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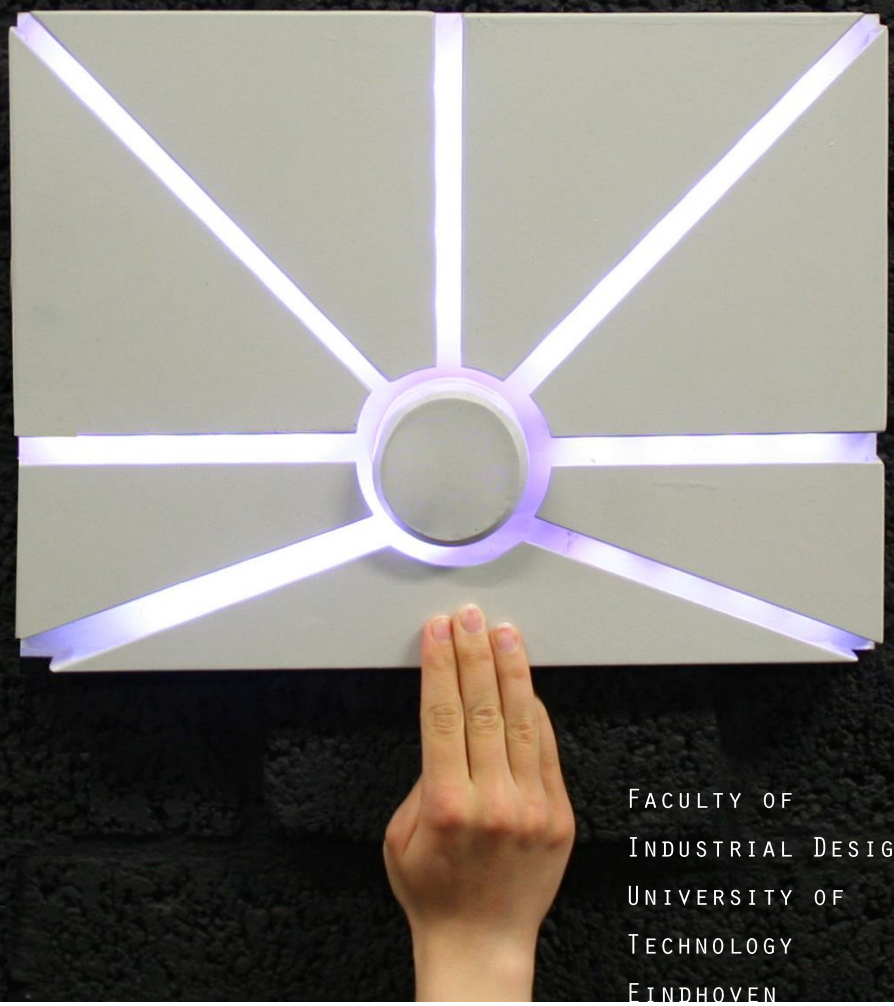
Social Lighting Project:

Helios



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ABSTRACT

This report will describe everything about our project, the design process, the prototype and everything else that is connected to our project, Social Lighting. We will present our vision for this project, and how this vision resulted in our prototype. The different iterations that we went through will be discussed and a business plan for our prototype. There is a short chapter which shows what we would do if we continued the project, and at the end you will find our four personal reflections. We hope you enjoy reading the report and experiencing a taste of what we have realized the previous semester.

Background

For our bachelor project in the light.time.space.move theme, called Social Lighting, the project goal was to create a multi-user interface for a special assigned room. This room is called the breakout area and it is equipped with Philips Hue lights. In this report we will answer the main question: 'How to create a multi-user interface that controls the illumination scheme of the breakout area?'

VALUES

Vision

For millions of years, the sun has been the primary light source of earth. But with the discovery of fire and later, with the invention of the light bulb in the end of the 19th century, humans have successfully used the power of light for their own purposes. But lighting is much more than the illumination of the room, light is more versatile than we usually conceive of it – the next paradigm shift is now. We believe lighting can be much more. It can be social and it can enhance your digital experience.

With the premise that we live in a society with an ever increasing pace, where people need to quickly assimilate new information and go straight to business, we believe the demand for intuitive, multi-user and direct feedback systems will increase accordingly.

PRODUCT DESIGN SPECIFICATIONS

Yellow Space: Light.Time.Space.Move

This project is clustered within the Yellow Space in the TU/e Industrial Design department.
The light.time.space.move theme considers lighting in a broad perspective and recognizes the opportunities of space, materials, reflections, projection, and dynamics. Time and space connects these topics and that is why we bear our proud name light.time.space.move.[1]
Light is an increasingly important topic; it largely determines how we perceive the world. Novel lighting technologies, such as solid state light sources and distributed control systems combined with innovative interaction techniques and system behaviour create huge opportunities to design new, innovative, lighting applications. These innovation lead to new trends, novel business model opportunities and can facilitate behaviour change.[1]

Social Lighting

Different people have different objectives and perform different activities at the same time. Adaptive lighting can set the right conditions for all these activities. Systems like the Philips Hue offer opportunities for such adaptive lighting environments, but the current interaction (a smartphone interface) does not fit the multi-user breakout environment. In the Social Lighting project, we are assigned to design a controller for the Philips Hue that enhances the dynamic and social qualities of the Breakout room context as well as other settings.

Breakout room

First year students are directed to design an interface for the Breakout area - Room 0.35e - in the Laplace Building at TU/e. Naturally the product also must be applicable to a variety of settings in addition to this one.

Figure 1 and 2: The Breakout area in LaPlace

PROJECT: HELIOS

So first of all, why did we choose the name Helios? Helios is Greek for sun (Ἥλιος), which is of course the natural source of light for the earth. This brings us to the design of our product, which is based on the outer lines of the sun. It is as if the interface represents the sun; it is the source of light in a room.

The Interface

The Helios project provides the user with a sensation control by attending to different needs and wishes through different levels of interaction.

Level of interaction with lights: there are almost limitless possibilities in light schema. In order to make the most out of these opportunities, while still keeping interaction with the interface pleasant and engaging, our design comes with 6 modes. The user can illuminate the room to her wishes by using the following illumination schemas:

1. Romantic: Dim, slight flickering rose light.
2. Work: Bright, blue-white to wake up and increase attention.
3. Party: Smooth transitions between various lively colours.
4. Chill: Inviting, relaxing yellow to promote closeness and informal chats.
5. Ambient: Automatic screen-controlled light (further explained below).
6. Off.

The ambient mode is a form of smart ambient lighting. In this mode, the colour scheme of the room will be modified to resemble the activity of the user based on a computer screen. The room can match the colours of a power point presentation or create a more immersive experience for gamers while following the game screen colours and updating them into the room in real time.

Control: First rotate the central button into the mode you wish to activate. Then, by swiping your hand into a specific direction, you will activate light sources in the corresponding areas of the room. Swipe right to illuminate the right section of the room, for example. Alternatively, a circular swipe will illuminate the whole room in the selected mode.

Different needs & wishes: The social part of the interface lies in the interaction of users through the interface. Once a gesture is recognized, the NeoPIxels will stay lit in the colour of the mode, so future users can quickly see which parts of the room are illuminated and in what mode.
The interface is both functional and intuitive. A gesture sensor recognizes the user's actions presence and hand movements. When movement near the interface is detected, the "hub", as illustrated below, subtly lights up, indicating the passing user that the interface works via gestures. After a quick wave, the user will easily understand how the interface works due to its smart immediate feedback system.

