INTERACTIVE LIGHTING

By

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Abstract:

THIS REPORT DEPICTS THE CREATION AND DEVELOPMENT OF A LIGHT INTERFACE MEANT FOR THE WORK-FROM-HOME SETTING. THROUGH THREE ITERATIONS THE DESIGN PROCESS IS COVERED, FROM THE EXPLORATION PHASE TO EVALUATION AND THE VARIOUS DESIGN PROCESS METHODS IN BETWEEN.

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Introduction:

Personal lighting systems have become increasingly common over the past years, partly through the development of the Phillips HUE system. These systems come with increased freedom and functionality to lighting, but the typical on-and-off switch does not meet the same functionality. During one semester we have designed and developed one possible solution, a tangible light interface for the work-from-home setting. We believe that by introducing a tangible and portable interface to the work-from-home setting we can increase a more pleasant work experience by decreasing distraction.

ITERATION ONE:

Brainstorming:

During the first group meeting, every group member introduced him- and herself. This gave an impression of the educational background, design identity and design vision of all group members. Also the personal development goals were described, so from the beginning there was a broad view on what everyone needed to get out of this group project.

By sharing the design visions and identities with each other, we formulated shared interests. This gave the first direction to the project, which was immediately concretized in a mind map.

Key vision of the project was enhancing health by creating a durable, timeless and modular system for a professional workspace. To succeed in making such a product, the design method of 'lean start-up' seemed a good starting point.

Originating from this project direction 'health through light', a more concrete project goal was listed, split up in three aspects of the project; the design challenge, design research and the context.

Design challenge:

- Enhancing mental-, physical health or both
- Modularity
- Consequences of the design (what effect does the design really have?)

Design research:

- Interaction possibilities
- Light effects on health
- Technological possibilities (Arduino, processing, etc.)

Context: Professional workspace (professional workers are the target group)

- Hospital
- Office
- University
- Café
- Sport centre
- Library

As this core aspects were clear the team began to research this design landscape by doing literature research.

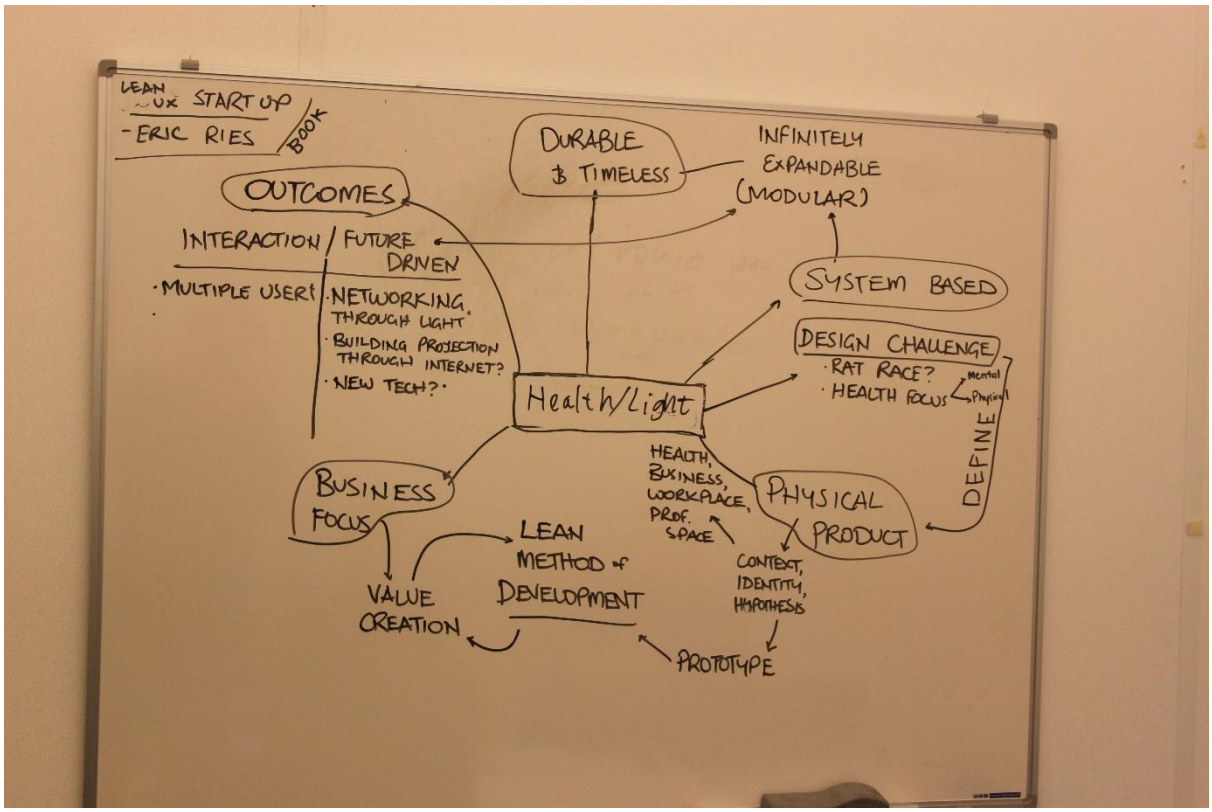


Figure 1: Mind-map of the projects direction as it was described in the first meeting

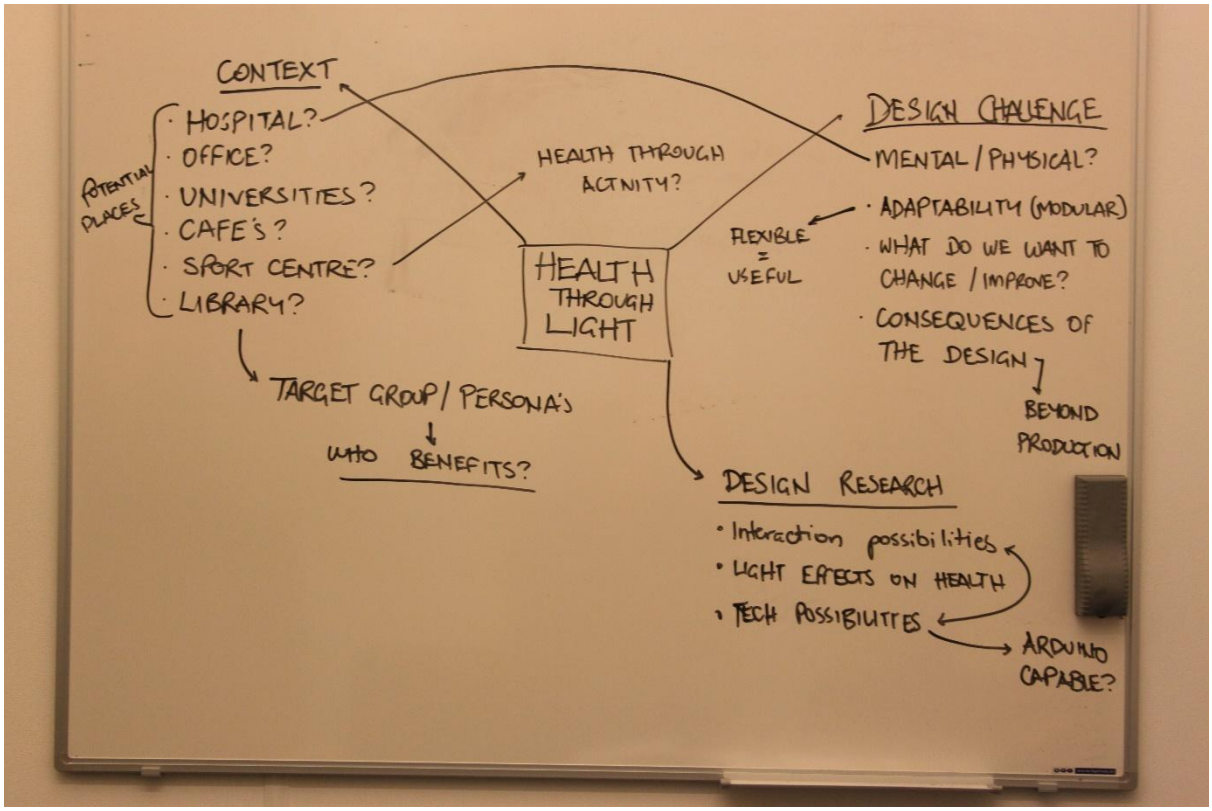


Figure 2: Mind-map of the projects goal as it was described in the first meeting.

Academic Research:

Our academic research began with the intention of identifying the benefits users could gain from utilising a light system specifically designed for certain tasks. We wanted to ascertain that light itself created different moods and emotions depending on its various factors (kelvin, intensity etc.) and what setting created what reactions from users. This research focused primarily on the effects lighting had on perception, cognition and affective state (Hawkes et al, 2010) and how the change to LED's has implication on the motivation of employees.

In tandem with our light research, we also wanted to identify the importance of working from home, and its relevance in the modern day setting. This was our area of exploration, however, we wanted to ensure that there was an open market for light products to expand within this context. Through the paper written by Stefano Ba (2001), we identified that in the modern era, it really is necessary for people to work from home nowadays, particularly young parents, whether single or married. We explored the symbolic emotions and attachments home workers place on certain aspects of the home, generating boundaries to separate work from non-work. Through this research, we wanted to discover what the benefits and challenges people face were when they engage in a working home lifestyle.

Upon identifying these various aspects, we looked into possible solutions to issues and means to reinforce positive outcomes for those working from home, all within a lighting context. In essence, if someone does work from home, how can the light they use benefit their experience during both work hours and non-working hours? We did discover that light was a major player in dictating people's abilities to work. "Indeed lighting serves the primary purpose of aiding human vision, and variation in factors such as light output and color temperature have been shown to affect operator perception, cognition and mood state" (Hygge and Knez, 2001).

Field Visits and Context Exploration:

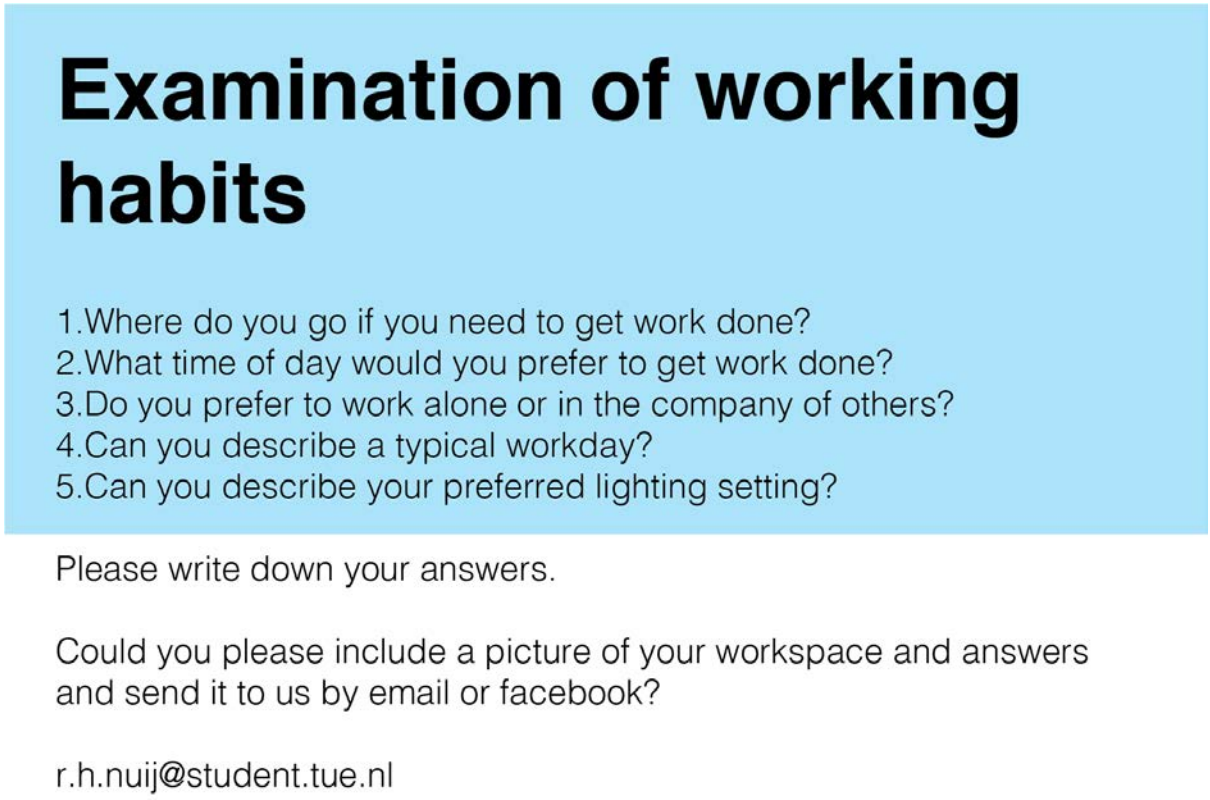
Since our group was asked to focus on the work environment, we started our context exploration by defining work settings. By brainstorming we discussed multiple settings such as office workplaces and public workspaces. But we did not find a setting that seemed interesting enough to go further with, so we decided to go on a field visit. We went through multiple buildings on the campus such as Metaforum and Flux to observe existing work spaces and lighting.

Cultural Probe:

We wanted to explore and better understand the behavior of people within a working context. In order to understand our context better we conducted a cultural probe. The probe consisted of 5 questions:

1. Where do you go if you need to get work done?
2. What time of day would you prefer to get work done?
3. Do you prefer to work alone or in the company of others?
4. Can you describe a typical workday?
5. Can you describe your preferred lighting setting?

We asked the participant kindly to write their answers in an email to us. Finally we received 5 emails and analysed the results. After the analysis of the data we found 7 aspects. We learned that people are the most productive in the morning with enough daylight during the daytime. After 16:00, people started to lose concentration. They all had a daily planning but it varied a lot, from a meeting to start a day to answering emails. Most of the time, people wanted to work alone so they could focus on their tasks. On the other hand, collaboration helped for a good work atmosphere, which also was important to some people. The outcomes of this cultural probe were helpful in understanding the latent needs of a user within a work context. We used this information in redefining the design scenario.



Scenario Persona:

In order to gain deeper understanding of our context we have decided to create scenarios. We used these scenarios to sketch an image of how a user in our context behaves, but also to understand what is physical environment looks like.

The image below represents one of these scenarios. In this one a possible interface is introduced. We named our user John. We decided that John is a contractor for a design firm and that he mostly worked from home. We assumed that he has no preferences for work hours and that he has a strict workflow. We also assumed, since he is a creative individual, that he has multiple activities during the day such as sketching, reading and typing.

Creating this scenario has made us aware that at this point in the design process we still didn't know much about our context. Not only our scenario, but also our mental model of our context was heavily based on our personal experiences and assumptions.

