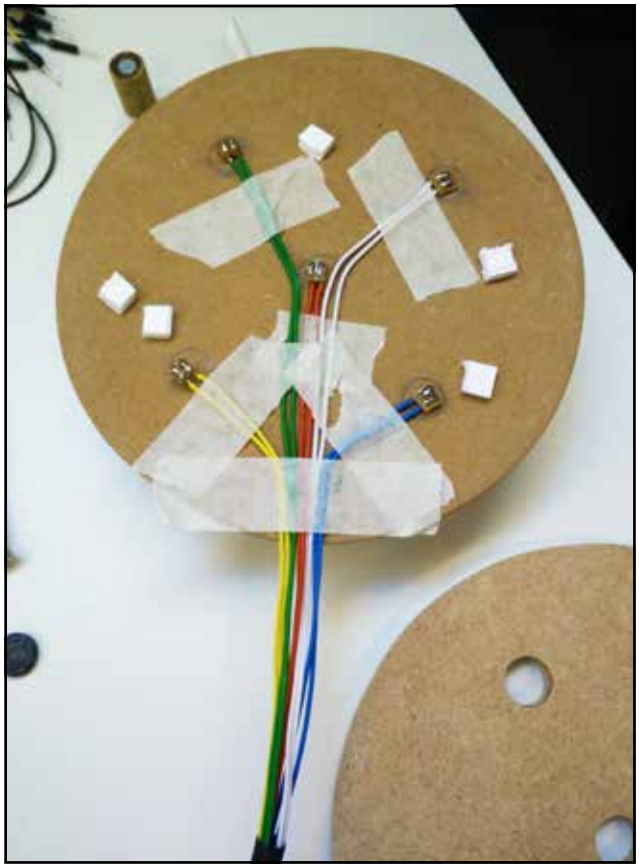

Fig. 4.3 Functional Prototype v1

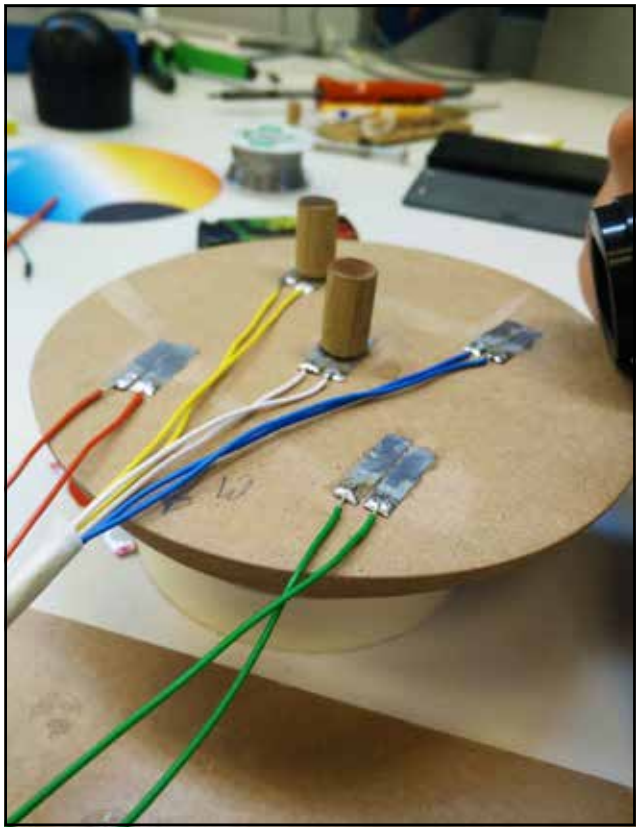

Fig. 4.4 Functional Prototype v2

Meanwhile, we connected a number of SMD RGB LED's in parallel an inserted them in the model Breakout Room which we made. By connecting them in parallel, we were able to control all of the LEDs with one pin of the hueFO.

The Arduino code that controlled the system was a series of 'if' statements which monitors the state of the pins to which the switches are connected. When the one of the switches reads a HIGH value, it is triggered to send a color value to the RGB LEDs. This is the basic principle on which our 'proof of concept' prototype functions.

We are aware that the Philips hue lights work on a wireless principle, but due to the restrictions discussed in chapter 4.1, we created this simple working prototype.