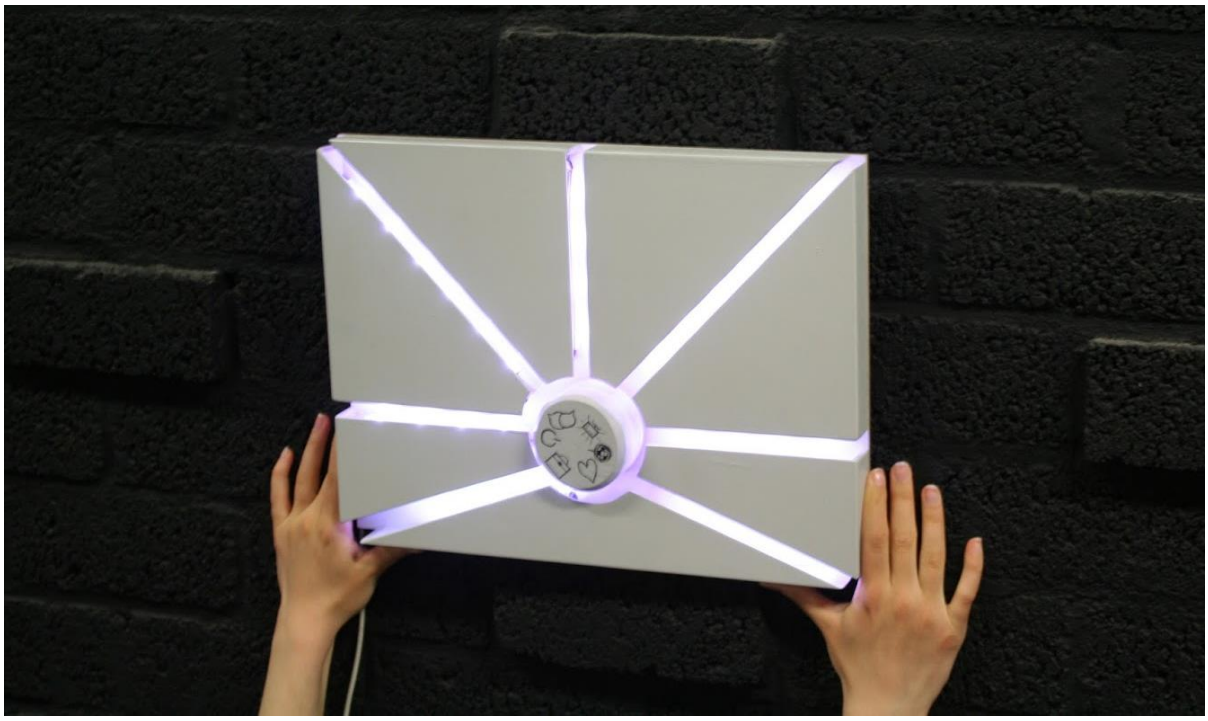

Figure 3: Final prototype

As the central symbol of light and life, we integrated the original light source: the sun, into our design. Ultimately, the design is not only functional and intuitive, but also aesthetically pleasing – it is a piece of art.

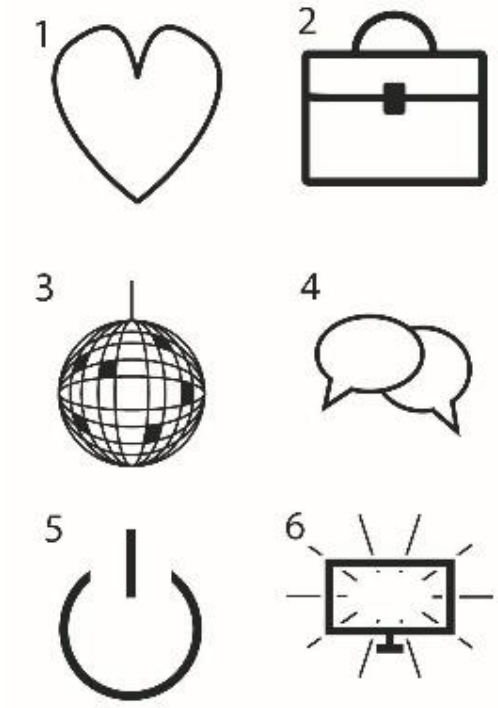

Figure 4: Icons that represent the different modes: 1. Romantic, 2. Working, 3. Party, 4. Chill, 5. Ambient 6. On/off

Philips Hue Lamps

For the best colours and transitions between immersive, mood setting modes, Phillips Hue lamps work in conjunction with the Interface.
Phillips Hue lights are wireless LED light bulbs that deliver every colour in the spectrum as well as flashing, pulsing and dimming.
From Phillips, the HUE lights are controlled via an app. It is the purpose of this project to create a physical interface to substitute the HUE app.

Figure 5: Philips Hue lights[3]

Prototype & Technology

'How to tell the interface which lights correspond to which motion. How does the interface know which lights to turn on when you swipe to the right?"

The outer case/box/shell of the prototype is made of plywood and the turnable knob with the different modes on it uses a potentiometer to keep track of its position.
The lights (NeoPIxels) inside are controlled by a microcontroller called Arduino, using the NeoPIxel Adafruit library [2]. NeoPIxels are individually addressable LEDs. The big advantage of this, is that it reduces the amount of wiring in the prototype (usually every LED needs to be soldered and wired separately). For the prototype a WS2812B strip is used.
Recognising gestures is being done by a Leap Motion device. The Leap Motion is a small device that is used for controlling a computer or laptop using hand gestures. It can also be programmed by developers using different platform integrations and libraries (e.g. Unity 3D, C++ and JavaScript), including Processing. To combine Leap Motion and a NeoPIxel strip, a serial communication between the programming languages Processing and Arduino is established on the Arduino board.

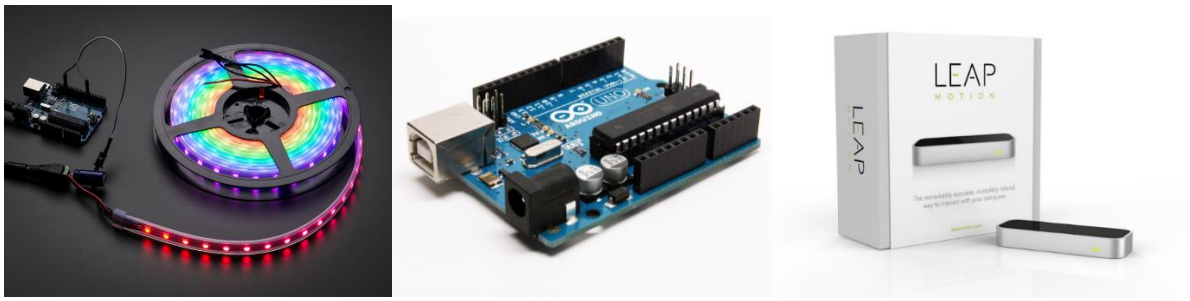

Figure 6: Adafruit NeoPIxel strip

Figure 7: Arduino Uno board → http://www.nexuscyber.com/arduino-uno-r3-atmega328
Figure 8: Leap Motion device → http://tweakers.net/pricewatch/341164/leap-motion-controller.html

Using the Processing library LeapMotionP5 made it possible to program the Leap Motion to recognise four different gestures. Those four gestures are a hand swipe gesture upwards, downwards, to the right, to the left, and a clockwise gesture using the index finger.