Although the scenario wasn't perfect in any sense, it has helped us to focus on a target group that seemed interesting for four of us: People that work from home.

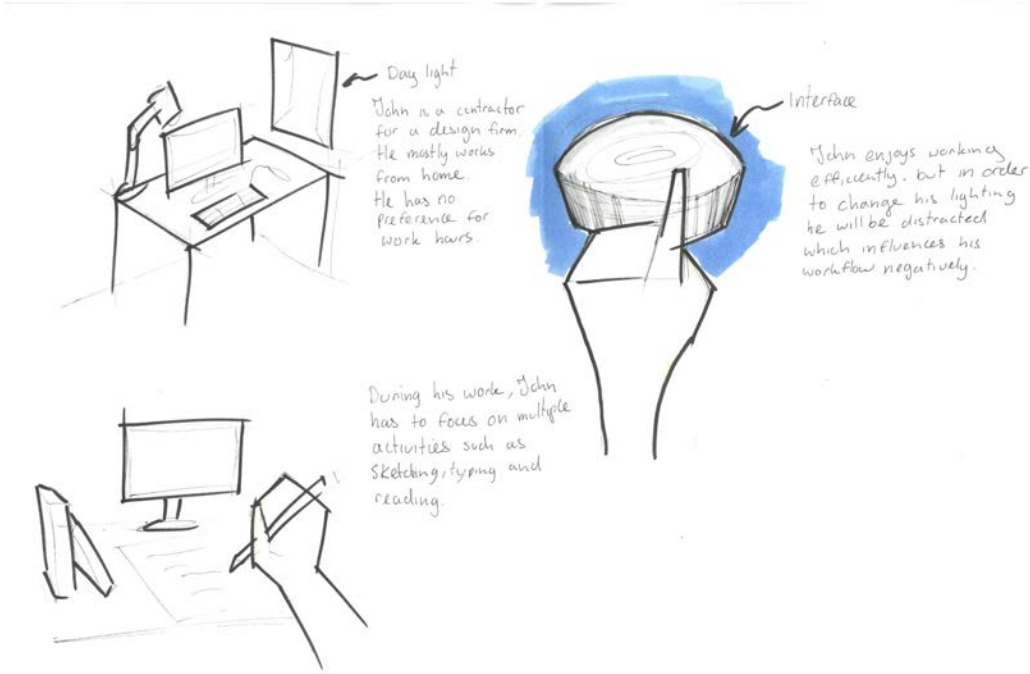


Figure 3: Scenario "John"

Interaction Exploration:

As the concept describes, the users should be able to control light settings in an intuitive way. Therefore, it is needed to explore the ways in which users would communicate with the light intuitively. To do this, two different ways of interaction with light were tested. Interactions with light without any objects between the user and the light (so no switch or remote control), and with an object between the user and the light were tested. We chose a little ball as interaction device. This test was done three times, all industrial design students. The setup and detailed analysis of this test can be in appendix A

Moving the hands up and down do the main points that came out of the first part of the user exploration where that changing the brightness is often. This means that the participants wanted an analogue scale, with a range from 0 to 100% brightness. The same scale is also useful for the saturation. The gestures to control this setting were based on a feeling of ‘letting go’ and ‘extracting’ the vividness of the colour. Changing the colour is controlled in a different way: here the participants preferred pre-sets that you can swipe through, back- and forward. Most hand gestures were in one line, a vertical or horizontal motion.

Figure 4: impression of the first part of the user test where the participant was asked to control the light without any controlling devices. This picture shows an example of a gesture to change the brightness of the lamp.

Concept Proposal – PERI:

This initial exploratory concept was not significantly focused on the features on the device itself, but it relationship within the home context providing a constant flow of lighting customization for the home user.

PERI - short for peripheral - was a wall-mounted proposal that focused on the flexibility of work in the home setting. Three dimensions define work: work per day, per week and per month or year (Christene, 2010). Since the dimension of work have moved in the last 30 years from primarily office based interaction, to a greater emphasis on telecommunications (Olson, 1984), PERI was a concept that could be used in every part of the room, depending on the user's needs, so that regardless of their location, their work light settings could be accurately depicted when they needed so.

Figure 5 : A theorised flow of the connection points of PERI within a house floorplan and a digitised concept image of what PERI finished concept could look like.

Since organizations must be adaptable in this economy, flexibility is a tool that allows employees to be responsive to business needs. PERI was a device that could reduce stress, improve productivity and job satisfaction because employees have more autonomy and control in achieving their work goals from home, whilst employers would have a workforce more adept to the 24/7 scheduling of global business.

Reflection and Analysis:

At the end of the first iteration, a first concept was presented. But how did we get there? The process of the first iteration was fuzzy and not structured at all. We were struggling in finding a clear direction for the project. Many activities were done: user exploration, prototyping, literature research, user involvements and a field visit, but they did not depend on each other in a logical order. The decisions why to do which activity came all from the same starting point: trying to find a solid concept.

The pattern we were stuck in was: brainstorming, research, and results, the feeling that the results were not satisfying, stop in this direction, and begin brainstorming again.

The step missing in this loop is reflection. As a result of this, we had many little pieces of information, all in slightly different directions. We tried to put this information together in one concept, but this felt not really satisfying. The solution to this was, as the coaches recommended us, to reflect on all aspects of the design process: The process itself, the information gathered and the directions we already researched. We had to combine and select this information, in order to make thoughtful decisions on the future direction of the project.

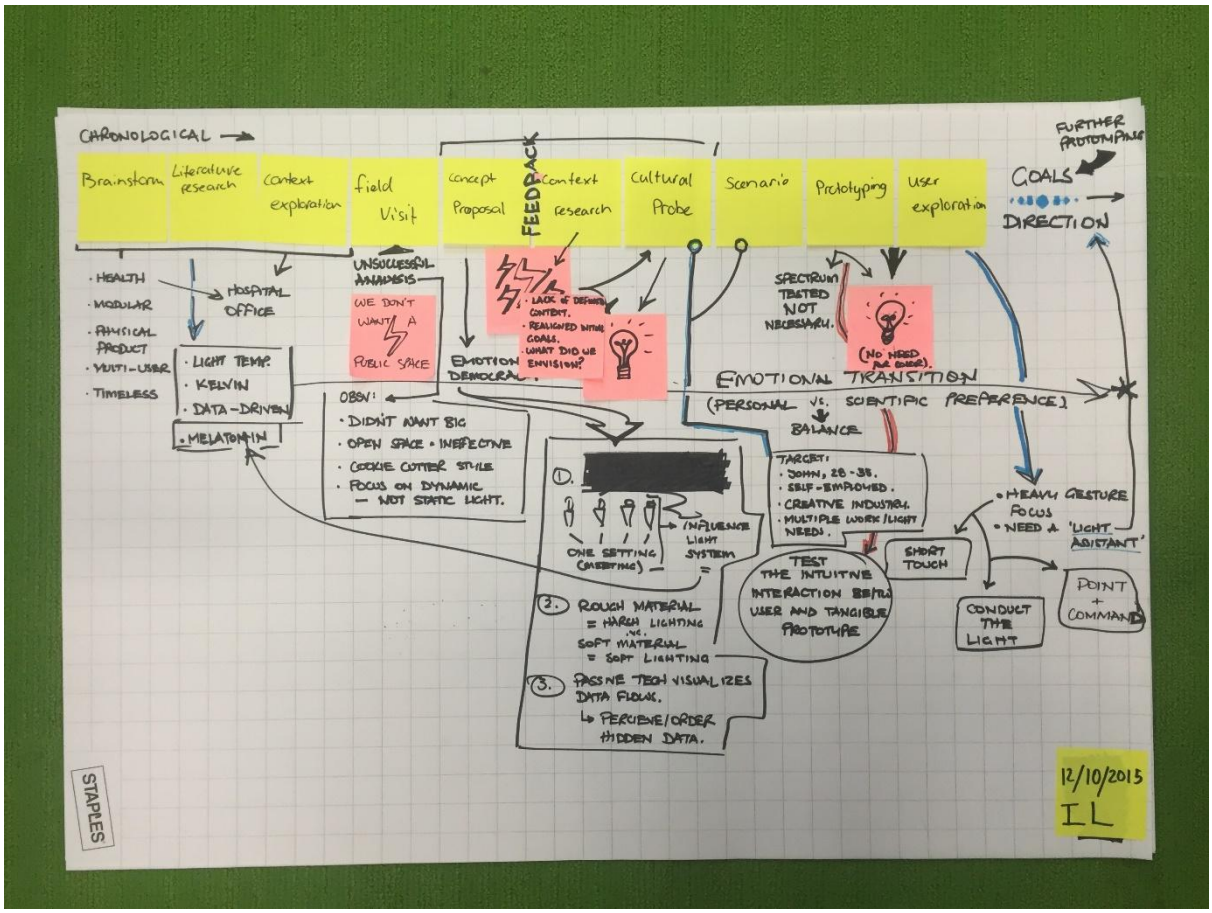


Figure 7: Analysis of the first iteration

The decisions we made after reflecting was that we want to focus on the home-working context for all kind of home-working individuals. This is the same context as it was before, but the target group is broader. While reflecting we saw that the concept of PERI was too specific and we were over thinking the concept. What we needed was a clear context mapping, and investigation of user needs within this context.

Another important decision made after reflecting was that we needed to work more systematically. Every activity should be analysed and reflected on, Also, the team leader should prepare a planning every week, which gives the project a clear direction.

ITERATION TWO:

Context Mapping:

As became clear while reflecting on the first iteration, we needed a solid understanding of context: Which workplaces do home-working individuals use, what activities do they do? Also the emotional aspects of working at home are important, as well as the reasons why people work at home. These aspects together create the special characteristics of working at home, which we described in three different scenarios, which can be found in appendix B.

By analyzing the scenarios we came to the spine of our design challenge: The Integration - Separation Continuum.

“Through everyday choice and practices, we each work toward enacting, reinforcing and modifying our ideas of “work” and “home” and how they should relate. This process – *The Integration-Segmentation Continuum* – is how people define the mental divide between work and non-work related activities.” – Christena E. (2015)

Ideation:

After having created user profiles and understood the context, we were given as feedback that at this point in the process we should generate as much ideas as possible in order to make a selection, this is where the ideation phase started. In order to make a selection between ideas we tried to generate as much ideas as possible. During this generation we decided not to discuss our ideas during the process but afterwards in order to leave space for others to share their ideas.

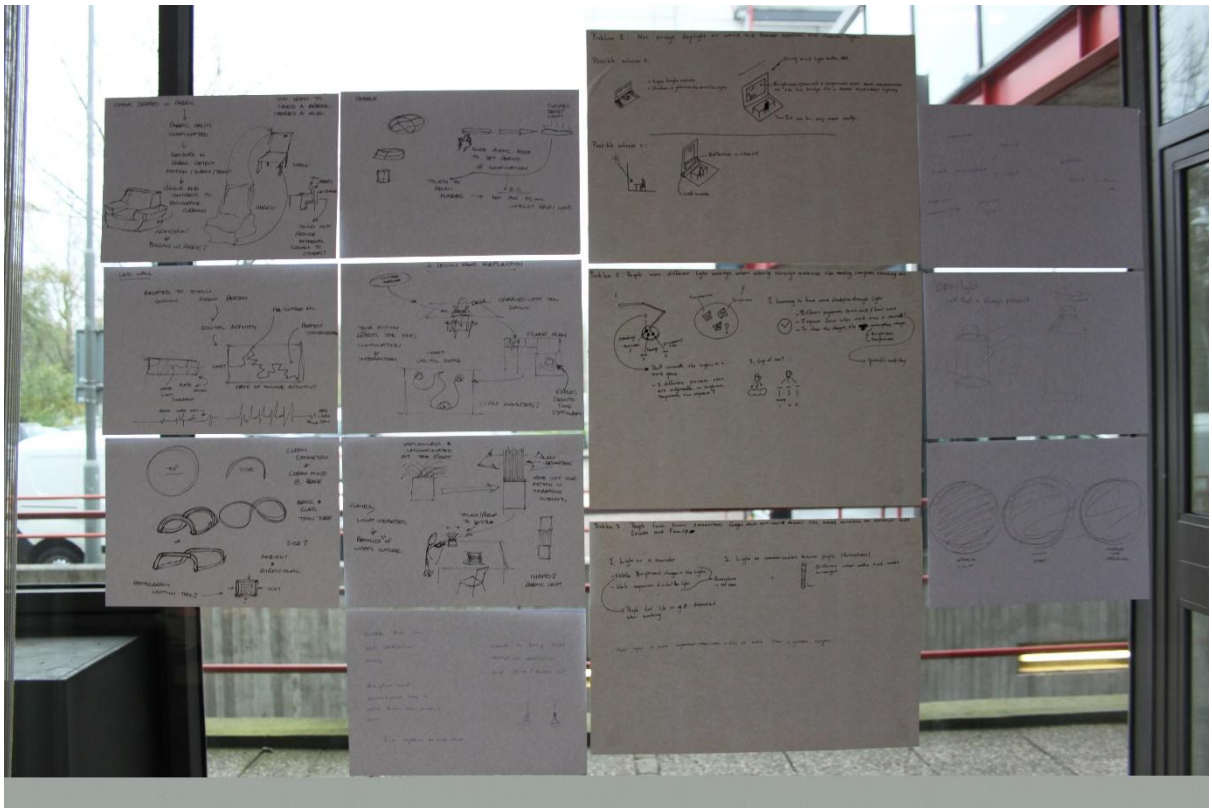


Figure 8: Mapping of ideas

Analysis of Values and Decision Making:

After having generated enough ideas, we have posted them on the window in order to see them all in one glance. We wanted the decision making to be structured process where we all can share our thoughts equally. In order to do this we wrote the positive and negative aspects of each idea on a post it. This way we could make a decision on a more objective level by comparing different aspects between ideas.

By using these aspects we have reduced our selection to 3 ideas. During this process we have identified our core values: Discipline, time management and distraction. Within these core values were relevant aspects we defined:

- Flexibility
- Focus vs. Distraction
- Work Time vs. Personal Time
- Intrusive vs. Non-Intrusive
- Enhanced Time Management
- Awareness → Of others, and yourself
- Environmental/Ambient

Figure 9: Mapping of ideas with feedback on post its

The analysis of these ideas was not meant only to make a decision, but also to understand which values we find important to implement in future concepts. After having discussed and analysed our ideas, we chose one of the concepts , but we were not satisfied with the concepts we had at that time.