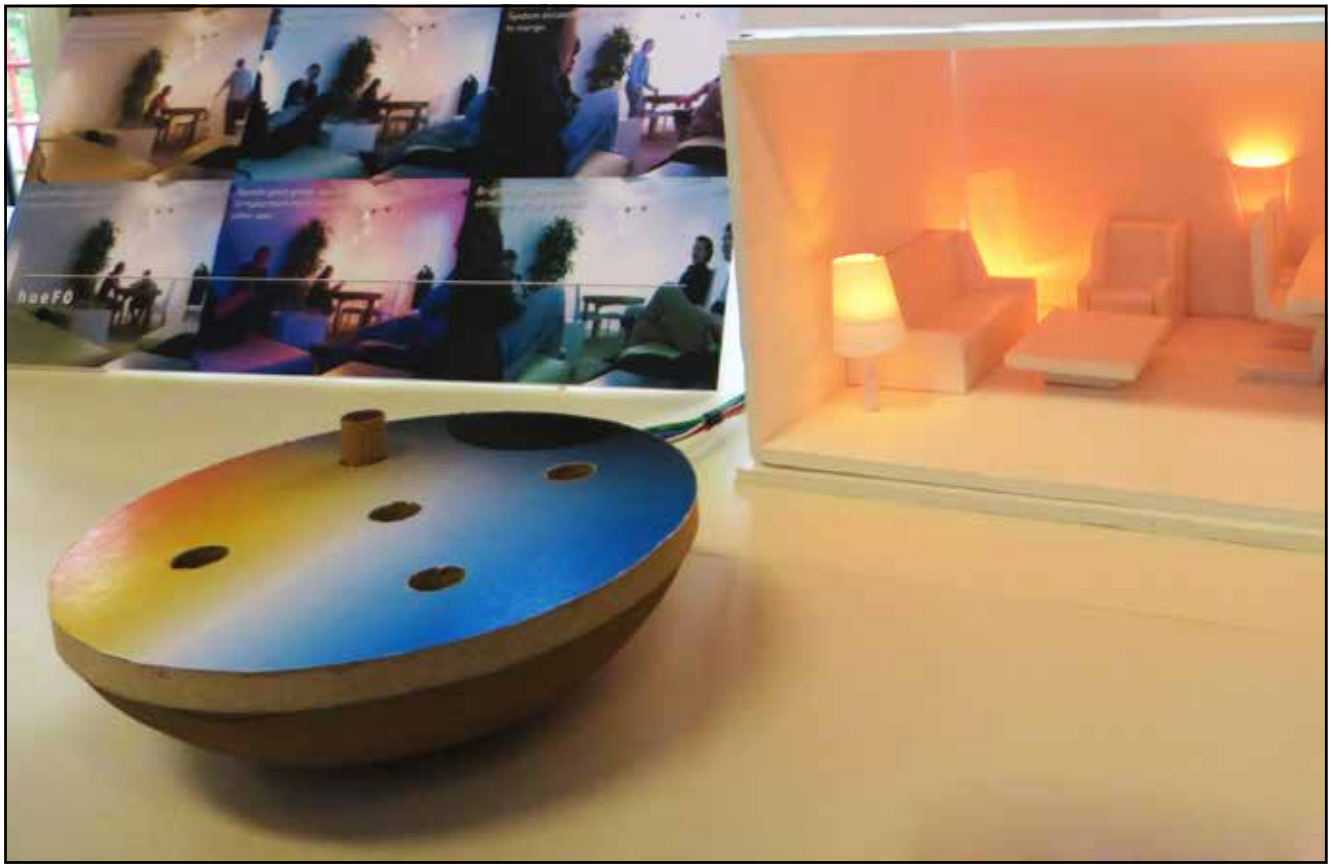

Fig. 4.5 Functional Prototype & Breakout Model

5. Users

The following sections describe the research that guided this project, and the involvement of users throughout the design process.

5.1 Project Focus

The main focus of this project was to improve the user experience of the Philips hue. We mainly tried to do this by making the interaction more intuitive, while also allowing multiple users to control it at the same time.

For this to work the product needs have a high visual transparency, other people's needs should be clearly broadcasted by the product. The user group is broad, as a Philips hue lighting system can be bought by just about any person, but the fact that our context was set as the Breakout room made this group considerably smaller: our user group consisted of mainly students and other staff members at universities.

The main group of people we wanted to do the testing with are people outside of this project. This makes them unaware of the context, which would give better, less biased results. The way we did these user tests was by inviting small groups of people in the context area (breakout room) and by having them simulate real life scenarios naturally by not explaining the purposes of the test.

By doing the user tests this way we can received a realistic view of how people view our concept, and what they thought about it. The results we wanted to achieve with this were mainly answers to some of the questions we had with during the design phases. Were the choices we made design-wise and technology-wise right? We also video taped the users tests from multiple angles to better analyse the reactions of the users after the tests, and in more detail.

After the tests we intended to ask the users questions regarding the interaction with the product which they just had. Most of these questions were about the interaction itself, not necessarily about the aesthetic design. We decided to do this because people tend to be emotionally biased in favour of us, they generally respond positive to projects because they don't want to discourage us in our project.