Figure 9: Hand swipe gesture → http://www.samsung.com/global/microsite/tv/common/guide_book_5p_vi/flip_left.html
Figure 10: Clockwise gesture → http://lacquer.fi/presentable/help/

User tests

LIGHTING MODES

We picked the modes for Helios and the corresponding colours ourselves. For picking the corresponding colours for all the modes, we used our intuïtion. But because not everyone might agree with what colour goes best with certain atmospheres we decided to find out more opinions on these colours. In this test, we also wanted to find out if the logos for the corresponding modes were clear.

An empty template of the user test can be found in the appendix B. To test these things, we first showed them all the logos that we had, and asked them to write down what they thought these logos had to represent. We had 7 different icons, since we had two different icons for the chill-out mode. Icon 4 and 5 are both for the chill-out mode.
After this, we showed the users 4 different lighting modes in the breakout area. These 5 different modes were romantic, working, party, off, and chill-out mode. We originally had anticipated to also show the ambient mode, but since the colour for this mode is already defined, and not available for change, there is no need to test this mode. That's why the table in the user test shows 6 different lighting modes. The users now had to pick which mode they thought was being showed in the breakout area.
We quickly realized that our romantic mode was not what it should be. We picked a dark and fierce red, although this didn't create a romantic atmosphere. Together with users we changed the romantic mode from red to a pink and orange colour, since this was found to be more relaxing, warm and loving.

Once we changed the romantic mode, almost all (at least 80 percent) of the results were as we intended them to be. So this showed that our modes were now correct. And since we received the best results for chill-out mode with the 5th icon compared to the 4th icon, we chose to use the 5th icon.

AXE

The initial idea was to create a sun as the design of the interface. Then we figured a compass would be more logical, because it naturally represents direction. In order to make a final decision about the looks of the interface, a user test was conducted. It was set up according to AXE (Anticipated eXperience Evaluation). AXE is a qualitative method that gives an initial perspective on the user experience for a product or a service. It is a method that involves singular users in an interview setting. The method builds on using visual stimuli to make evaluation participants imagine a use situation and to reveal
their attitudes, use practices and valuations. AXE is both an evaluative method and a method for collecting suggestions for improvement. The results connect perceived product attributes with different dimensions of user experience.

We conducted this test in the hope to find what we should change about the product we are making. Terms that were heard frequently include: simplicity, new, interactive and calm. As these are all positive terms, we decided not to change the elements of the product that triggered these terms. Another thing that was received positively was the combination of the gestures with the knob in the middle of the panel. So we decided to leave this combination in the final prototype.
As this was also the moment of deciding on the shape of the final prototype, we asked the users about their feedback concerning the three different shapes we had stalled out during the test. The middle one, resembling a sundial was obviously the worst shape to choose, as the handle in the middle of the panel would be interfering with the use of gestures in the product. We also got the feedback that this one was looking like a piece of antique, something we did not want to achieve with this product.
The compass on the other hand gave the impression that it would be lying on a table instead of hanging on the wall, several users noted. As a compass is used to give wind directions and having this vertically would not make much sense to a lot of people.
Overall, the prototype we used during the midterm demo-day was the one that was most preferred of the three, people related the sun with light and comfort. There was some confusion on how the turning knob would work however, as turning it would mean that the semicircle would be hanging outside of the panel in certain settings. This is something we considered and integrated into the final prototype by making it round and adding two extra rays to the bottom of the panel.

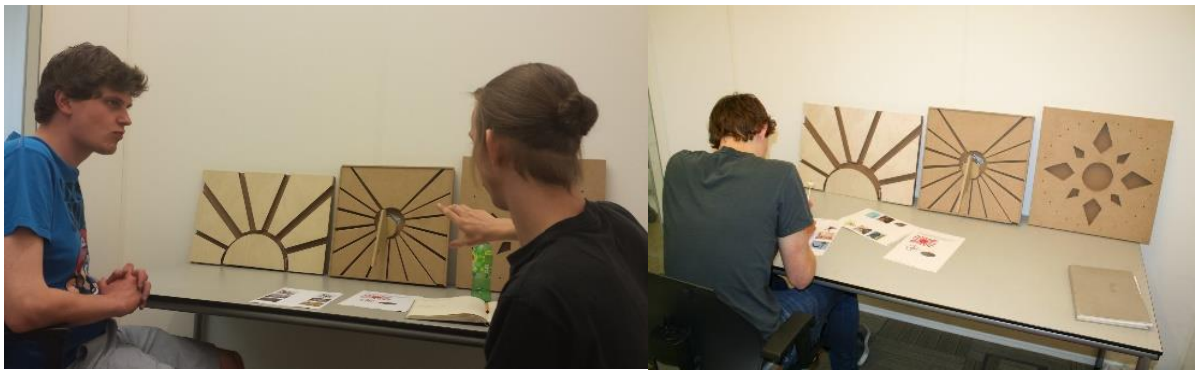

Figure 11: Conducting the user test to get feedback on the three interface design

Reference: http://www.allaboutux.org/axe-anticipated-experience-evaluation

DESIGN PROCESS: ITERATIONS

First Iteration

Group work was kicked off with a quick and dirty prototyping session.
The mission: make a first prototype of the controller/lamps.
We made several prototypes, as shown in the picture below, but we presented two main ideas.

Figure 12: All quick prototypes of the day

The first prototype was inspired by a shower temperature heat controller. Light colour can be divided into warm yellow tones which stimulate melatonin production and blue tones that stimulate attention, two modes can be activated: Business and Cozy. By holding onto the static white section and turning either the blue or yellow knob, the intensity of the respective colour can be controlled. Regarding the multi-user focus, when the current light setting is important, the user can press the sides of the prototype so they sink and fit into the white center part. This way no one can rotate the knobs.

Figure 13: First quick prototype

The second prototype doesn't work with colours or intensity at all. The only two inputs are based on the atmosphere of the room.
Firstly, you can put in the amount of people in the room by turning the yellow knob. You can then let the system know if the amount of people is important for the lighting. Secondly, you let the system know if the atmosphere in the room is formal or informal by turning the green knob. Also for this input you let the system know the importance of this factor by pushing the knob inward or outward. The system then calculates the best lighting for the room according to these two inputs.
This prototype doesn't work with colours and brightness, but with the atmosphere within the room. This allows people who are inexperienced with lighting modes to still pick a lighting mode that is suited for their situation.

Figure 14: Second quick prototype

Following our presentation, only two people spoke up and both said the ideas were good. Later, however, as a hint to all students, the professors said:

- Adding an extra function to show the other members of the room of the priority of the current lighting setting might be an option too many for the user. This extra option bothers more than helps.
  Conclusion: The system design must inherently show the priority status of the current program. Without the user having to choose to show it.
- Start with just one light colour. Focus on intensities and transitions. Only add more colours after this is done

In comparison, another group made an interesting contribution: a flower that opened or closed according to daytime (like a sunflower). They also made a little mouse controller aimed at children. A little tail and soft fluffy shape invited kids to play with lights by pointing the mouse at lights and thus turn them on and off.