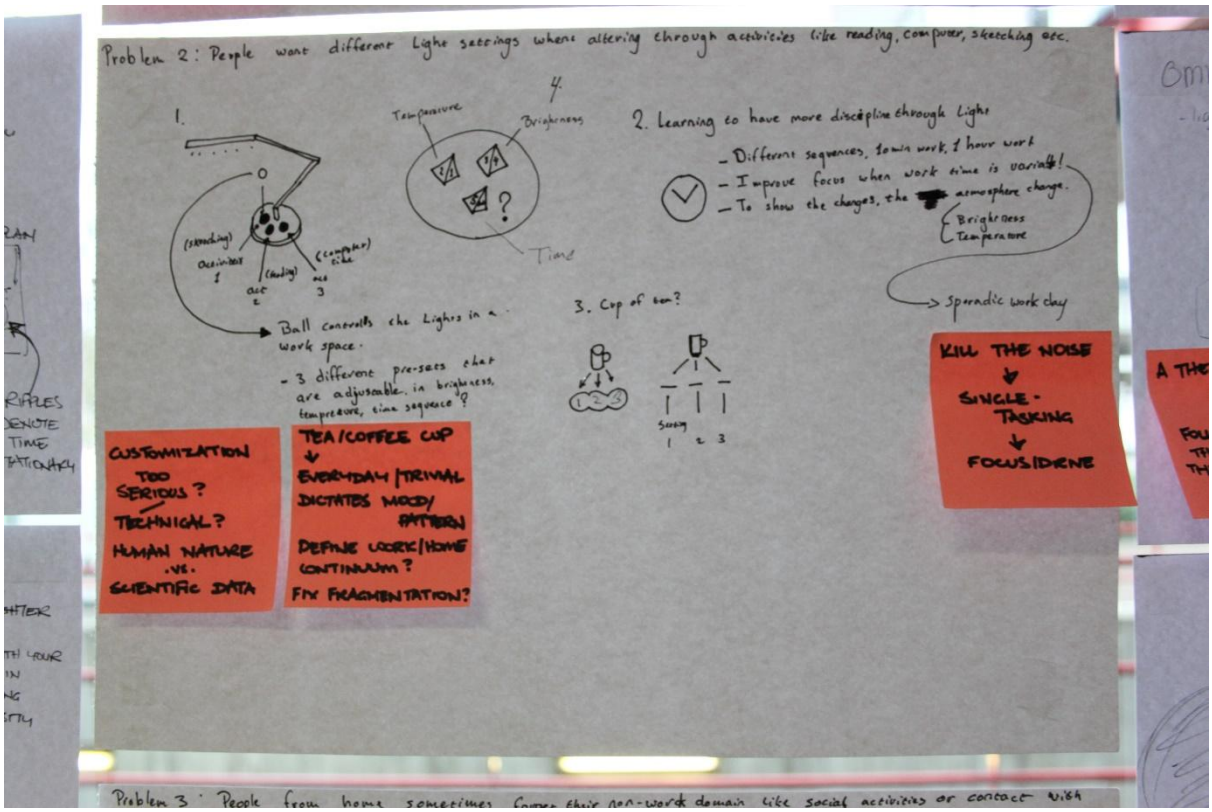
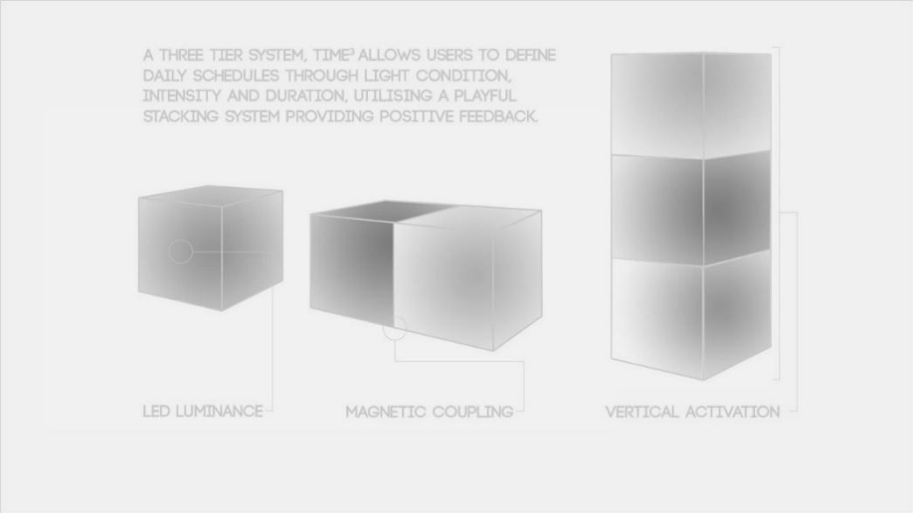


Figure 10: Pyramids idea with feedback

Concept Proposal – TIME^3:

By keeping the values we have analysed during the selection process we have made a new concept proposal. This concept would consist of three individual blocks that each represent a parameter. The parameters would be: lighting pre-set, duration and brightness. The user would select his preferences by turning the block on a specific side. The system would then be activated by stacking the three blocks on top of each other. The vision of this concept is to improve the working experience by introducing time management and reduced distraction. Instead of using a smartphone, the user can easily rotate the blocks to set his preferences. The cubes would be connected to the HUE system in order to have an ambient effect.

Figure 11: Concepts visualization "Time 3"



User Testing:

After prototyping the cubes and defining the concept of TIME^3, we were ready to grasp the conception from users on our concept. At this place in the process, there was no opportunity to execute an extensive user test within context, so we did a co-constructing stories user test (Buskermolen and Terken). The mind of a designer often differs from a regular user's perception of the concept, therefore it is important to get feedback from potential users. Within this test, we focussed on the way the user envisioned to use the product. Is the experience the user envisions the experience we are aiming to create? The detailed setup and results of this test can be found in appendix C.

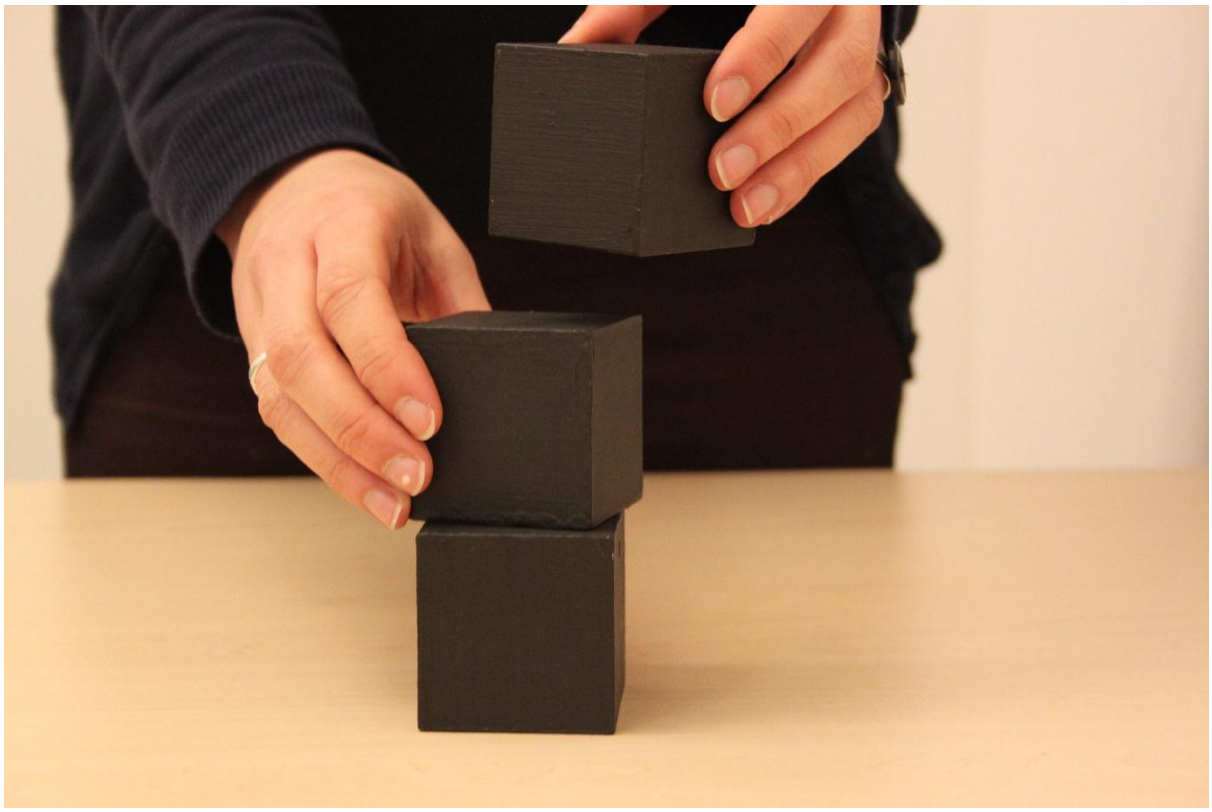


Figure 12: shows a possible interaction with the three cubes; the prototype we used during the co-constructing stories user test.

The most important results of this user test was that the participant pointed out the ambiguity of the marker moment. *"The flash, or marker moment can be distracting when you are in a workflow, but can create awareness of time and is a reminder when you are having a break."* Another interesting aspect of workspace lighting is that the participants like to work with a concentrated light on his desk. This 'spotlight' helps to focus on the work by ruling out distractions in the surroundings.

Reflection and Analysis:

During the second iteration the process was structured well. Starting investigating the context to find user needs gave us a solid base to start ideating from. The ideation needed some time, resulting in a good number of different ideas. The analysis of these ideas gave a list of values and aspects that had to be brought down to the core of the concept. This was a real struggle. Finding the balance between simplicity of the concept, without losing meaning and usefulness of the product was hard. During this phase of the project all team members were very critic and we could not agree on the best concept, since everyone had the feeling that the concepts were not good enough. Therefore the motivation of the group members was low. But, as we pushed ourselves further, we had an enormous breakthrough. All pieces of the project fell on the right place within the concept of time^3, which felt like a triumph. With new motivation the team worked hard to concept in a way that showed its potential.

The feedback we received at the mid-term demo presentation was positive. We definitely were on the right track. But we were not there yet. The concept had to be tested, since in this stage of the project, the concept could still be adjusted. If we should start building the final prototype and then test the concept, we would not be able to improve the concept anymore. Also, we should design the tangible interaction of our prototype, as the interface of the cubes should be improved. Therefore literature research should be done. We should think of the right forms corresponding to the parameters that need to be controlled with the prototype.

ITERATION THREE:

User Testing:

Once we moved into the final stages of concept exploration, we began to validate our design assumptions and highlight any required changes and alterations through qualitative user testing. Due to the intensive nature of our device being utilized over long periods of time, in order to create a discernible effect, we concentrated on providing the test subjects with ample time to use the device without specific guidance.

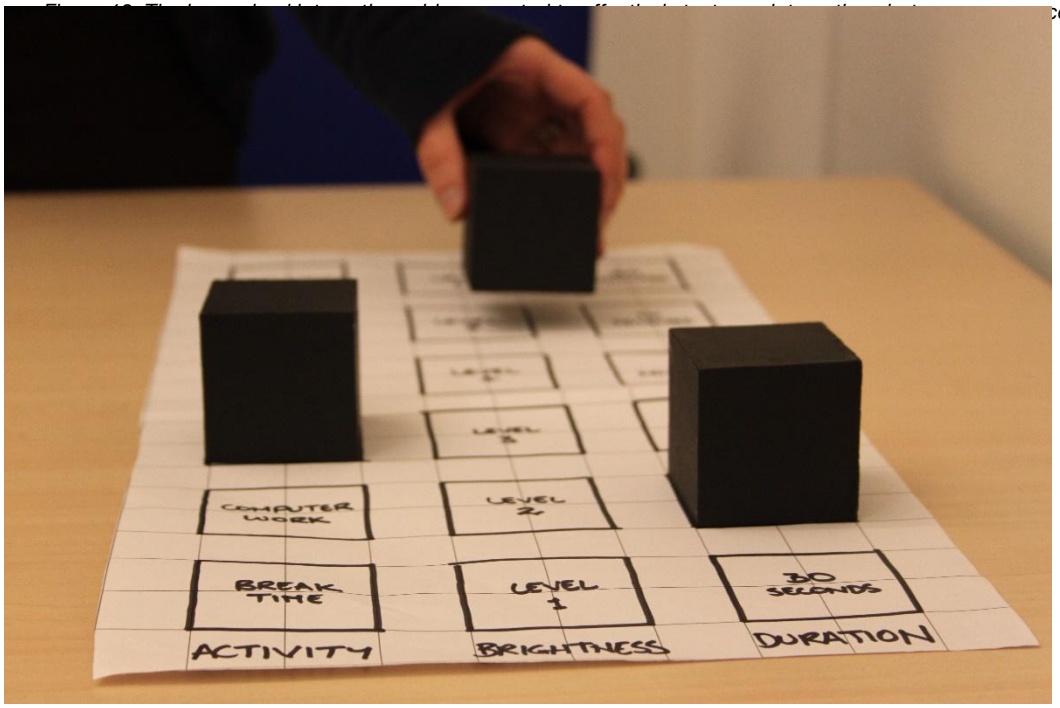
We booked the Interactive Light Projects test room, known as the “Breakout Room”, for a full day, and cleared its interior of everything but its couch, side table, desk, chair and potted plant. The desk we placed underneath three hanging lights, each with a hue bulb within it. These hues were connected to an interactive server where we were able to define six light pre-sets (based on colour and intensity of each of the three lights). These pre-sets were dictated based on the information cleaned from our academic research into the effects of artificial illumination through light-emitting diodes (Boyce, 2014). Once finalised, these pre-sets were as follows:

- Computer Work
- Break Time
- Reflection
- Entertainment
- Writing
- Reading
-

Once the light settings and desk in the breakout room were assembled, we planned to use the three cameras installed in the roof to observe a participant working for an hour at the desk we set up. The volunteers we had gleaned were asked to bring in some of their own work, and were not informed of the nature of the test. We would conduct a pre-test interview with each contestant, identifying their preferred work habits, light settings and the context of what they work on, and dependant on their studies/ profession. Once the test was concluded, we would again interview the test subjects, based on questions formed from observations throughout the test duration. This form of qualitative data was crucial in identifying real-world issues or conflicts with the concepts function, allowing us to adjust setting options, identify ineffective anomalies, validate the hypothesis behind the concept, and help dictate the eventual shape of the finalised concept.