Based on the feedback, we assessed the interaction with the product, and decided on whether we should change it. Obviously, if we get positive feedback the need to change anything will be much lower.

Fig. 5.1 User Test Session Snapshot

5.2 Research Approach

At the start of this project, we began by reading several research papers that were relevant to designing multi-user interfaces. This made us aware of the different influences that light has on people, and how they interact with it.

From these papers, we derived guidelines that we followed throughout the project. These were:

1. Designing an interface with only color temperature will provide a more unified experience for users (as explain in chapter 3.3).

2. Users must reach a consensus for light settings, not the system. In other words, averaging the user inputs will not provide adequate results.

3. A physical interface provides opportunity for discussion between users over the light settings. This therefore reinforces guideline two.

The main research papers which we used for this process were 'Designing a light controller for a multi-user lighting environment,'[1] and 'User interaction with everyday lighting systems.'[2]

When we understood how the system should react on the different scenario's, we went to the breakout room in the LTSM space, where we conducted user tests using the method described in chapter 5.1. We came to interesting results. Since the people knew each other, they were focused on the conversation, and not too much on the test itself. When the system would give notifications (soft red or blue light appeared) they did not notice this. When we used dark red or dark blue, they noticed it.

From this experience we came to the conclusion that the system can easily be very intrusive in conversations. Only in this way people will notice it. Since our coach, Michael Cruz Restrepo, was really helpful, he noticed that the system acts like an angry "parent".

Is this really what people wanted?

We also tested the interface in the breakout room to test the interaction with the interface itself, without system intervention. Users really liked the interface and it's look. In our observation and their opinion, it seemed that we have created a quite playful and simple interface for the Philips Hue, which encourages people to interact with each-other.

We also conducted user test to investigate the representation of the pins to the lights. We tested several possibilities which are described in more detail in chapter 3.3. According to the users, they preferred not having a particular representation since it makes the interface much more playful.

These tests provided information which we used to develop our concepts further and iterate on the problems. Users played a key role in our project. They gave us neutral information and feedback to develop our concept. We always considered or integrated their suggestions.

Fig. 5.2 User Test Session Snapshot

1 Designing a light controller for a multi-user lighting environment, R. Magielse, B.J. Hengeveld, J.W. Frens, TU/e

2 User interaction with everyday lighting systems, S. A. M. Offermans, H. A. van Essen, J. H. Eggen, Springer-Verlag London 2014

6. Reflections

These sections feature the individual reflections from each of the group members for the hueFO project.

6.1 Willem Ermeling

The Light Time Space and Move space attracted my attention for a long time. I was really curious and willing to work with light. Its project called Social Lighting was the only project that I really liked, there was no other project that I preferred over this. The reason why is because of the clear tasks and technology behind light (it was not vague at all). There are endless possibilities and the Philips hue is the perfect example for this.
This project clearly illustrates the concept that we created. In order to actually create our product, a lot of work needs to be done but these are potential future plans. I really liked working with Nikola and Arthur. Discussions were not rare in our group but it was never a big deal after all. Since we knew each other from our mentor group in the first quartile of this year, we started to know each other better and better.
Since the beginning of this project we were - in my opinion - really productive. We did research before we started working on our concept. Compared to my last project, where we just dived in the concept without knowing the supporting elements of our concept due to lack of research. Of course there was time for some jokes and conversations but the progress of our project had the priority. Besides that, this is the first time I experience a group in which we do not have hard feeling to each other. This made the group ambience really nice and comfortable.
I considered myself for a short period as a person that wants to involve everybody. We had to deal with one person that did not show up or did his work properly this was not a time that I liked. I really felt responsible to get him involved within our project, but this slowed me down. However, he decided to quit the study so therefore things changed a little bit since we knew we could not rely on him.
In my previous project I was not always as ordered and structured as I should. During this project we made a weekly planning and kept a weekly report. In this way I always knew what we did and what deadlines were set. This proved me that working in this way offers more structure and control on the project. When important decisions needed to be made, everybody participated. We all wanted this project to turn out nice towards the final demo days and this happened in my opinion.
However, I do have the feeling that I should have taken more initiative during this project. I should have helped Arthur with the movies and Nikola with the posters. In this way I could have developed the competency Communication and Form and Senses in a larger extent. Teamwork was no problem in our group. We always made guidelines and organised meetings so as a group we really made a growth.
The bottom line is that this project showed and proved its quality. This was something that my previous project had a lack of. You can clearly see al the work we have put in and this is deeply satisfying!

6.2 Nikola Gaytandjiev

I initially took for the Social Lighting project for two main reasons. The first was that my interests with industrial design lie more with product design, and designing a physical interface for the Philips HUE seemed like a good challenge. The second reason was that I wanted to learn how to incorporate and use technology in meaningful user interactions. Looking back at the process I went through in this project, I have achieved this goal and learned much, much more.