Conclusion: involve the user in the design, invite them to interact. Use metaphors in your design. What does the shape symbolize?

Next week we were required to define a scenario for our product. At first, we were rather unsure and opted for trying to combine the needs of different users in a single room. Our initial scenario consisted of a person entering the breakout room expecting to work, when someone was already sleeping with dimmed lights inside.

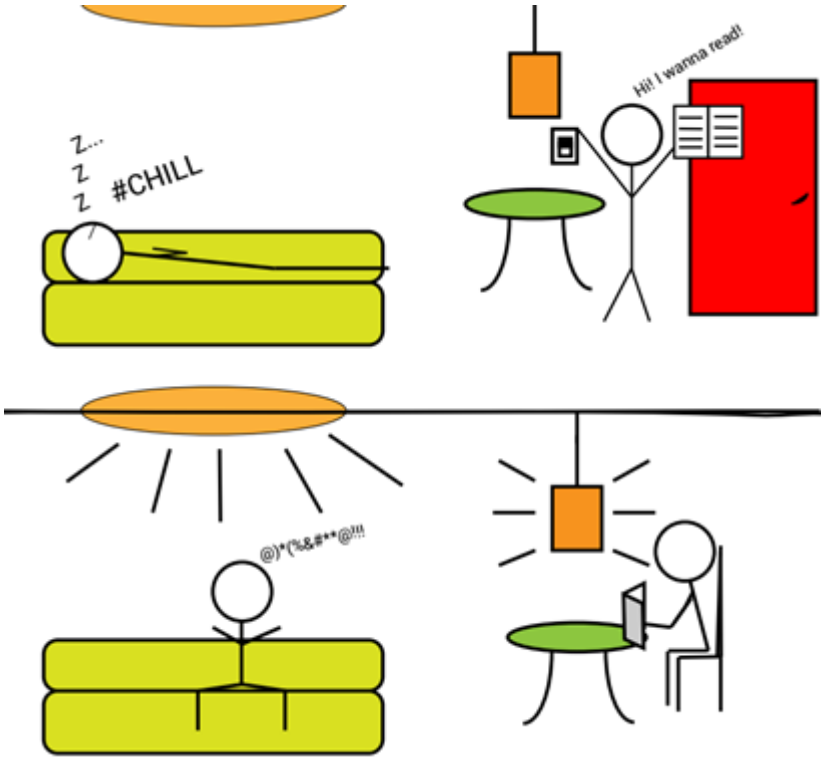

Figure 15: first scenario

Second Iteration

Admittedly, our initial chosen scenario was more motivated by the short time constraint imposed by the course organizers than by foresight and concrete goals. Our mission as a team favors options that will facilitate future design decisions and team development. We soon went back to reevaluating our scenario as to make it more realistic given our constraints e.g. breakout area, current and desired team skill, time.

The second scenario was gaming: a group of people who are gaming together in a room go from relaxing and talking to paying attention to screens. Often, lights are turned off during this transition. During both solo gaming sessions and LAN parties, specific, dynamic light settings can be of added value to the gaming experience.

Once the scenario was set, a prototype idea quickly emerged: immersive gaming with Hue . The predominant screen colours and intensity of a user connected to the interface would be transferred onto the light of the room in real time.

- Also interesting for LAN Parties. Spotlights by team. Light is influenced by player's health or spatial position. Players that are spatially close have same light colour. Track API.

Problem: immersive lights are a good idea, but it doesn't make people socially interact – it only enhances gameplay.

Based on this problem, we decided to make two light "modes":

1. Automatic "Gaming mode" where lights are controlled by computer screen colour scheme
2. User controlled "Chill mode" for game breaks.

- Also interesting is a smart light for gaming which enters Gaming mode by manual initiation. Gaming mode returns to Chill mode when players step up from their chairs. Light intensity increases with sound, making cheering and exciting events in the game even more immersive.

- Another point of interest: Light could be directed via gestures. You point at the controller and change between modes or light sources without having to get up from your chair.

The idea of dynamic lights for a more immersive and social gaming experience was generally agreed upon by this project group. The interface would be a product that can be sold and used by the same users for a long time period before becoming boring. It is a durable product, making it economically sensate and with a wider range of application.
The idea was there, but we still needed a shell for it. What would our interface look like? We discussed, sketched and made several quick prototypes.

Figure 16: Interactive plutonium vials control lighting
Figure 17: Control light with minimalistic table piece

Third Iteration

The next big step was transitioning from an interface residing on a table or in the form of a chandelier to an interface on the wall. The wall is less intrusive and more practical – the interface is easily accessible and cannot be lost.
The initial idea was to have a "screen" on a wall, where you could "paint" on with hand gestures. Based on the predominant colour strokes on different areas of the screen, the illumination in the room would react. If the right area of the screen is yellow, the right area of the room would be yellow. This would allow for a playful interaction with the screen, where people can control light by painting on the wall. The problem here lied on the large array of LEDs we would have to install and code for to make a functioning prototype.

Figure 18: The effect of foil inside canvas and how light shines
Figure 19: Cut canvas

Still, the idea of motion and directing light by "painting" was valid. The next iteration was a sun, where one could illuminate different parts of the room by lighting up the corresponding sun rays via gestures. A painting canvas was cut out and the idea was to cover the inside part with aluminium foil and shine LEDs through the cuts, so the interface could light up.
From the canvas, we progressed to experimenting with plywood, as it created a more durable effect of higher quality than the canvas. We aimed at creating a "light path" such as the one we found interesting in the canvas. The results follow in the images below:

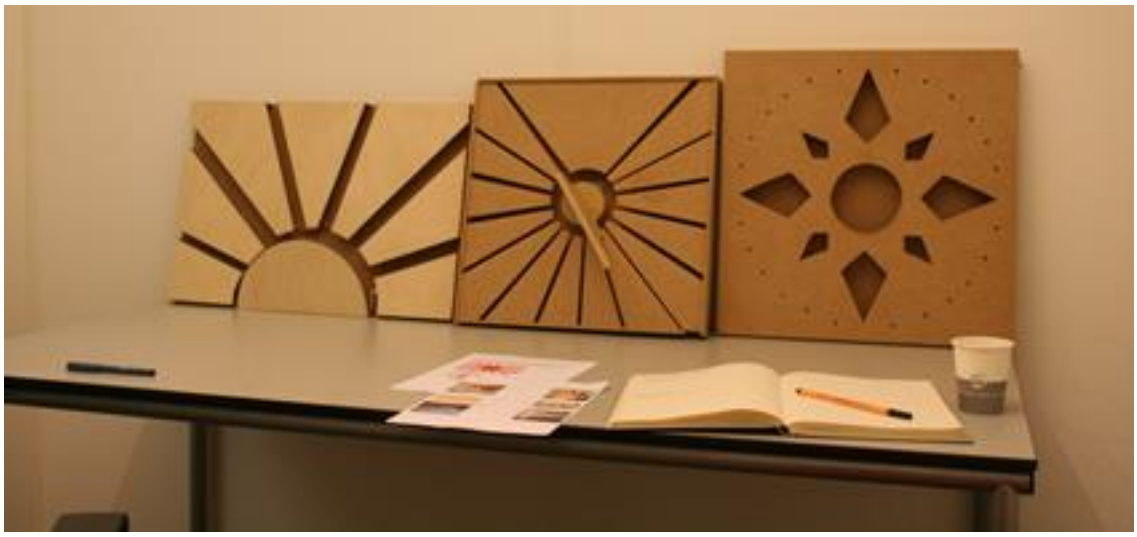

Figure 20: MDF prototypes

While the overall shell of the prototype was still being defined, we were set on using motion to control the Hue lights. With a strand of Adafruit NeoPIxels, an Arduino microcontroller and a MS Kinect, we compiled the code for the project. The code was written using the Arduino as well as the Processing IDE to control the Kinect and the Hue lights. Within a few weeks, we were able to integrate the NeoPIxels into a prototype and run the code successfully.