Before commencing however, we quickly realised that the camera resolutions were not detailed enough to allow us to conduct our initial setup, the three cubes from TIME^3, painted black (to be better visible through the webcams), with each function/setting written on the corresponding side. To rectify this visual issue, we drew up two identical grids, three by six, with one cube dedicated to one of the three columns. The user would move each of the cubes along their respective columns to select the light setting, brightness and the duration for that setting. The brightness ranged from 1 to 6, increasing by approximately 16% for each stage. The time durations began at 30 seconds, moving up to 30 minutes. These duration settings were not ideal or reflective of the overall concept usage, but due to time constraints they were an effective means by which to force the user to interact with the test.

cept and test



We conducted two successful tests, with an Architect and an Engineering student, deliberately avoiding fellow Industrial Design students, who would be more inclined to question the motives of our test. When each student moved the cubes, they were told there would be an automatic system at work, however, we utilized the Wizard of Oz testing method to replicate the automated aspect of our concept. Watching each test together, one team member would adjust the light settings and brightness through the server, another would reset the timer for each adjustment of that cube, and the remaining two members would make observational notes and formulate questions for the post interview. Once each time duration was ended, a 'marker moment' was switched on in the room, in this instance, a bright pink light that pulsated in intensity, until the subject either reset the duration cube, or changed the overall light scheme setting.

Each test was a successful insight into the function of our concept.

The Architecture student initially took 10 minutes to briefly test each setting, before settling into work. In the post interview, he said that the writing setting was perfect for sketching and rendering, a clean, mildly warm light, which he said "allowed me to see the depth of colours that I was sketching very well". This was his by far, preferred light setting. He explained that warm, yellow lighting was his preferred choice, and usually much closer to his desk, a lamp instead of a ceiling/hanging light.

The Engineer tried the computer setting and the entertainment settings first. In the post-interview, he explained "I'm not inclined to test every aspect of a system… If I find something I like, I generally stick to it". The blue tinge to the computer light setting was enjoyable, as he explained, he was much more inclined towards cold lighting over warm, as warm light reminds him of candles and make him feel sleepy. He particularly enjoyed the muted reddish/purple of the entertainment setting, saying that it felt like it muted the background when he was watching a short movie, allowing him to focus better on the film.

Figures 14 & 15: Our two test subjects, Alberto, an Architecture student; Alessio, an Engineering student.

Both commented on the ineffectiveness of the bottom four levels of brightness, and how they both prefer to have the brightness settings up significantly higher. Each said that they didn't particularly need these bottom settings, as level 4 was low enough to enjoy the entertainment setting, which was the darkest either of them wanted the room. Each also noted that the devices interaction was overly large, and that having an interaction on a much smaller scale would be more effective. The Engineering student even noted that something small enough to sit beside his laptop whilst typing would be perfect, or even a device that stood above the screen, as these locations would allow him a fast adjustment of the light without having to turn away from his work. The muted simplicity of the cubes was noted as useful though, as they "melted into the background" until required again. This confirmed for us, that a minimalistic form would be the right design choice.

The marker moment was an unpleasant experience for both. The Architecture student said that "the idea of light changing outside of my control really bothers me… I want to always be in control". When asked how he would prefer to experience a marker moment, he immediately said locally, that if the modification came through something on his desk, like the cubes themselves, it would be much easier to deal with. Also, he noted, don't change the colour of the setting for the marker moment, just create a slow pulsing pattern, so as to grab the attention of the user, but not shake him out of his concentration abruptly. "That is bad for my work flow". The Engineering student also didn't enjoy it, but understood it intent better. Ï knew the moment it went off, that it was that unpleasant because I had to change something… So I did". He was the first to discover that merely resetting the time cube reset the whole system, an insightful observation to note, given that he instinctively knew to attempt that interaction on the very first marker moment.

Figure 16: Utilizing a Wizard of Oz testing technique, we were able to simulate an advanced lighting system, passively observing the participants through ceiling-mounted cameras.

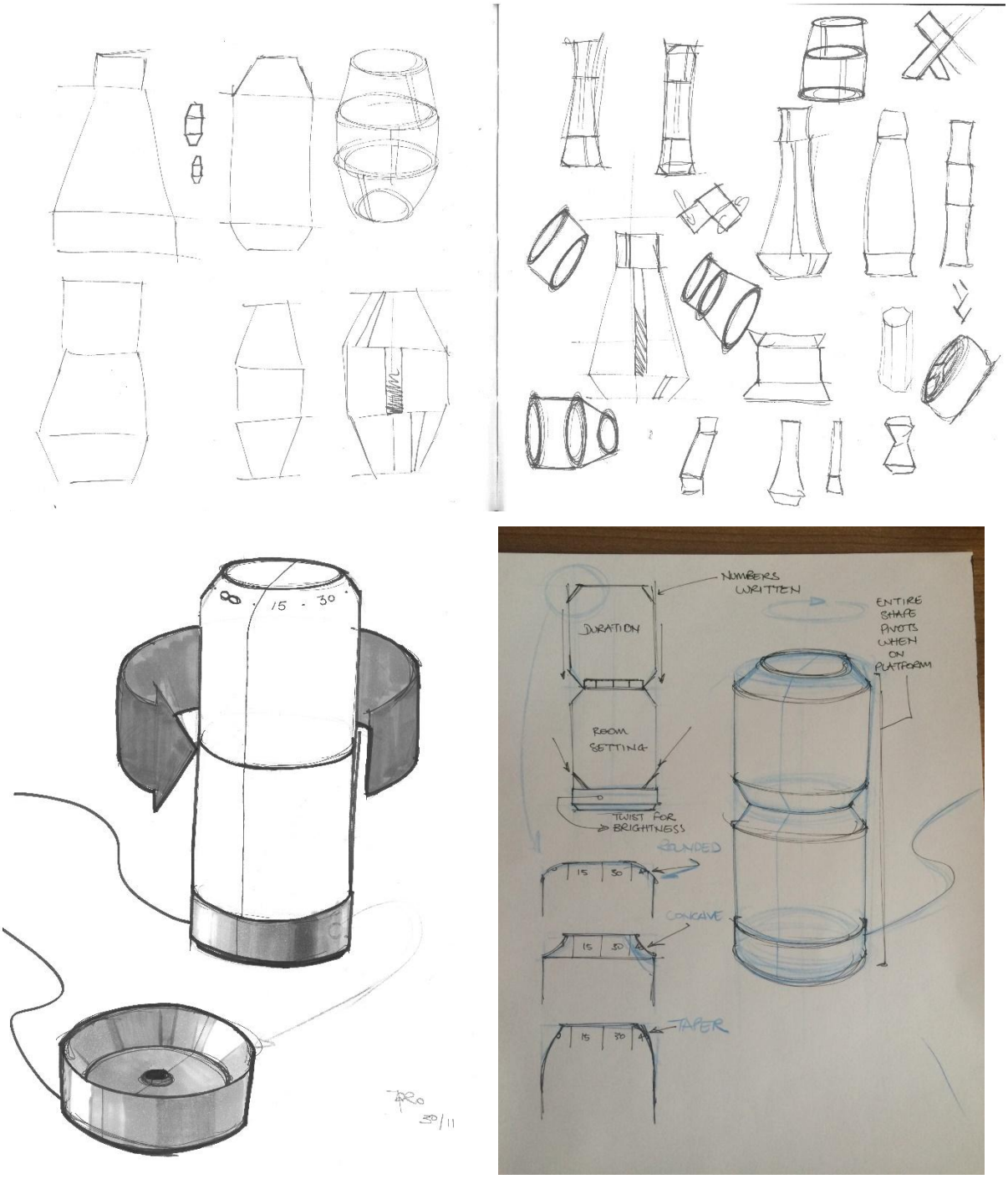
We made several decisive changes to our concept as a result of the tests. These outcomes were not so much alterations as much eliminations of possible functions. We decided to drop the bottom 40% of brightness and begin at the even level of 50%. We also confirmed that a smaller, locally based device was the key to this concept, as it would require minimal user adjustment, in order for interaction, including the marker moment being housed locally within the device. No colour alteration for the marker moment was deemed necessary, and we moved towards finalising the shape of the concept prototype, maintaining a minimal form, as to maintain a muted, passive presence when not in use. If the concept for altering your light settings – without disturbance – is distracting you, then that concept is a failed design.

Form Exploration:

The form of our design concepts was a crucial consideration within the design, not merely from an aesthetic perspective, but from a motivational one. No user is naturally inclined to use a device that is ungainly or complicated in appearance, so our aesthetic mission was to develop as minimal a device as possible, to compliment the surface the user utilised and encourage user interaction.

We began with research into the level of interaction we wanted between user and concept. We discovered the concept of 'graspable user interfaces' (Fitzmaurice, 1995) in the development of TIME^3, and wanted to pursue the idea of a tangible interface within the device itself, providing users with immediate data feedback that could "serve as manipulable physical representations of… value and operations" (Ulmer & Ishii, 2001). Due to technical limitations, we realised that the separation of each setting – as with the TIME^3 – would not be feasible, and thus concentrated on user interaction within a single contained design. Through our research and concept sketching we identified that we wanted two levels of interaction within the prototype, the physical and thus 'tangible' interaction of turning dials to dictate settings, and the 'intangible' interaction of LED's lighting up the side, as an indication of passing time. The distinct material separation of the final concept was also derived from our research, as Urp (1998) identifies that contrasting materials suggests the implication of separate functions to new users.

Tangible Interaction research coincided with concept sketches of form and function for the third iteration of our concept. Having initially focused on a minimalist rectangular tower in the TIME^3 concept, we wanted to maintain a similar clean shape, whilst maintaining the functionality of six options per setting. We settled on the hexagonal prism after deliberation, which we felt was the best solution from an aesthetic and functional point of view, both technologically straightforward and discrete.



Figures 17, 18 & 19: Various sketch explorations we conducted when exploring the potential form of the concept for our third iteration.

Once the tangible interaction between the user and prototype was decided, we constructed several MDF models of the potential dials, exploring comfort and the indication of their usage. The physical sizings of the dials, as well as the necessity of chamfers or fillets were necessary to explore, as these would dictate the diameter of the prototype as a whole.

These were fast and dirty models, made during a group sketch meeting where we shared ideas and explored their physical feasibility and effectiveness through MDF and drawing.

We found that a cylindrical knob was the cleanest aesthetically, but lacked the affordances of more geometric shapes. If close examination of the dial rotation were necessary for effective use, then the usability and purpose behind the concept would be without purpose. As such, we chose a hexagonal prism, matching the number of settings dictated by the TIME^3, and gave both the top edge and the edges of each hexagonal plane a very light chamfer, softening the harsh edges of the hexagon, more comfortable to hold for the user, without disrupting the appearance of the model.

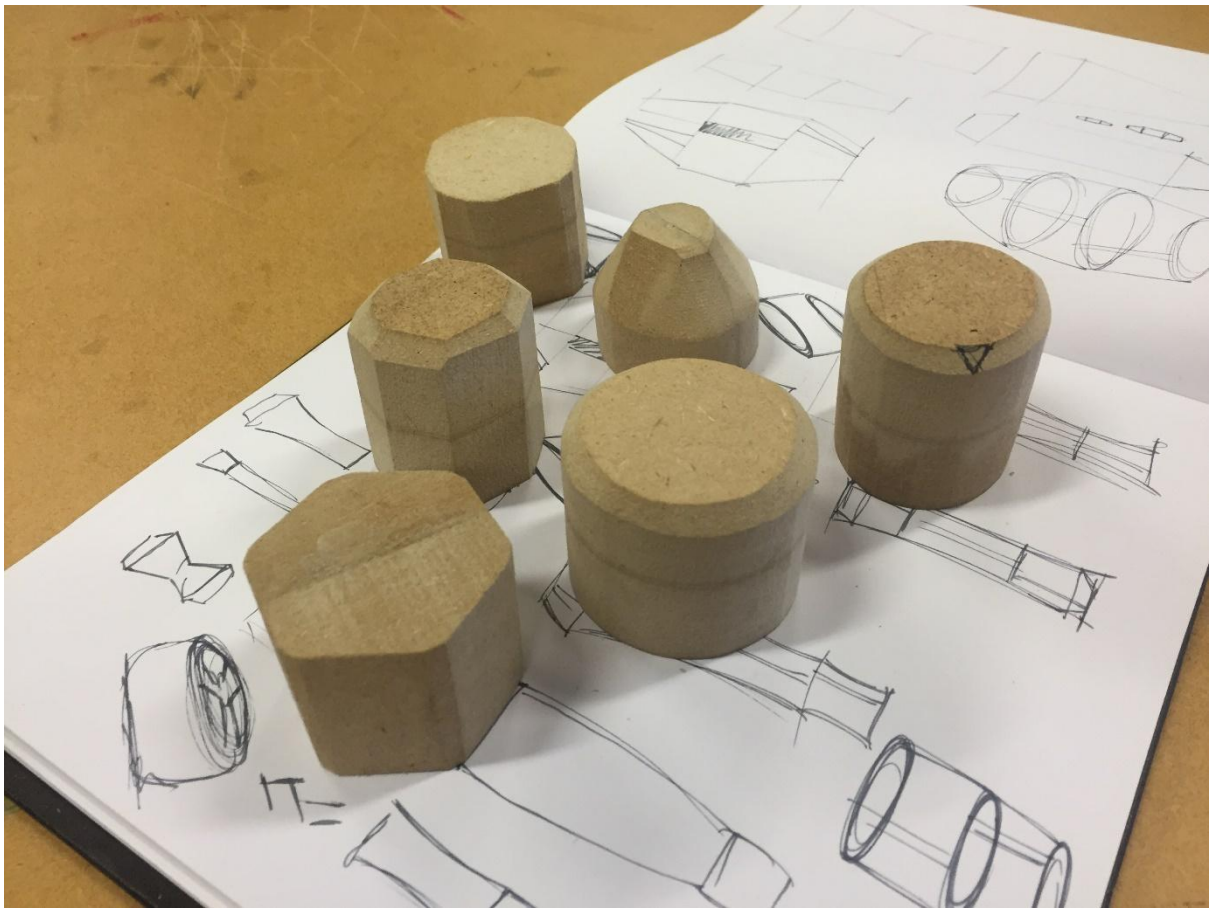


Figure 20: The rough form models made from MDF.

Due to the tight geometry needed for the device to hold electronics within a minimalist form, we opted to have the main body and inner ‘core’ of the prototype modelled in the 3D program, Solidworks. This step required a significant number of intricate measurements of all the dictated electronic components to be used within the prototype.

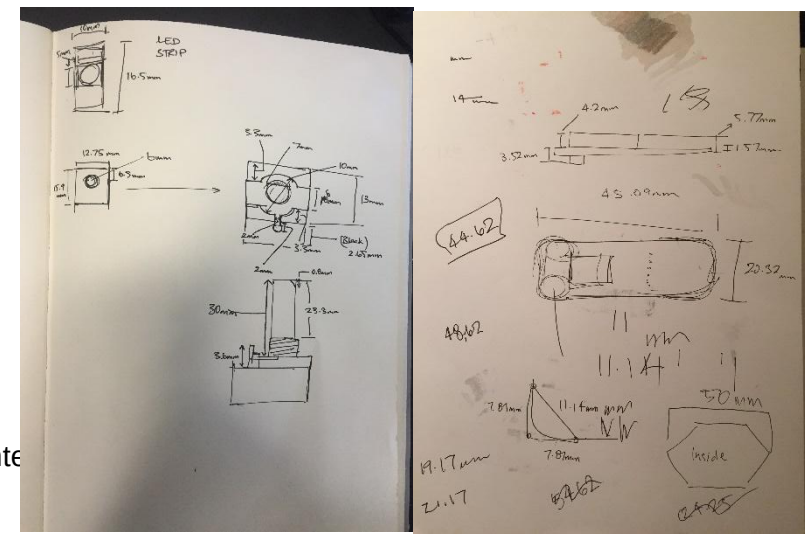


Figure 21 & 22: Detailed measurements of the required electrical components needed within the concept were required before 3D modelling began.