Perhaps my biggest personal achievement this semester was that I solidified my ideal design process, and therefore follow a structured, methodical and considered design process. Starting with research in order to learn about the topic and then following with ideation that was based on the research gave more relevant initial ideas to work with. Then creating simple prototypes and testing them with users and refining the ideas is a good way of working. After reaching a solid user experience and concept, we started prototyping a more refined model, and testing this again with users. It was important for me to create this workflow because I previously felt that I followed a very scattered design process and risked losing touch with what is important for the design.

In order to address my goals for developing the IT competency that I wrote in my PDP, I spent a lot of time during this project working on the prototype, both with the electronics and with the coding. Although the prototype did not contain complicated electrical components, the idea of making one which allowed users to interact with it and experience the product the way it was intended was an achievement. The code for this project was something that caused considerable frustration during the prototyping phase. It contained several bugs that restricted the experience. I learned how to find these bugs through systematic trial and error, and how to solve them to improve the user experience by making more streamlined code through the use of a series of ‘if’ statements in the Arduino code. Despite this, in the future I will develop this knowledge more by making more fully functional prototypes.

From a user focus perspective, I gained a lot of experience during this project of how to work with users throughout the design process, and incorporate their feedback to improve the design. We had constant contact with users throughout most phases in our process, and regularly conducted both shorter and more expensive user tests. I am aware that feedback from users is not always relevant or the right direction for the design, and thus I have gained some experience in trying to eliminate the irrelevant information from user tests, and try to find the essence in what the users are trying to say. My assignment UFP Basics also helped with these part of the design process, and I gained understanding of how to incorporate those techniques in my project work.

I also spent a considerable amount of time during this project working on the form of the hueFO, and building the aesthetic prototype. I learned new techniques for making models such as vacuum heat moulding and laser-cutting. I spent a lot of time refining the design and making nice finishes to the prototype, and combined these techniques with my existing knowledge in FS to create an accurate model. I believe that I achieved this, and I am very pleased with the final result of the hueFO.

In the 3rd Quartile, I took part in an IC assignment, where I learnt techniques and frameworks for idea generation. I was able apply this knowledge to the project work in a practical way, which lead to the idea of the hueFO. It was a valuable experience because I learned how I can use the frameworks from my assignments in a practical project to generate fresh ideas.

As far as teamwork is concerned, I could not have asked for better teammates. Working with Arthur and Willem was very easy, and we understood each other well. I feel that we each filled in each other’s weak areas, and overall we formed a very strong team.

In conclusion, this project allowed me to apply the knowledge that I gained from assignments and from my first semester in TU/e, to a project. It was a very rewarding experience, and I am very happy with the outcome.

6.3 Arthur Geel

In my personal development plan6 I stated that I wanted to improve my overall competence with this project. I also wanted to involve the user more in the development of a product, which made the Social Lighting a perfect fit for me. Since this still is my first year in Industrial Design, I wanted to do as much as possible in as many competency fields as possible, to reach awareness in every competency after my first year. This meant that I tried to be involved in every part of the design process, from idea generation to applying the finishing touch on the final prototype.

In this project I learned a whole lot of new things. Instead of jumping into the project like I did last time we did our research before we started the design process. By reading into the general properties of light and the effects of light onto people I had a clearer view of what we could achieve with this project. Before we did anything we set up some guidelines that the concept needed to follow. Doing this is a great way to start the project, because you have a clear context which helps you in the creative process at the start. This is a huge change from my last project, where a lot of the work was unstructured.

Something that my last project lacked was the input of users. Because of organisational reasons we could not plan as many visits to the school environment where our potential users were, so it was hard to get unbiased feedback. This time around user testing was one of the focal points in the project, which led to me gaining a lot of experience in this matter. We based some critical decisions in the design process on user feedback, and the user feedback also provided us with options that we hadn't explored up until then.

In this project I was in charge of producing the videos used in the Mid-Term – and Final Demo Days. The thing with videos like these is that they have to communicate your project well. Since I only had a limited time in the video to share what the project is about, I had to make decisions on what I wanted in the video, and what was less important. The entire process of producing these videos has helped me in my communicational skills, as I can now recognise the most important things that need to be said about the project.

This project has also helped me in developing my skill in Form and Senses. The design challenges we faced during the project has led to us stepping out of our comfort zones, using techniques I have never used before, such as laser-cutting and making plastic copies of MDF models with head moulding. These are some very interesting techniques that I might very well be using in future projects.

Overall I am quite content with the results of this project, as I have completed all of the goals I had set for myself in my personal development plan. I had a great time working with my fellow team mates, and I especially enjoyed the new way of interacting with the users. It's satisfying to see people grow fonder of your product as the product is growing.