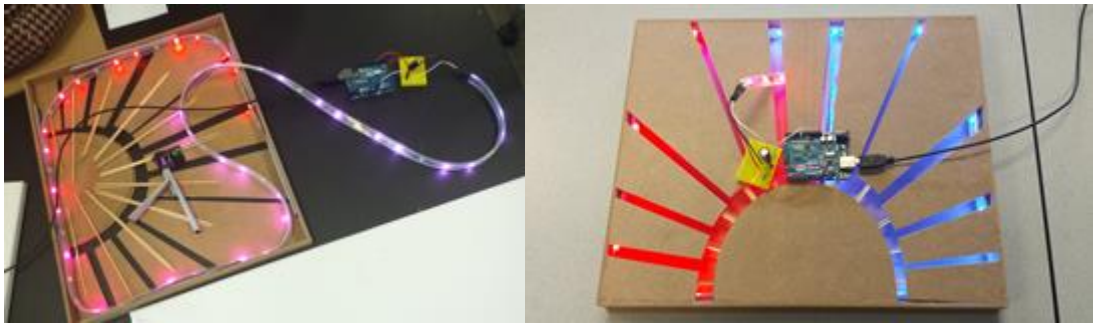

Figure 21/ 22: Working prototype and adding electronics

Figure 23/24: Kinect and the Mid-term Demo Days prototype (31th March)

This working prototype was able to light up the corresponding sun ray depending on the direction of the hand motion. If the user waved to the prototype, Ambient mode would be activated. On the second wave, the prototype would return to the previous light setting.

Fourth Iteration

The 3rd prototype was successful and received positive feedback, as further explained under the "Independent Reviews" section of this report.
The final iteration of this prototype focused on solving technical problems and adding more light modes.
In the technology realm, we substituted the Kinect by a Leap Motion sensor. The Kinect was about 25 cm long, and wasn't handy to be carried around. The new leap motion sensor is much more compact - 8 cm - and in addition to that the device can still sense motion up to 1 m. This issue, however is negligible, given the addition of a button to manipulate the colour of the light.

In the centre of the sun, a potentiometer was added to allow for a rotating button, which is used to select the mode you want to light up the following gesture induced sunray.
As for the motion sensor, the gesture system was slightly modified: a circular motion with your finger will light up the whole room. As with the previous iteration, a swipe to direction X will illuminate the sun rays and the room in direction X.
The overall size of this prototype is also smaller than the earlier ones - making it more delicate and inviting to make gestures with your finger.

https://www.leapmotion.com/product

BUSINESS PLAN

What if we would our product to actually get on the market? What will be a good business plan to start with? An initial business plan is described in this section. [3]

Figure 25: Helios Enterprise logo

Executive Summary

Helios Enterprise is a new start-up business with eyes on creating intuitive and integrated lighting interfaces. These interfaces will take changing light settings in a room to a whole new level.
Our interfaces are, in contrast to usual light controllers, controlled by hand gestures. This is the key to what makes our product a unique but also natural experience.

As we said before, we strive to 'bridge function and aesthetics by validating every design decision with users.' This means that we care about our customers and therefore take feedback seriously. By doing so, an intimate relationship is established between user and enterprise.

A possible step to get our product to the actual market is through crowdfunding websites, for instance the well-known Kickstarter.com. In the era of social media, crowdfunding is a good way for products that have potential to be further developed and brought to the market.
A collaboration with Philips Hue could enhance our start-up business even more. Our product is able to connect to such lighting systems. Philips currently uses the Hue app to communicate to the Hue light bulbs. [4] We are able to provide an integrated interface.

Business Description

Currently there are four enthusiasts working in our company. Each of them has their own own specialty. Due to this small amount of employees there is a fast team dynamics and every project is takes personally by each one of us.
Our newest development in our specialty, gesture-controlled light interfaces, is that we are working on interfaces that are modular. The basis material will be polished metal, but the front can be customised. Also the idea in mind of a light interface that only needs gestures as input is being worked on. This way, controlling lights will become an immersive and natural experience.
Having our product in your private home (or somewhere else) could then have more personal value.

Market Strategies

MARKET SEGMENTATION, ANALYSIS AND STRATEGY

Figure 26: Possible target market analysis

Other than private homes for the product to be used, lecture rooms and even hospitals are potential places. Lecturers could gesture to the lights on the high ceiling to control them. Hygiene in hospitals is one of their top priority. By controlling light with gestures there is no need to touch light switches and this results in more hygiene.

Helios will satisfy people who intuitively want to control lights in a room.
The initial target group were young adults who were either sitting in their living room or a relaxation space at work. However, the actual age can vary of course. Older people and children can also learn how the interface works. For us, this will provide the possibility for building a loyal client base.

Competitive Analysis

The competitors within our market have different product strategies, they do not use gestures to control light. However, they too produce light interfaces, though in a different matter. Apps and touchscreen interfaces are a popular way to control lighting, because they are easily modifiable. This is a strength of our competitors (such as Philips, how ironic), but this is also a strength of Helios products.
Though our current weakness is that the user cannot see the room clearly to verify their desire while using the product. This can be exploited by making a variation of products, for example placing it on the table. Also by making it smaller or even remove the interface entirely (people use gestures towards the lights to control them) can improve our chance of success on the market.

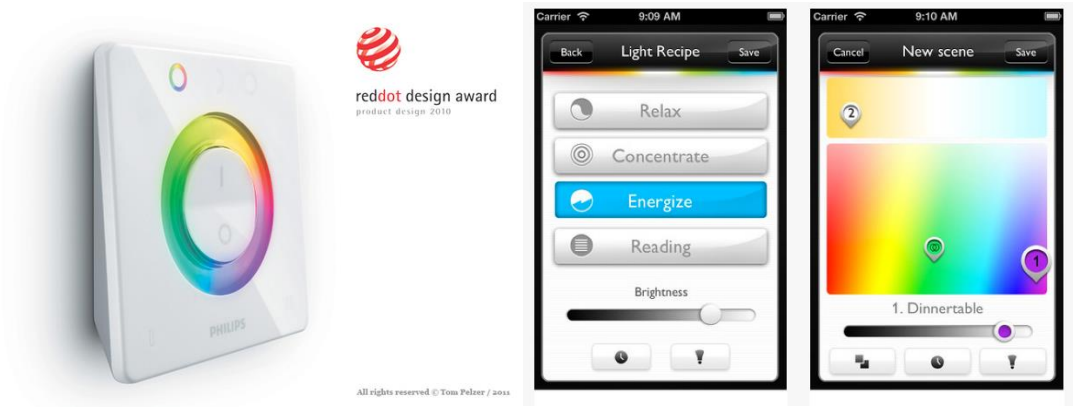

Figure 27: A potential light interface of Philips → https://www.behance.net/gallery/1559321/To-Be-Touched-Lighting-User-Interface-Portfolio
Figure 28: The Philips Hue app interface → http://gathering.tweakers.net/forum/list_messages/1523525/33

Design and Development Plan

Most of the product design description has already been discussed in the 'Project: Helios' section. So in short, the Helios product will require the following components:

- 30 NeoPIxels
- Microcontroller (preferably an Arduino Uno)
- 2.4 m^2 of sheet metal (depends on the customer's demands)
- Potentiometer
- WiFi and Bluetooth transceiver
- Hand gesture sensor (such as the Leap Motion)

These components together with the time and effort to put together will add up to about €40. We would aim for €60 for the final product. To further develop the product and lower the production costs a development budget of €5000 will be needed. This will enable Helios Enterprise to reach its goals.