Once all the measurements were recorded, the modeling was broken into three main parts.

- Modelling the body caps that would secured the potentiometer to the body of the prototype,
- Modelling the outer cover of the prototype, which would act as a diffuser for the LED's within.
- Modelling the inner structure of the prototype. This 'core' was the vital component of the piece, housing the microprocessor, the LED battery pack, the LED's themselves (attached to its outer wall), connecting the caps securely through matching form-patterns, and pinning the cover in place, over the core and between the two caps.

The process of modelling these components was time consuming, as we had to ensure for allowances in the 3D printing. Once each component was complete, we digitally assembled them, incorporating a basic model of the microprocessor, potentiometers and battery pack into the assembly, to help highlight any intersecting components. Once complete, the models were each sent to separate print locations, depending on finish requirements. The cover was the aesthetic finish of the prototype body, thus we sourced an (expensive) 20 micron resin printer to create it. Both the caps and inner core were not crucial aesthetically, but required structural stiffness and high detail, so we source two PLA printers at 50 microns each, cheaper and structurally more sound than resin prints.

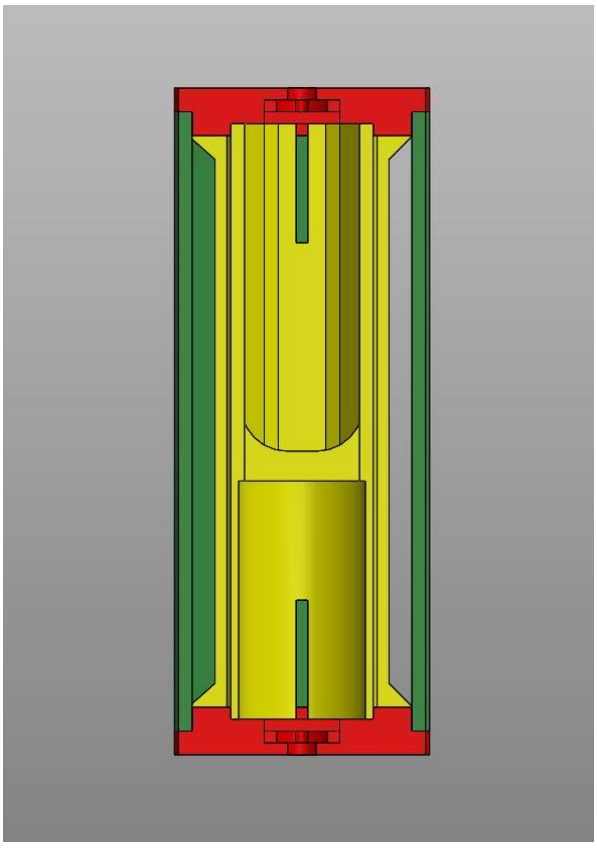


Figure 23 & 24: Front on and Side on section views of the 3D components of the concept when assembled together.

Lastly, the form of the dials had been dictated, but we wanted their materiality to convey a sense of value and importance. Users are more inclined to value design that is highly-refined, so we decided to look into milling the dials out of solid metal billets. We located a local scrapyard and sorted through scrap brass, copper, steel and aluminium. Ultimately, we found two small billet cut-offs of brass and aluminium that were serviceable. We created a general assembly drawing of the dimensions required, including the inner chamber for the potentiometer and its locking nut. With these plans and the two cut-offs, we used the expertise of the Vertigo workshop staff to cut four material models. A cylindrical aluminium dial was first – with the appropriate chamfer and inner chambers – to further analyse a cylindrical piece in comparison to a hexagonal one. We then had a test portion of the remaining aluminium cut into the hexagonal shape, to confirm the diameter and chamfer weights were appropriate for real-world use. After this confirmation, we had the two brass pieces milled in full, into hexagonal prisms. The weight and smooth finish of the polished dials was incredibly satisfying to hold, and the subtle golden tinge of the metal conveyed a satisfying sense of worth immediately. Thanks to the diligence of the staff in the Vertigo workshop, the pieces fit perfectly onto the potentiometers, and flush with the edges of the 3D printed caps and cover.

Figure 25: The newly finished metal dials, sitting atop the GA drawing used to dictate their overall dimensioning.

Technology Development:

Electronics

Throughout our project we explored several technologies. We integrated technology in our prototype at the end of our process because we wanted to determine our concept first. We were afraid that if we would focus too much on the feasibility part of the technology it would affect our process steps and freedom in ideation.

We worked with the Philips HUE system, Processing and LightBlue Bean (Arduino) and different kinds of actuators and sensors. We chose these technologies because they were easy in making prototypes. In order to interact with the Philips hue system we used several sensors in our process.

In iteration two we build our first working prototype named PERI, which consisted out of sensors connected to an Arduino, Processing and the HUE system. Initially we used three sensors: potentiometer, slider and a piezo. The piezo was a bit off in serial readings so finally we decided to use a joystick instead for better stable readings.

After a feedback meeting, we concluded PERI wasn't a success. After some process and meetings we started to build our validated prototype named CEL in iteration three. For CEL we used a different setup than PERI. We worked with the Philips HUE system, Processing and LightBlue Bean (Arduino) and different kinds of actuators and sensors. We chose these technologies because they were easy in making prototypes. In order to interact with the Philips hue system we used several sensors in our process.

The Arduino was too big for our prototype. We stumbled on a LightBlue Bean through another student. The size and the flexibility of the controller was exactly what we needed. A LightBlue Bean is a micro controller that is easily to program via the Arduino IDE. On board, there is a Bluetooth connection with a possibility for serial connection, an accelerometer, RGB LED and a temperature sensor. For more specifications here is the system architecture:

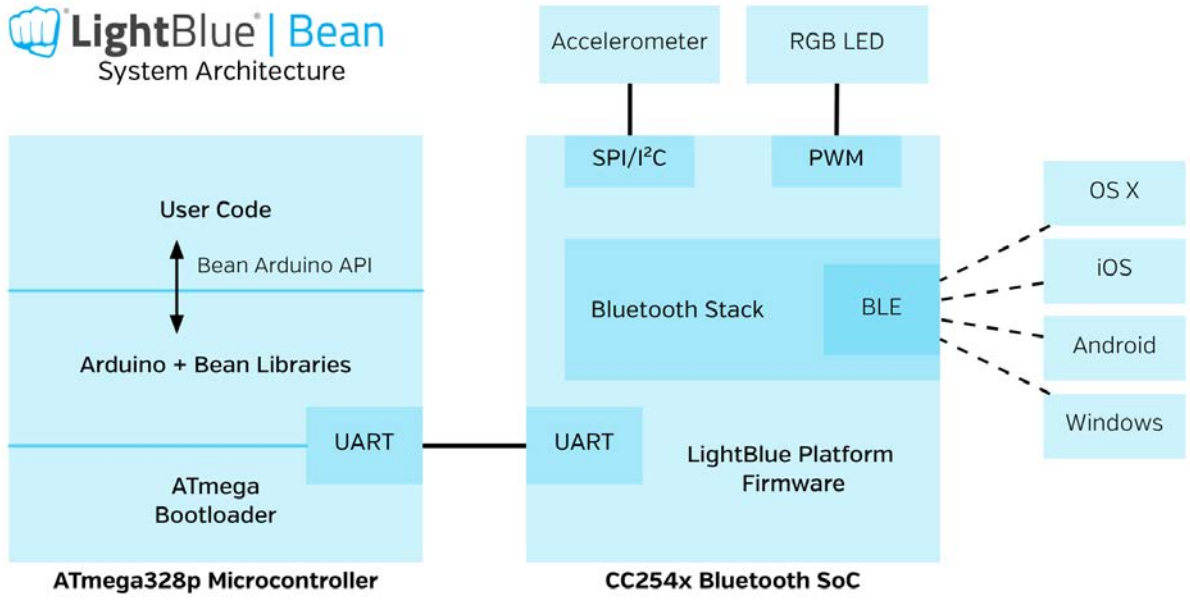


Figure 26: LightBlue Bean system architecture

The LightBlue Bean is super-efficient. When the on embedded LED would blink for a few weeks with 30 second intervals it would last for 39 days (LightBlue Bean, 2014)

In the circuit below we defined our final setup. The circuit consisted of two 100K potentiometers and an accelerometer as sensors and one WS2812B RGB full colour LED strip as an actuator. The potentiometers are connected to the analogy inputs of the light blue bean. The accelerometer is embedded on the IC. The LED is a digital output since it is a digital actuator. The Bean sends the serial data that is obtained from the sensors to the laptop using a Bluetooth virtual serial port.

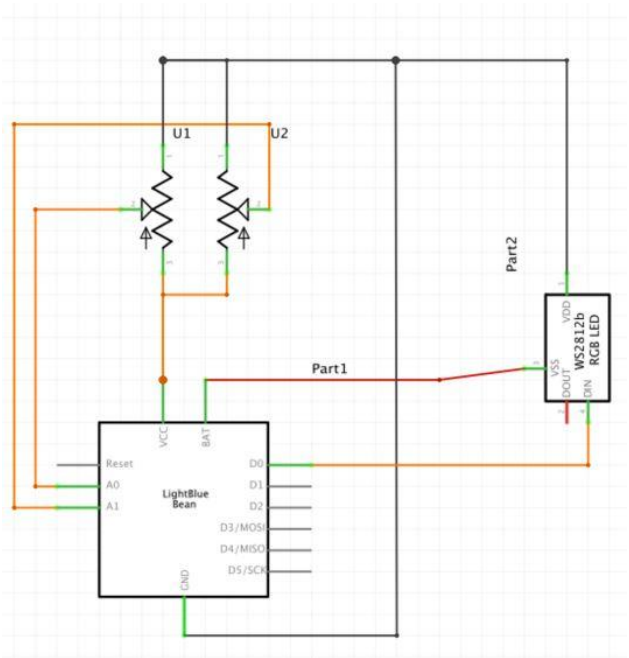


Figure 27: Circuit diagram of CEL

We first prototyped with an Arduino. This was much faster and easier to alter the circuit than the Light Blue Bean because if you want to prototype with the LightBlue Bean you need to solder your components on the prototype board. After the programming and the connecting the circuit. We uploaded the whole sketch on the LightBlue Bean and everything worked as desired.

Programming

In the project we used the Arduino and Processing language (codes can be found in appendix D and E) to connect the sensor data to the actuator and HUE system. The communication worked as followed, because the LightBlue Bean works with a 3v cell battery. It outputs only 3 voltages. In the circuit we connected the potentiometers to the Vcc(IC power-supply pin) of the light blue bean. When you are using a source voltage of 3v you get a serial input value of 0 to 600 rather than the 0 to 1023 with 5v.

We programmed it in a way that the algorithm will look in the array for the area where the current value of the potentiometer is:

```
int sensorVal[numSettings] = {100, 200, 300, 400, 500, 600}; //Array values potentiometer
```

To find the right value in the array when someone turned the knob, increasing or decreasing the numbers, we made a special function in the code which we called for twice, in the part of the code of potentiometer one and two. When a user turned the knob, the algorithm would look for the distance where it is and was and from this it calculates the right position and converts the number of the array and returns it to the code. E.g. when the sensors are activated by turning the knob clockwise, light blue bean would have send a bit to processing. The numbers of bits are 0 to 18. Every bit activates a different action in processing:

```
int getSetting(int sensorValue1or2) //sensorValue absolute waarde


{
 int closestSetting = 0; //Array values potmeter 0,1,2,3,4,5
 int smallestDistance = 600; //Hier eindigt de getallenlijn voor allebei de sensors
 for (int i = 0; i < numSettings; i++) //int sensorVal[numSettings] = {170, 341, 512, 681, 852,
1023}; //Array values potmeter 0,1,2,3,4,5
 {
   int dist = abs(sensorValue1or2 - sensorVal[i]); //functie dist = absolute value (positive
         number) of sensorValue - sensorVal [array]


   if (dist < smallestDistance)
   {
     smallestDistance = dist; // = Stores the value to the right of the equal sign in the
         variable to the left of the equal sign
```

```
            closestSetting = i;
  }
 }

 return closestSetting;
}
```

In the Arduino code, potentiometer one is connected to bit 0 till 5 and will activated the activity setting in Processing. There are 6 activities: break time, pc work, writing, reading, entertainment and reflection. Every activity setting consisted out of one command that would have been sent to the Philips HUE bulbs when the specific number between 0 to 17 was received in Processing. Thanks to Serge Offermans, one of those commands looked like this:

```
sendHSBToHue(12, 100, 255, 220); // First int is bulb ID, second hue, third saturation and fourth the brightness
```

Potentiometer two is connected to 6 till 11 which activate 6 different time settings, respectively: 15 minutes, 30 minutes, 1, 2, 3, infinite hours. These time settings are connected to the actuator (LED strip). The actuator will subtle show the light of the led strip when time pass by. When the 15 min setting is activated one will see the led strip, led by led getting illuminated calculated according to every different time setting.

Bit 11 till 17 activates the brightness of the HUE lamps in processing. The last bit is getting activated when the actuator is fully illuminated. This means that 5 LEDs are illuminated with a number of 255. This will send the number 18 to Processing and the actuator will stop. In processing the number 18 will activate a so called marker moment. The HUE light bulbs will pulse for a few times to let the user know time is over.

In the diagram on the next page we have outlined the Arduino - Processing communication to make it visually clear.