CONCLUSION

The main goal was to find an answer on the question: “How to create a multi-user interface that controls the illumination scheme of the breakout area?”
From our perspective we fulfilled this goal through different iterations and user tests. Our concept is indeed a multi-user interface that controls the lighting that cannot only be used for the breakout area, but also for other rooms. Helios is multi-user in a sense that it can satisfy desires of multiple people (in the same room).

REFLECTION & FUTURE

We are satisfied with the overall result as well as the our own development. Though given an extra week to our project, we would add a final iteration to our project. The hub is a bit clumsy and having a whole circle in the middle of the board destroys the harmony of the composition to a certain extent.

The next modification would consist of a step backwards to the 3rd prototype: we would keep the half-sun design and add tap buttons to change the modes.

A future development would be to add an option to set your own modes, as well as making the interface modular, as to allow for a custom sized sun.
Making the actual system that allows the user to connect the lamps to the interface properly would be a priority.

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[2] http://www.digitalurban.org/2014/02/ifttt-netatmo-philips-hue-linking-data-to-lighting.html
[3] http://www.adafruit.com/products/1138
[4]

[] NeoPIxel Adafruit Arduino library https://github.com/adafruit/Adafruit_NeoPIxel

[] How To Write A Business Plan http://www.entrepreneur.com/landing/224842
[] Meet Hue http://www2.meethue.com/nl-nl/

Yet unlisted references:

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- LeapMotion + NeoPIxels: NeoPIxels following your hand movement when the 'hub' is off → http://tinwhiskers.net/?p=841
- Adafruit NeoPIxel Überguide http://dlnmh9ip6v2uc.cloudfront.net/datasheets/Components/LED/adafruit-NeoPIxel-uberguide.pdf

INDIVIDUAL REFLECTIONS

Aidan Bundel

This project has enabled me to dive into the technology of gesture recognition, interface design and controlling lights for the user experience. It feels like I have made a lot of progress in my Integrating Technology competency in terms of programming in the Processing as well as the Arduino platform. Because I followed information technology at middle school, I had a solid basis in programming. So after this project, I was able to do more than just basic programming (e.g. blinking a LED in Arduino, drawing shapes in Processing).
The User, Focus and Perspective element is one of the priorities in the Social Lighting project. Since I helped with some of the user test that were conducted, I now know a few more types of user tests.
For the Designing Business Process competency I made a potential brief business plan of the Helios project. This helped to gain more insight in how start-up businesses put up with competition for instance, but also how to get your product on the actual market.
I am also pleased with the teamwork and communication in this project. We had a quite clear task division in the end, which makes it a lot easier for me to focus on my task.
Finally, it is clear for me that overall I made quite some progress in my process as an industrial design student during this project. Looking back I also had a lot of fun too.

Erik Wubbels

In this project I was, together with Stan, mainly responsible for the shape of the product and the conducting of user tests. This helped me to develop the competencies User Focus & Perspective and Form and Senses. Other than that of course I had the chance to develop Teamwork & Communication as with every group assignment.
For the user tests we did some tests that were made up on the spot. During my assignment "Designing for the User Experience" I got introduced to some more professional and tested methods, however. I wanted to incorporate this knowledge into the user tests for this project. For this I used the site AllaboutUX.org to find some proper user tests to evaluate our product. I decided to use the Anticipated User Experience test, to evaluate our idea. Even though the test gave results that helped us develop our project further, I think that it would have been better to have done this test earlier in the design process.
The form and senses part involved a lot of sketching and iterating with physical objects. We started with the quick and dirty prototyping session, which I think helped me in my ideation process more than actually making good looking prototypes. After this we started thinking about our actual product, set in the scenario we made. I spend a lot of time sketching ideas, and making prototypes. I think I have substantially developed my ability to quickly put together a prototype to be used and tested as well as thinking about design choices along the way. Later on in the project I went straight to prototyping, instead of sketching the idea out (besides a rough idea of the shape). For the future I will have to do this instead, as some of the prototypes were not ideal and not really that thought through (the sundial shape for instance, which had the lines not thought through as well as the turning handle).
As for teamwork and communication I think I have grown a lot this project. Whereas in the previous project we did not have a clear division of tasks, during this project we did. This helped me a lot in focusing on my specific task and being able to focus on this instead of helping each other with every little detail. This also caused a pretty fast development of our product and held us on track during the project.

Nicole Mascarenhas

Competencies developed: Ideas and Concepts, Form & Senses, Integrating Technology and User Focus & Perspective in addition to Teamwork & Communication.

By the outset of this semester, I had no intuition about how a multi-user light controller should look like. This project thus prompted me to search for inspiration in art and I learned to work with derivative and symbiotic ideation to come up with a theme and interaction method for the interface.

My main takeaway from this project, however, was to "divide and conquer" your problems. I learned that without setting boundaries on our design space, we run the risk of not solving any concrete problems and delivering a concept of transitory value. By redefining my premises and design opportunities, I was spurring out the guiding thoughts and main ideas throughout this semester.

Beyond coming up with a system to make lighting more accessible and social, I paid attention to the user with means to invite and prompt to control light via gestures. During a user test, it became clear that people don't have a clear intuition about how to manipulate light and are often confused about affordance. I learned that light is more versatile than we usually perceive of it, although most lighting interfaces nowadays typically consist of a simple on/off switch. Using a motion sensor in Helios made the affordance issue prominent, since people don't routinely use gestures for control. I learned that it's important to prime people into performing a non-routine action by for example, having a demo mode or a "hint" as to how to operate the product.

By creating a multi-user lighting interface, I also learned that there are multiple ways of stimulating communication trough design. I had initially taught of using light as a means of nudging people to talk face to face. However, another more practical solution from the user perspective, is to use the interface itself as a means of communication by displaying other people's light choices and allowing people to make their lighting choice based on this information.

As a designer that focuses a lot on the technical, I put a lot of emphasis on learning to work with my hands and get a "feel" for the material, as to be guided by it. In the Helios project, I worked with scrap material and learned to see every oddly shaped piece of cardboard as a prototyping opportunity. By sketching a few ideas, doing some quick and dirty prototyping and finally asking for independent reviews, I also learned to always reflect: "How does this add to the user experience?" "How is the user primed to take this action?" and "What is the perceived affordance of this form?"

In the integrating Technology realm, I worked on the first iteration of the prototype with MS Kinect. Together with Aidan, I learned how to bridge different platforms and technologies: Arduino, Phillips HUE lights, Processing IDE, a laptop and a Kinect with minimal program complexity. As a designer, it is primordial to understand information transmission in order to create products involving all of the

user's sensing capabilities in a mutually explorative manner. I believe a good design isn't limited to the user's, nor the machine's sensing, creating and processing ability.

We had a good work dynamic and rather clear task division during each iteration, this allowed me to focus on the tasks on my hands: programming, researching light technology, making exploratory prototypes, CAD modelling, making a poster, writing voice-overs for the videos, helping around, or yelling "Guys! I have an idea!"

Stan Vugs

This project was very different from my previous project, Bugged from Playful Interactions. This project seemed more 'serious', as the Bugged project was a bit silly and of course playful. Especially the goal of the project is more clear, and this enabled us to easily make our group vision on how to overcome the problems and come up with solutions within this project.
The competencies that I developed within this project are of course different as well. The main competencies that I developed in this project are very clear; User Focus and Perspective and Form and Senses. Together with Erik, we did most of the user tests and worked on the design of the prototype. This is turned out well, since these competencies were not very developed in my previous project.
The important thing about user tests which I've learned is that it is all about a good preparation in which you think of everything. What I will definitely do differently in next user tests is giving people more open questions. In the Logos and Lighting Modes User Test that I set up, I asked people to pick predefined pictures and modes and to match them with the predefined lighting modes that we made. This limits people's contributions in a user test. If I asked them which colours and brightness they would choose for different modes, the user test would have been much more engaging.
For Form and Senses, Erik and I have made a lot of prototypes. This really enabled us to see what the advantages are of one way of doing it, compared to the other. In the beginning we used simple materials, like mdf and duct tape to compose a simple prototype. I think our final prototype looks very neat. We used better wood (plywood), and glued the parts tidy onto each other.
I also gained the skill to just make a lot of prototypes. Previous semester I said that it is important to make a lot of prototypes, but I never really got round to do it. This semester we really did this, and it immediately showed improvements.
The teamwork in our project was good. There was a clear task division, and there was no need for a group leader (which I think is a good thing). This was also my first time to be in a group with an English speaking student. Although I do not have any problems with English, I think this is still a good training for my English.
Besides these competencies I also developed other competencies. I did some of the coding with the NeoPIxels. I created two videos that show the concept (one for the Mid Demo day, and one for the Final Demo Day). I made an oversight of the activities after the Mid Demo Day for Design and Research Processes. To work with light and its influence was new to me and literally and figuratively opened my eyes about the possibilities of light. I find light very interesting, and think this is really a big opportunity for companies.
And most importantly, I had a lot of fun in this project!

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APPENDIX A

Arduino Helios Code

```
#include <Adafruit_NeoPIxel.h>
#include "FastLED.h"
// Number RGB LEDs in strip
#define NUM_LEDS 44


// Define array for leds
CRGB leds[NUM_LEDS];


#define NEO_PIN   6
#define POT_PIN   A2


// Parameter 1 = number of pixels in strip
// Parameter 2 = pin number (most are valid)
// Parameter 3 = pixel type flags, add together as needed:
//   NEO_RGB     Pixels are wired for RGB bitstream
//   NEO_GRB     Pixels are wired for GRB bitstream
//   NEO_KHZ400  400 KHz bitstream (e.g. FLORA pixels)
//   NEO_KHZ800  800 KHz bitstream (e.g. High Density LED strip)
Adafruit_NeoPIxel strip = Adafruit_NeoPIxel(NUM_LEDS, NEO_PIN, NEO_GRB +
NEO_KHZ800);


int directionInput;
int modeValue;
int count;


uint32_t off      = strip.Color(0, 0, 0);
uint32_t chill    = strip.Color(70, 50, 0);
uint32_t work     = strip.Color(0, 70, 70);
uint32_t ambient;
uint32_t romantic = strip.Color(70, 10, 0);
uint32_t party    = strip.Color(0, 50, 70);;


uint32_t mode[6] = {off, chill, work, ambient, romantic, party};


int previousPosition;
int currentPosition;


void setup() {
 FastLED.addLeds < NEOPIXEL, NEO_PIN, GRB > (leds, NUM_LEDS);

 pinMode(POT_PIN, INPUT); // initialize the pushbutton pin as an input

 strip.begin();
 strip.show(); // Initialize all pixels to 'off'
 Serial.begin(9600); // Listen for input (9600, 19200 or 115200)
}


void loop() {
 directionInput = Serial.read();
 modeValue = analogRead(POT_PIN);
 delay(5); // delay in between reads for stability
```

```
 modeValue = map(modeValue, 0, 680, 0, 5);   // scale it to use it with the modes
(value between 0 and 685)

 //Serial.println(modeValue);

 if (modeValue != 0) {
   counter();
   switch (modeValue) {
     case 1: // Chill
       chosenDirection(30);
     break;
     case 2: // Work
       chosenDirection(30);
     break;
     case 3: // Ambient
       chosenDirection(30);
       //ambientMode();
       //Serial.write(102);
     break;
     case 4: // Romantic
       chosenDirection(30);
     break;
     case 5: // Party
       partyMode(party, 500);
     break;
   }
 }
 else { // Off/reset
   //allDirections(off, 30);
   count = 0; // Reset counter

   // if our position has changed
   if(directionInput != currentPosition) {
     // take note of where we were
     previousPosition = currentPosition;
     // take note of where we are now
     currentPosition = directionInput;

     strip.setPixelColor(currentPosition, work);
     strip.show();

     // make the previous LED turn off
     strip.setPixelColor(previousPosition, off);
     strip.show();
     delay(10);
   }
 }
}


void counter() {
 if (count < 5) {
   count++;
   onebyOne();
   delay(400);
 }
}


// Turn on the pixels one by one
void onebyOne() {
 for(int j = 0; j < 3; j++) {
   for(int i = 0 ; i < 4; i++ ) {
     memset(leds, 0, NUM_LEDS * 3);
     switch(j) {
```

```
      case 0:
        leds[i].r = 255;
        leds[i].g = 255;
        break;
      /*case 1:
        leds[i].r = 255;
        leds[i].g = 200;
        break;*/
    }
    FastLED.setBrightness(40);
    FastLED.show();
    delay(80);
  }
 }
}

// Fill the dots one after the other with a colour
void allDirections(uint32_t c, uint8_t wait) {
 for (uint16_t i = 0; i < 10; i++) {
    strip.setPixelColor(i, c);
    strip.show();
    delay(wait);
 }
}

void chosenDirection(uint8_t wait) {
 switch (directionInput) {
   case 97: // Right
     for (uint16_t i = 2; i < 4; i++) {
       strip.setPixelColor(i, mode[modeValue]);
       strip.show();
       delay(wait);
     }
   break;
   case 98: // Left
     for (uint16_t i = 4; i < 6; i++) {
       strip.setPixelColor(i, mode[modeValue]);
       strip.show();
       delay(wait);
     }
   break;
   case 99: // Up
     for (uint16_t i = 6; i < 8; i++) {
       strip.setPixelColor(i, mode[modeValue]);
       strip.show();
       delay(wait);
     }
   break;
   case 100: // Down
     for (uint16_t i = 8; i < 10; i++) {
       strip.setPixelColor(i, mode[modeValue]);
       strip.show();
       delay(wait);
     }
   break;
   case 101: // Clockwise: All directions
     for (uint16_t i = 0; i < strip.numPixels(); i++) {
       strip.setPixelColor(i, mode[modeValue]);
       strip.show();
       delay(wait);
     }
   break;
 }
```

```
}

//Theatre-style crawling lights.
void partyMode(uint32_t c, uint8_t wait) {
 for (int j = 0; j < 10; j++) {  //do 10 cycles of chasing
   for (int q = 0; q < 3; q++) {
     for (int i = 0; i < strip.numPixels(); i = i + 3) {
       strip.setPixelColor(i + q, c);    //turn every third pixel on
     }
     strip.show();

     delay(wait);

     for (int i = 0; i < strip.numPixels(); i = i + 3) {
       strip.setPixelColor(i+q, 0);        //turn every third pixel off
     }
   }
 }
}

// Input a value 0 to 255 to get a colour value.
// The colours are a transition r - g - b - back to r.
uint32_t Wheel(byte WheelPos) {
 WheelPos = 255 - WheelPos;
 if(WheelPos < 85) {
  return strip.Color(255 - WheelPos * 3, 0, WheelPos * 3);
 }
 else if(WheelPos < 170) {
   WheelPos -= 85;
  return strip.Color(0, WheelPos * 3, 255 - WheelPos * 3);
 }
 else {
  WheelPos -= 170;
  return strip.Color(WheelPos * 3, 255 - WheelPos * 3, 0);
 }
}
```