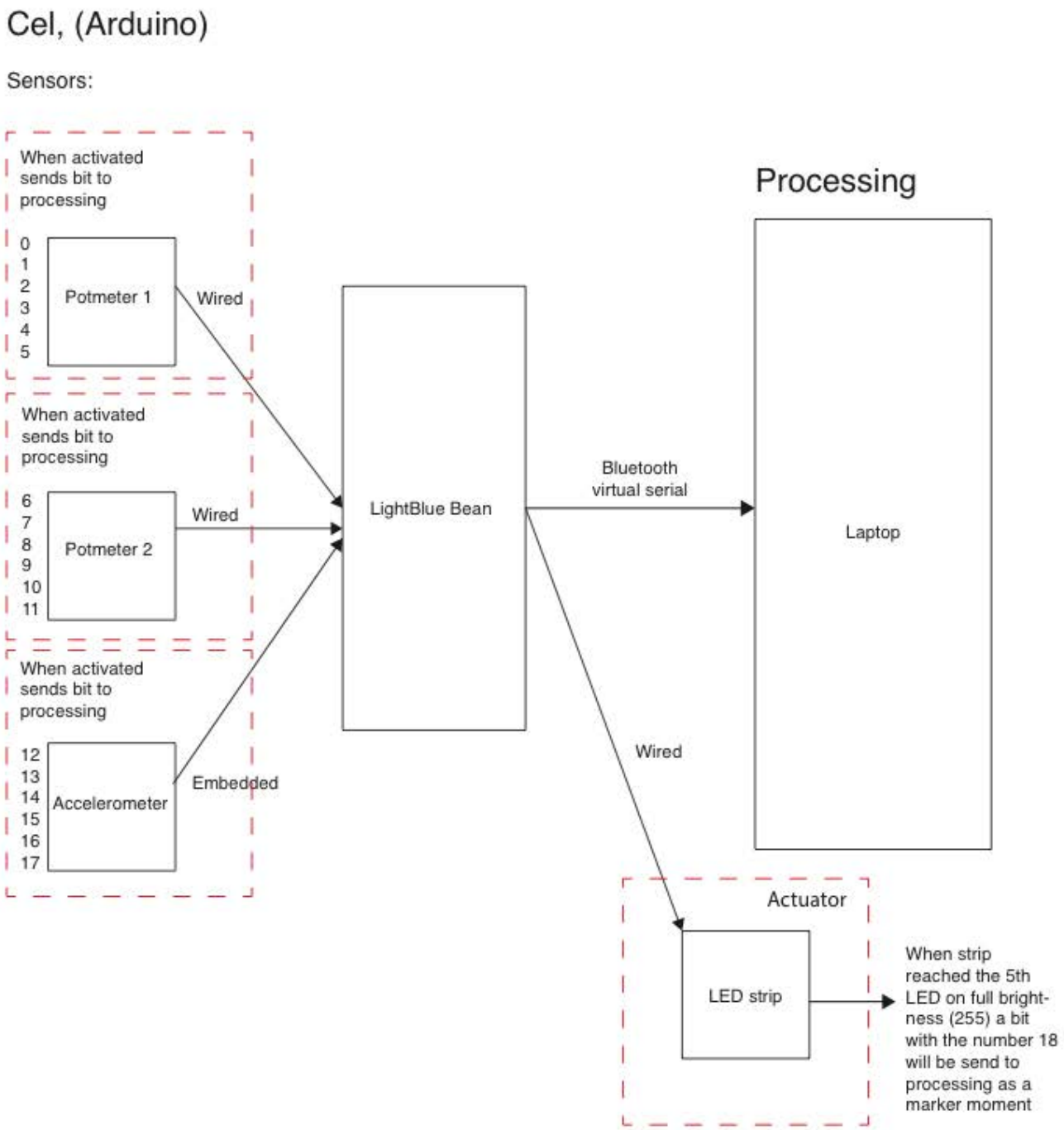


Figure 28: Showcases the diagrams of the communication between CEL(Arduino) and Processing.

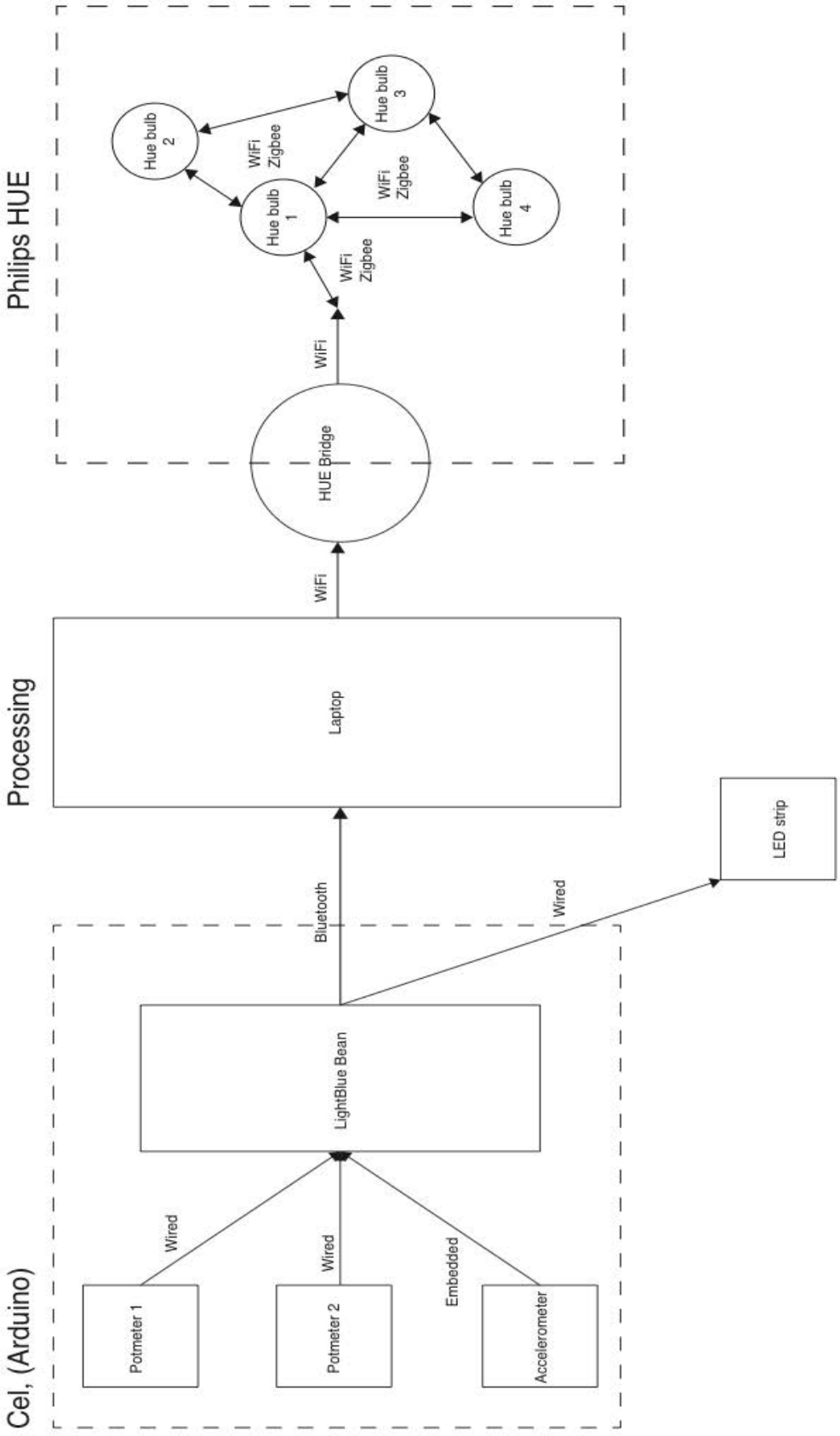


Figure 29: Showcases the diagrams of the total communication of CEL.

Issues and Reflection

An issue was that the light blue bean is connected to a laptop. Part of our concept was to make the controller portable. If we made a few more iterations we maybe could have connected it directly to the HUE Bridge instead, without using a laptop, e.g. using a Particle Photon micro controller, that is able to connect with the small WIFI chip. That would have made the object more autonomously and independent.

Another problem we encountered was the connection of the wires of the circuit. It was very fragile. For the next time it would be better to make a solid breadboard PCB for the prototype. Also, the accessibility of the electronics was hard because of the construction of the case. Next time it would be easier to create a case that is horizontally sliced in two and hold together with screws so it is easy to mount and dismount the electronics when a problem occurs.

Prototype Assembly:

The assembly of the physical prototype was a challenging chapter in the development of this concept, most notably due to a number of challenges presented by the material limitations of 3d printing.

Once we had accumulated the necessary parts, we listed:

1x Beam Microprocessor

2x Potentiometers (360 degree rotation)

1x LED light strip (five diodes)

1x Cell battery pack

Various wiring

2x Brass rotating knobs

2x PLA printed plastic knob caps

1x PLA printed plastic ‘core’ structure

1x Resin printed hexagonal cover (one plane removed)

1x Opaque acrylic rectangular panel (filled the missing cover side)

These parts were accumulated from various sources, and as such, it took considerable effort to securely connect the electronics within the device, and then assembly it safely. Overall, it was a success, but not without issues, the largest of which was the first printed copy of the ‘core’ structure. Printed through a 3rd party supplier, the core upon arrival was badly warped and damaged on 1/3 of the bottom section.

Since the internal section for the core was hollow and carefully measured to exactly fit the microprocessor and battery pack within, the warped walls of the core resulted in a

frustrating several hours of alteration. The core was central in function as well as name. It held and protected the electronics, connected to the caps which held the potentiometers at either end - which in turn were connected to the brass knobs – and its hexagonal profile held the resin cover in place to finalize the concept design. Having to cut and sand away partitions to attempt to fit all the parts cohesively ultimately was a pointless endeavor and we ultimately had to discard this initial core. Fortunately, we had allowed for this possibility, and had a backup model ready to print immediately, should anything untoward occur to the initial core print.

After this initial setback however, we were reasonably fortunate for the remainder of the assembly. The potentiometers were each attached to the PLA caps with a nut and bolt, and the resin cover was slid over the core structure, Held in place through the hexagonal design.

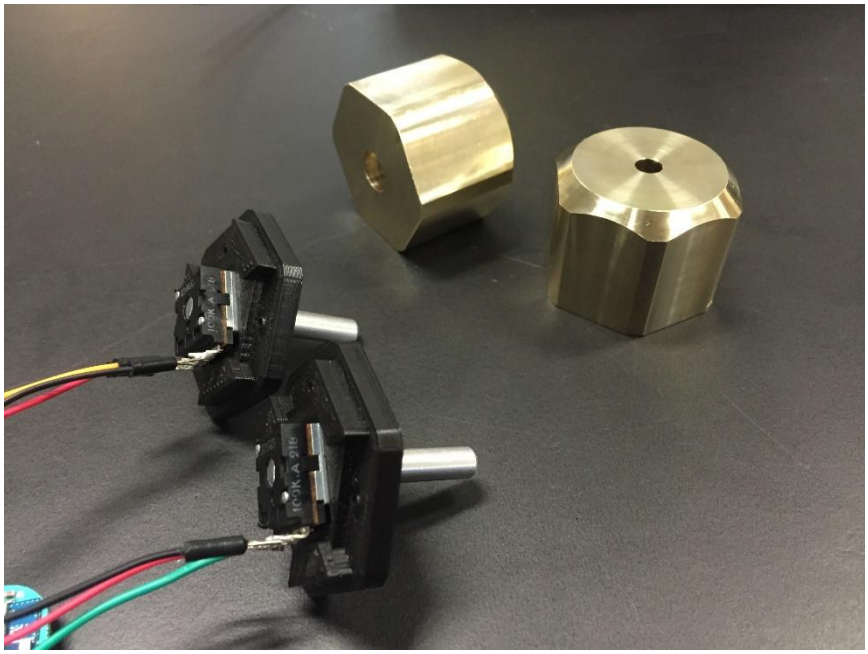


Figure 30: The exposed caps of the concept, with the potentiometers already screwed into place. The potentiometers would then slide into the metal dials.

Once the cover was secured, each PLA cap was screwed onto the respective open end of the (new) core, securing them with three screws for each cap. Once the central body was secured, we connected the brass knobs to the shafts of the potentiometer using a liquid rubber cement. The brass (as mentioned) had an inner chamber milled out from the bottom of each knob, allowing for each knob to sit flush over each potentiometers securing nut, against the smooth surface of the PLA cap.

Figure 31: The careful measurements and checks paid off – when the brass was complete, each fit perfectly flush against the edge of the concept prototype body.

The very last step of assembly was the gluing of the opaque panel into place, within the hexagonal resin cover. This final step was an intricate process that we learnt a lot from in the consideration for the next iteration. Due to the chemical nature of the cyanoacrylate glue we were using the secure the plastic, this would stain the acrylic panel noticeably, blotting the smooth surface with a dark patch, regardless of the increasingly smaller amount of glue we applied for each attempt.

Figure 32: Despite the issues with gluing the acrylic in place, the end result was still a satisfying diffusion of the LED's, particularly for a piece only 1.25mm thick.

After several acrylic panels were ruined, and the resin cover itself began to flex slightly under the pressure of constantly being pulled apart, we decided to cut a small 'V' shaped grooved into the cover's open sides, and file a point onto the acrylic, sliding it into place. This temporary solution was usable, but delicate and easily displaced when being used, a solid consideration to re-design in our next iteration.

Overall, our prototype for the concept was satisfying in its aesthetic appearance, but it did have several shortcomings we would wish to highlight, and explain the conceptual function the prototype would have instead.

Firstly, the brass knobs were too heavy to be used on a device constructed primarily from plastic. The weight was oddly balanced, heavily skewed to either side of the prototype unless you held it perfectly in the middle, raising concern over the risk of dropping the concept, especially if used on a daily basis. Theoretically, we would also have icons on each plane of the hexagonal knobs to convey which setting the user was choosing. However, the technology required in order to accurately etch these icons onto the metal knobs was not easily feasible, and as the milling of the knobs themselves took over a week, we did not have the time or knowledge to justify the risk of etching on the icons. The clean finish of the metal was crucial for a coherent air of luxury within the device on Demo Day. For the next iteration, we would like to utilise salt-water etching to permanently place the icons on each of the six sides (of each knob).

Figure 33: The conceptual development of icons for the concept was still in development, as we attempted to balance clear distinction with a minimal line work.

Our solution to this would be to manufacture the final knobs out of aluminium and shorten their dimensions from 30mm to 20mm in height. This would mean that the significantly reduced weight of aluminium would not cause the accidental damaging of the device, but would also not take away from the polished refinement of metal finishing, and would allow us to anodise the aluminium, expanding the potential colour scheme of the concept.

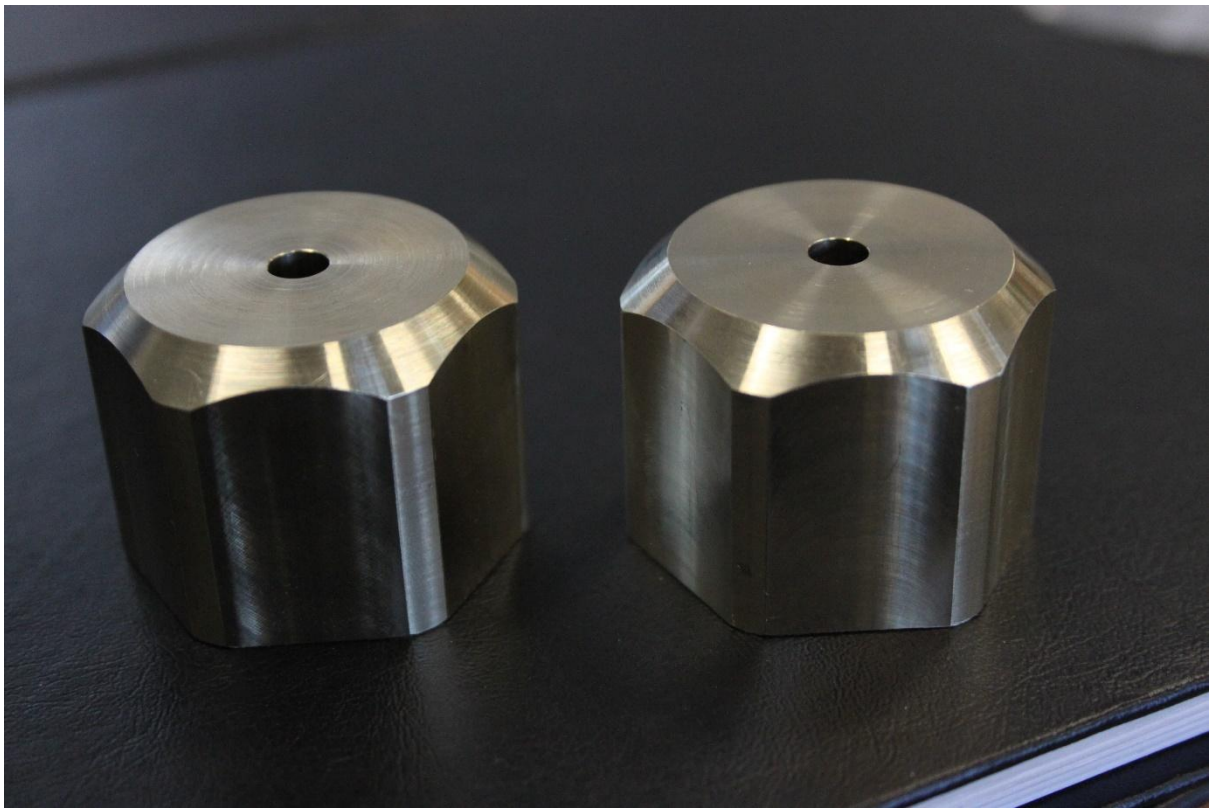


Figure 34: The weight and solidity of the brass dials was both a great strength and weakness of the design, one that we have since reconsidered to maintain its luxurious finish.

Secondly, the internal core of the prototype was too weak to be the main support structure. With metal at either end of it, attached through the potentiometers and caps, the core was not constructed of a durable enough material to be long lasting. We would like to research the possibility of a simplified core that is made of aluminium, and can be split in two, length-ways, so as to allow easier access to its hollows compartments (for electronic maintenance/modification). When any changes were finalised, screws would secure the two sides of the core back together. It should be noted that for continuity purposes, the caps would ideally also be constructed of aluminium, so as to eliminated the possibility of plastic wearing down and failing.

Thirdly, the resin cover of the concept prototype, a matte black, would be an opaque colour, and would not be missing a side of its hexagonal profile. This would eliminate the need for a panel attached after the fact, smoothing the aesthetic appearance of the model, but also strengthening the cover overall, as it would be a closed geometric shape with structural integrity. The design decision to leave out the side was however, a deliberate decision dictated by the technological capabilities of the electronics we had on hand for the project. We initially wanted to have 30 LED’s within the prototype, five diodes for each of the core structures six sides, but the power consumption of that number of diodes would run the batteries dry within minutes, rendering the prototype useless for continual demonstration and use on Demo Day. Therefore, we decided to use just five diodes, attached to the one side of the core. The resin we printed the case in would be far too expensive in opaque, thus we decided to remove one panel and attach an opaque replacement after the print.

Fourth, and lastly, we were not able to incorporate the brightness aspect within our concept prototype for Demo Day. For the theorised market product, we would like to control the brightness through some form of gesture, ideally tilting or rotating the device back and forth to increase and decrease the brightness of the connected lighting system. Unfortunately, due to time and coding constraints, we were not able to resolve this issue fully, and so incorporated set levels of brightness within each of the light settings for demo day, to at least demonstrate the theoretical scope of control the concept had over light.

Demo Day Feedback & Reflection:

Our Demo Day was a fruitful endeavor from a development perspective, as we were not only welcomed with many positive comments on the function and complimenting aesthetics of our prototype, but also inundated with intuitive considerations and feedback on how to further develop our design for the continued iterations of our concept.

In regards to the shape of the prototype, people universally enjoyed the simplicity of the hexagonal prism. They felt its minimal aesthetic leant itself to the function of the device, but it was suggested to us on several occasions to consider shortening the overall length of the prototype by as much as one-third. This would tighten the appearance of the device and bring its centre of gravity closer to the surface it was standing on, reducing the risk of it toppling onto its side.

Figure 35: The consistent theme of brass colouring matched with black was successful aesthetically on the Demo Day,

drawing people in to ask question and most importantly, touch the polished concept prototype and look through our photo booklet.

Materiality wise, people appreciate the highly polished finish of the metal knobs. We received many compliments on the value conveyed by the materials of the device, and were encouraged to take that a step further by incorporating more metal into the hidden core, a suggestion we had already noted down amongst our team. In regards to the brass specifically, several concerns were raised over the weight damaging the device should it fall, and someone suggested that we either replace the brass for aluminium, as we earlier considered, or hollowing out the brass to reduce its weight, as it was too heavy as it was to confidently handle and manipulate. One individual suggested actually separating the two knobs through material, one being hollowed brass and the other aluminium, to reinforce the differentiation between the two.

The resin cover and opaque acrylic cover were adequate for the Demo Day model, but a suggestion was made to replace the entire cover for a closed off frosted black glass or darkened acrylic, dense enough to heavily diffuse the LED lights within the concept, but uniform in appearance, eliminating the need for an acrylic panel that didn't match the remainder of the cover.

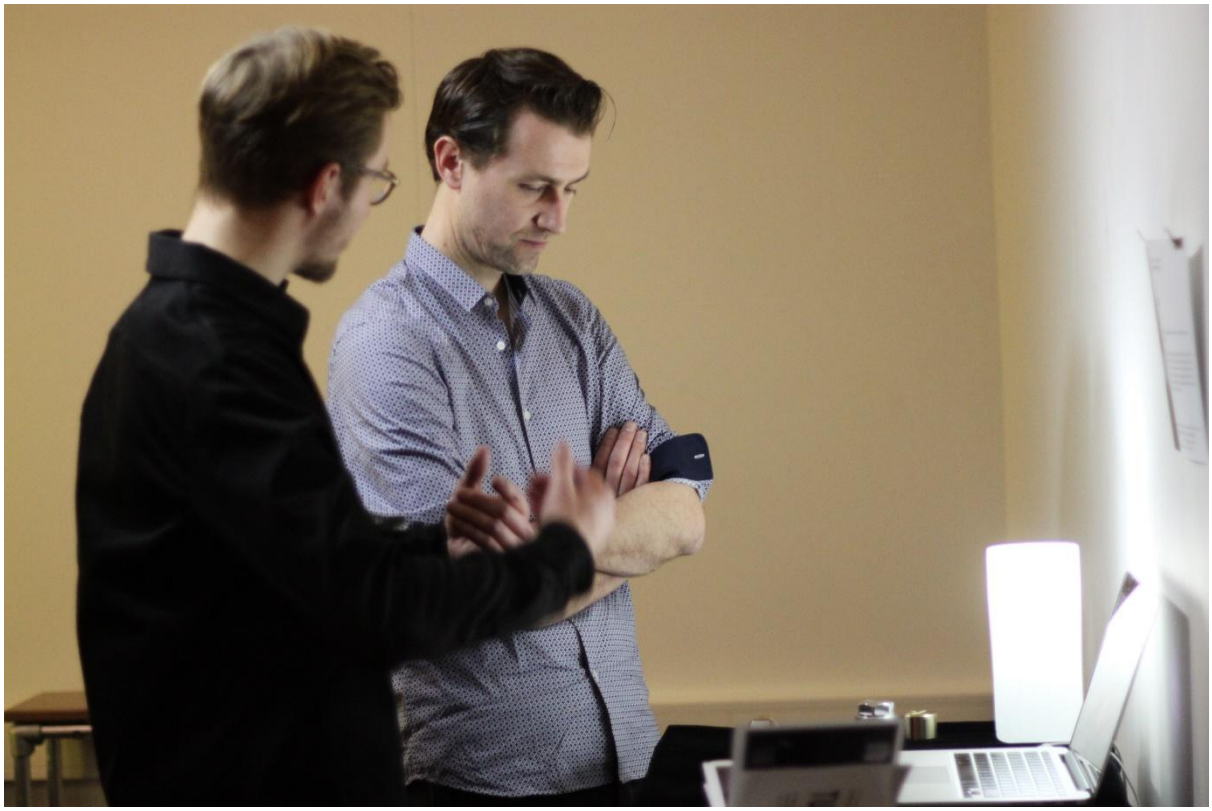


Figure 36: Our project expert, Serge, gave us excellent feedback on the possible interaction to alter brightness, a tilting motion to each side for less or more light.

Function-wise, the suggestions we received were insightful and considered. Our project mentors each emphasised the importance of the user interaction, and wanted us to carefully consider the function behind the theoretical alteration of brightness. Our initial idea was to shake the device in order to alter the brightness, but each mentor suggested more graceful alternatives, to maintain a beautiful interaction within a beautiful concept. One

suggestion was to have a touch sensor on the hexagonal cover of the prototype, and moving your finger up or down the prototype would alter the brightness, a clean – if technologically challenging – prospect. The second suggestion was to utilise the already functioning gyroscope within the microprocessor, and tilt the entire device either direction, in order to adjust brightness. This was a wonderfully helpful suggestion that was both practical and in line with the interaction we wanted to promote. Shaking is an aggressive tangible interaction – poor for work concentration – whereas tilting is a calm alternative and able to be adjusted to a far greater degree of control.

Each suggestion was marked down for consideration in the next iteration of our project. For the next iteration, we would broaden our research and perspective, looking to envision the different scenarios of use and context in different space. Could our device be used by the travelling businessman, able to connect to light systems anywhere in the world and set them to his preferred settings? This is a question we would want to address. We would also want to research the concepts effects over a longer period of time. This would allow us to validate the idea that it does help you to remain disciplined when balancing work and non-work related activities, and possibly allow you to work more effectively, for longer.

Final User Test:

To finalise iteration 3 we decided to do a final user test. The goal of this test was to examine if the timer aspect of the prototype in practice would be an improvement for the discipline of a participant in a work home environment. We first made a setup, which can be viewed in appendix F. We decided to inform the participant about the concept and then the participant had to work for one day with our prototype. At the end of this day we interviewed the participant about the experiences with CEL.

Figure 37: Final user test participant

The outcomes of the test (included in appendix G) were surprising. The normal work day of a participant consisted of six to ten working hours. At the same time in the morning when the participant wrote his to do list, CEL was incorporated in the planning. According to these tasks the participant adjust the time knob of CEL. The time settings of half an hour and two hour were the most frequently used during the day.

In general, it gave a lot of physical energy throughout the day since it reminded the participant to take breaks. CEL was not only appreciated by the fact it gave a lot of energy, the participant was new to the use of colour control of their light in a home setting and it gave him a good mood. On the question how CEL would fit in his home setting, he stated: “I don't know, the possibility to control the colour of the light is new to me, I like it and I think it really can add value. It also has a positive effect on my mood and therefore my well-

being” The overall experience of the participant was positive with some negative remarks. In functionality there can be improvements like a start knob when a latent user would use CEL with feedback on a matrix LED screen.

The biggest problem with the object was that it wasn't clear how the participant could set their preferred setting. Another remark concerning the interaction was the urge for a sequence of pre-sets chosen by the participant. In other words, the participant wanted to save his preferred settings so he didn't had to turn the knob the whole day or even a week. What if the product could learn from the use of a latent user to accumulate the settings for the next week as extra personalization? The LEDS on CEL didn't added extra value because they took away his concentration. Alternatively, the participant would have preferred to see a full colour LED matrix connected to the chosen setting ‘theme’ which showed a countdown timer using digits as time. The weight of CEL was too heavy and too large. The participant suggested a size about twenty-five percent smaller but emphasized to leave the aesthetics of the design intact. The timer aspect was appreciated but not how it was designed. The participant told us that “Very often a product can look pretty but that doesn't mean the interaction will also work flawlessly as planned”.

This was a learning moment for all of us. People perceive interfaces different than designers do. If we had more time, we could have made two prototypes with different time displays to research which potentially could have been better.

Reflection iteration 3

During the whole design process, we focused less on the technological restrictions and feasibility. This has enabled us to make concept decisions that were not biased by the aspect. As result some of the components of the concepts were not fully developed.
In iteration three, our focus and effort has shifted towards realization and thus feasibility of the technology. This has enabled us to create a functional prototype we have deployed during the final user test in order to get reliable results.

Although the prototype was fully functional, it was not fully developed from a practical point of view. For example, the accessibility of the electronics in the final prototype could have been better. We could have made the casing of the prototype in two pieces. If we had directed our focus to a more technical and practical point of view earlier in the process, we could have avoid it. In the future we would integrate this knowledge to bypass practical difficulties.

Through material exploration and material choice, we believe that it has brought the prototype to higher level. It was also beneficial for the presentation and user tests because it was easier for others to imagine the product and interaction because it's closer to what want to achieve. The use of different materials has also contributed to the form exploration. It has enabled us to not only explore in shape, but also in mass and texture of different explorations.

Having more time to develop the concept has given us the opportunity to validate different aspects of the concepts such as the parameters and the user experience. The multiple user tests were of great help for the validation of the concept. During the process the preparation and execution of the user tests were crucial. It was important to give the tests subject the same amount of information and the same ambience, so that the result can be more reliable.

As a result, the overall experience of the final prototype was positive. Although there were some deficiencies we have managed to complete the third iteration successfully.