Processing Helios Code

```
import com.leapmotion.leap.CircleGesture;
import com.leapmotion.leap.Gesture.State;
import com.leapmotion.leap.Gesture.Type;
import com.leapmotion.leap.Hand;
import com.leapmotion.leap.SwipeGesture;
import com.onformative.leap.LeapMotionP5;
import processing.serial.*;


Serial port;
LeapMotionP5 leap;


String lastGesture = "";
int currentGesture;


int previousPosition = 0;
int currentPosition = 0;


public void setup() {
```

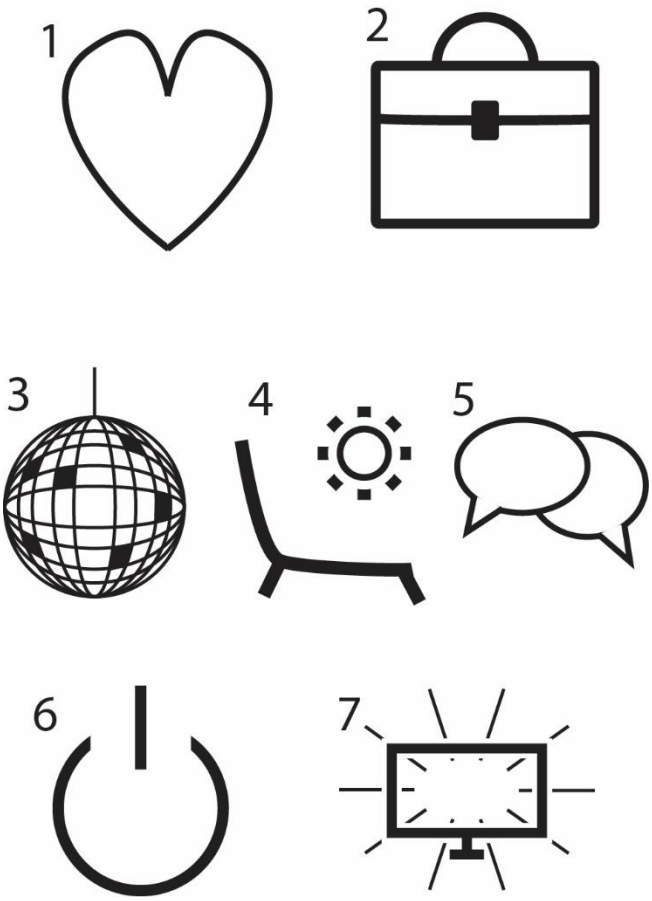
```
 size(600, 600);
 textSize(40);

 leap = new LeapMotionP5(this);
 port = new Serial(this, Serial.list()[0], 9600);

}


public void draw() {
 background(0);
 leap.enableGesture(Type.TYPE_SWIPE);
 leap.enableGesture(Type.TYPE_CIRCLE);

 for (Hand hand : leap.getHandList()) {
   ellipse(leap.getPosition(hand).x, leap.getPosition(hand).y, 20, 20);

   // 0 - 24: 25 LEDs on my NeoPIxel Strip
   currentPosition = (int) map(leap.getPosition(hand).x, 0, 1000, 0, 43);

   if (previousPosition != currentPosition) {
     previousPosition = currentPosition;
     port.write(previousPosition);
   }
  }
 fill(255);
 text(lastGesture, 200, 300);
}


public void swipeGestureRecognized(SwipeGesture gesture) {
 // Display Gesture object data
   if (gesture.state() == State.STATE_STOP) {
     for (Hand hand : leap.getHandList()) {
       //Classify as right-left or up-down
         if (abs(leap.getDirection(hand).x) > abs(leap.getDirection(hand).y))  {
           //Classify swipe as either horizontal or vertical
             if (leap.getDirection(hand).x > 0)  {
                 println("Right");
                 lastGesture = "Right" + "\n";
                 port.write(97);
             }
             else {
                 println("Left");
                 lastGesture = "Left" + "\n";
                 port.write(98);
             }
         }
         else { //vertical
             if (leap.getDirection(hand).y < 0)  {
                 println("Up");
                 lastGesture = "Up" + "\n";
                 port.write(99);
             }
             else {
                 println("Down");
                 lastGesture = "Down" + "\n";
                 port.write(100);
             }
         }
    }
   }
   else if (gesture.state() == State.STATE_START) {
   }
   else if (gesture.state() == State.STATE_UPDATE) {
```

```
   }
}

public void circleGestureRecognized(CircleGesture gesture, String clockwiseness) {
 if (gesture.state() == State.STATE_STOP) {
   if (clockwiseness == "clockwise" && gesture.durationSeconds() > 0.25)  {
     println("Clockwise");
     lastGesture = "Clockwise" + "\n";
     port.write(101);
    }
 }
 else if (gesture.state() == State.STATE_START) {
 }
 else if (gesture.state() == State.STATE_UPDATE) {
 }
}

public void stop() {
 leap.stop();
}
```

APPENDIX B

User Test Lighting Modes

Part 1.
On the right are 7 icons for different lighting modes. Write under each icon what you think it illustrates.



Now write for each number corresponding with the icons which lighting colours you would expect for the corresponding mode.

1.
2.
3.
4.
5.
6.
7.

Part 2.
We will now change the lighting of the room to different modes. Fill in the following table for each light mode, which icon and your associated mode goes with the light mode (1, 2, 3, 4, 5, 6 or 7).
(Leave the first row open, so we can later fill in the mode that we had intended for the light mode.).
There will be 6 different light modes, so one icon will be left out.
If you make up your mind about one of the Lighting Modes you can correct yourself by filling in your next thought in the row beneath the initial Assumed Light Mode. If you then still want to correct yourself you can fill in the last row to correct yourself again.

	Light Mode 1	Light Mode 2	Light Mode 3	Light Mode 4	Light Mode 5	Light Mode 6
Intended Mode (leave open)						
Assumed Light Mode						
Assumed Light Mode Corrected						
Assumed Light Mode Corrected 2						

AXE User Test