Project Process:

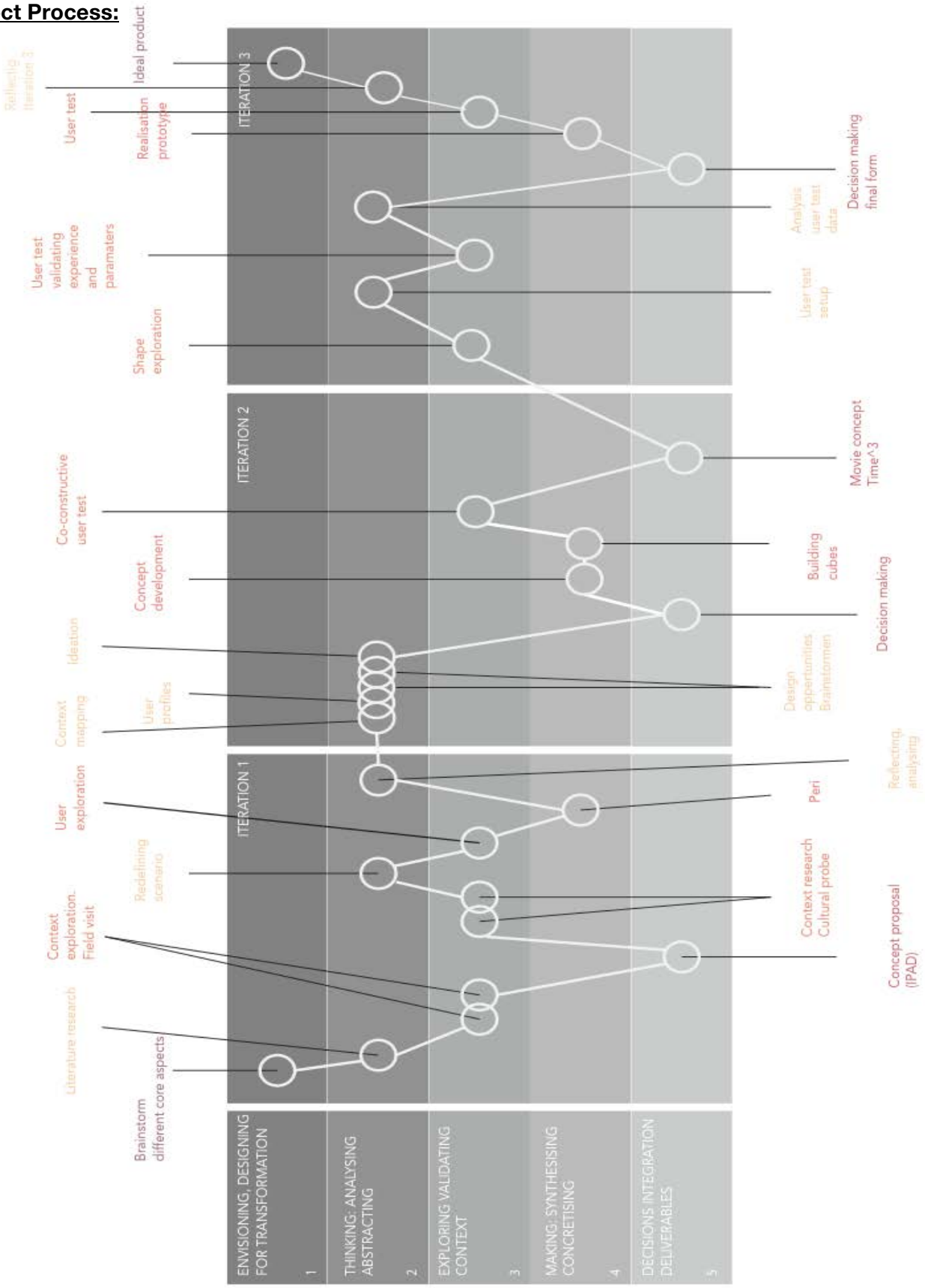


Figure 38: The visual map of our design process throughout the duration of the project.

Individual Reflection: Selim Haase

At the start of the project I felt anxious because I knew I was going to work with 2 much more experienced students. I have managed to translate this negative feeling into a positive attitude by challenging myself to keep up and reach their level of development.

Overall I consider the teamwork as a positive experience. I'm aware that for a group of people to achieve the members should be motivated, this was the case since I believed my team members were as motivated as me. What I also enjoyed during the project is that I have managed to develop competencies by taking initiative in specific work in the process. I also believe that my teammates gave me the space to decide what I want to develop, which I found pleasant.

Working with strict iterations was new for me. During previous projects I was never able to complete 3 iterations. I became aware that by doing multiple iterations I have more insight on my process, which leads to improvement. For example at the end of the first iteration I realized that the individual phases of the process were not coherent; I felt that the process was fragmented. I soon became aware that this was the cause of a lack of reflection between the phases. I tried to improve this in the second iteration which had as result that the design process was much more coherent.

During the project I tried out a more research oriented approach than what I'm used to. For example assumptions taken related to the effects of light on the user. By basing assumptions on academic research I believe the quality of the design and design process has improved, since it contributes to the validation.

On the other hand I also feel that the concept is stronger because I created multiple opportunities to validate the concept, mainly through user testing. By implementing the knowledge I have acquired through the attending the UFP elective. I have managed to get the more out of the user tests by improving the preparation. I believe that the reliability of the result has been improved my using a clear test structure for all the participants.

More focus on validation than realization, made me feel anxious because of lack of time and expectations concerning the result. During this process I have learned that focusing less on the technical restrictions can lead to different results. But I am now aware of the importance of validation and I have learned different ways to prove the effectiveness of concepts.

One of the goals I have identified at the beginning of the semester is that I wanted to acquire knowledge and developing skills related to using materials and aesthetics. I believe that the project has given me plenty opportunities to realize this goal. For example translating the sketches I have made to a model and eventually the final prototype. Having used metals was new for me, but I truly believe that it has contributed to the aesthetics and interaction of the final prototype.

Individual Reflection: John Daniel Rhys Mirabelle

My university back home, The University of Technology Sydney, maintains a course focused on products and engineering, on the refinement of models and understanding their manufacture and function. My experience at TU/e has been vastly different. From my perspective, TU/e appears to be a university focused on the development of ideas and services over tangible products. The emphasis on coding and electronics is also vastly more developed at TU/e, and these points of difference are why I have gone on Exchange, as an opportunity to experience design thinking through the frame of a more conceptualised university.

Personally, this project was an opportunity to increase my understanding of interactive design, collaborative teamwork, and the process of developing iterative design. The idea of exploration for the sake of understanding and the reiteration of complete design cycles, from research to idea to concept formulation to presentation, was something I was not used to, and definitely an alternative way of thinking about design. Design processes are heavily focused on at TU/e, and I enjoyed the emphasis on idea justification and the exploration of concepts, rather than just the development of an aesthetically beautiful product. That being said, my group definitely worked hard to develop a concept that was refined and polished for Demo Day, which I'll admit I was pleased about.

From a cooperative perspective, this project has been fruitful in the development of my team skills, communication and management. Our team has had moments of conflict, due to our different mind-sets on design, but we have been able to address these constructively and ultimately turn our different approaches as designers into perspectives that lent body and strength to our design concept. It was comfortable working so closely within a small team of designers to resolve a design directive, and a thoroughly enjoyable experience, as I have never before experienced an entire semesters worth of teamwork on a designated project.

As a result, I have now recognized that electronic processing and data visualization platforms like Arduino and Processing are not strong suits of mine, but I also understand that as designers, we cannot be skilled at everything – what is the point of collaboration if not for bringing different expertise together. My development as a designer of user-interaction ideas and human centred designs has greatly increased due to this project and particularly my team mates. Whilst I was able to share my knowledge of 3D modelling and presentation, they have shared their approaches to design questions, concept validation and how to frame an entire process around the end-user. During these past six months, I have become more conscientious of the purpose behind design as a whole, rather than the end image of a design. I question the reason for form over function now more than ever, and I know I have grown as a designer and more importantly, as a design communicator and leader. It has been a challenging but fruitful experience to be a part of TU/e, and the Interactive Light Project this semester.

Individual Reflection: Randi Nuij

I described in my learning goals that I wanted to explore my capabilities as a team leader. I became aware of my qualities and weaknesses performing in this role. I have a clear vision of the structure, steps and direction of the process, which is important to give the team members direction step by step. But I also missed important aspects of leadership: being able to make decisions and present myself as a team leader to my group members. I now know that I should not be afraid to speak up and show myself. And, as this project was of a really high standard for me, I am confident that I can lead other projects to a good end.

I also made a major development in understanding design processes. As me and my team members came from different educational backgrounds, we had different design approaches and were used to different design processes. To explain my explorative design approach and iterative design process to the others, I needed to fully understand what I was doing and why. This gave me a critical attitude towards my own design approach and a broader perspective on other design approaches (research based) and processes (linear design processes). Thereby I am able to use elements of other approaches and processes in my own design processes.

Another aspect of design we focussed on in this project was aesthetics. I felt that at this faculty, the focus lies on the development of innovative, technological and meaningful concepts. The aesthetics and presentation of the concepts are considered less important. Within this project it was the first time for me to focus on this aspect of design right away, which made me aware of the differences. To create an experience, aesthetics are important too. I also see now that the material standards of prototypes can easily be raised. We are not limited to MDP and Perspex for prototyping materials, but we can use any material and make it as pretty as we want. I definitely am going to focus on aesthetics in future projects, because it takes the project to a higher level in all aspects of the process.

Acquire programming skills was another important learning goal, so I tried to embed this in my project. Starting without any programming experience, I still have a long way to go until I can program the software of a prototype with multiple in and outputs. In this project I first touched on this set of skills, but it needs practice. A lot more than I have had now, this will take time. I have to begin from the start and gradually work my way into a programming language.

Individual Reflection: Sietze van de Star

As a pre-master student, graduated from the University of the Arts Utrecht(HKU). My old University is strongly focused on aesthetics, conceptualisation and individual signature. During my graduation I felt uncomfortable in designing based on my own assumptions. Therefore, my goal was to attend the TU/e because of the scientific and user focused approach.

My smart goals were defined by the deficiencies that were given in a letter by the departmental admission board (appendix H). These deficiencies included computer-science, electronics and designing for the user experience. Therefore, I followed three electives regarding those contents (infographic, appendix I)

During the past semester, I acquired new skills and knowledge that I integrated in this project. Overall, I have gained deeper understanding of the user and society, technology and realisation, math data and computing as well as creativity and aesthetics competencies. Therefore, I was and wanted to be responsible for the electronics, programming and the UX part of the project. I craved to learn these skills to create tangible user interfaces as a tool for creating prototypes for the research on a better user experience.

In the beginning of the project, there were some struggles in my team because of our different backgrounds and characters. In addition, I didn't fully understand the design approach of the ID faculty. I familiarised myself with the design methods and required knowledge in order to be constructive. In our project group, I tried to stimulate the development of my team members by supporting their wishes of learning competencies that they wanted to acquire. I made sure they had room for those ambitions.

During the whole project, I have learned how to use the reflective transformative design process method. I discovered it is a good and supportive method that allows me to see an overview of the steps we made by organising, reflecting and documenting the iterative process. In the past semester my development impelled the sympathy and acquired the fully understanding of the process steps, from concept exploration to user testing, since I was not familiar with this during my previous studies. The freedom I experienced of the method fits in my way of working. I realised that the freedom of exploring new concepts and knowledge is an important part of my identity. I used the method also as a beacon when I got stuck in the process.

The knowledge, skills and my change of attitude brought me to the next level as designer. To research and develop the why in the project rather than the what and how of a product is the biggest improving for me as a designer. This strongly changed my vision (current vision is included in the appendix). I believe that in the future this acquired palette of tools will effectuate my vision. Proved in this project and electives, I feel I succeeded in my smart goals.

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Appendices

A. User exploration “intuitive interaction with light”

Setup:

Connect Hue to android Application.
Place the participants in a dark room. In the room is a table with two table lights, and a ceiling light, but all turned off. Ask the participant: how would you turn on the light without a switch?

Assuming that the participant will try to turn on the light using hand gestures, speech or physical contact with the lamp itself, Wizard of Oz the effect the participant tries to achieve, using the Hue application on a mobile phone.
Ones the light is turned on, ask: how would you change the brightness? Colour? And saturation?

After that, give the participant the little ball and repeat the test. Here it is assumed that the participant starts interacting with the ball, in order to control the light.

Participant 1

Part 1
- Brightness, on/off

Up: Wave the light up with the palm of the hand up
Down: repressing the light by moving the hand down with the palm of the hand down.
- Colour changing

Swipe through the colour palette in steps. Both from left to right as from right to left
- Saturation

Open and close the hand with the palm of the hand up. Closing means less colour, as if the participant tries to capture the colour from the light. And with opening the hand again, he lets go the colour again.

Part 2
- Switching on and off

rolling the ball on a vertical axis on the table
- Colour changing

rolling the ball on a horizontal axis on the table.

Comments from the participant:
He would like to control the lights separately. The most intuitive way to do that would be to point at a lamp and speak. Like ‘hey you lightbulb, please turn purple’, and ‘Hey other lightbulb, turn vivid orange for me.’

Participant 2

Part 1

- Brightness:

This participant envisioned a knob above the lamp, and made the gestures to turn the knob. Turning the knob clockwise is increasing the brightness, turning the knob counter clockwise is decreasing the brightness.

- Colour changing:

Tick on the lamp to step through all settings. You can only step through the setting in a set order and direction.

- Saturation:

Open the hand with the palm up, and move the hand up means a more vivid colour. Moving the hand down while closing the hand means less saturation

Part 2

- Brightness:

Hold it in your hand with the palm up. Just holding gently is most bright. Squeezing the ball making it smaller makes the light smaller.

- Change colour:

Throw the ball at the lamp, every time you hit it, it the lamp changes colour.

Comments:
'to me it feels most intuitive to modify the light with gestures: then there is nothing between me and the lamp/ light.

Participant 3

Part 1

- On/off: clap twice
- Brightness:

Moving the hands up and down, like a conductor of an orchestra. Up is bright, down is less bright.

- Colour:

Swipe through settings in steps, to left and right.
Or rotate the lamp itself like a knob. Rotating clockwise is seeing new settings, counter clockwise is back to the settings you have already seen.

Part 2

- Of/off:

throwing the ball at the lamp, when you hit it, it turns on, hit it again and it turns off.

- Brightness:

Envision your workplace as a grid, if you want more light in the middle of your desk, place the ball in the middle. The light needs to follow the ball like a spotlight.
Or, put the ball closer to the lamp for more brightness, take it further off for less brightness.

B. USER PROFILES

Steven, business analyst

Ones he gets up, he checks his e-mail, than he has breakfast, takes a shower and gets dressed. Now he is ready for the day!
HIs life is a heavy work-home integration: he works all day until the early evening, in a rhythm of short coffee breaks and a lunch break. Around five, he will go off to the sportschool to exercise. After that, he will just proceed working. Before dinner, he will go over his e-mails again. Around 9 he quits his working day and heads off to have dinner with friends. He will end the day with some drinks and then go to bed.
This guy is living on his own, in his early 30's

Laura, 31 year-old mother

Who works for a publisher. Her 20-month young child is still too young for kindergarten, and made the conscious decision to be with her child. Because of this constraint, she needs to work from home.
She gets up early in the morning to take care of her child and have a quick breakfast together with her husband, who has to travel to his work. She has a sporadic working day, altering between work, caring for her child, social activities and work again. When her husband comes home, she prepared the meal and they eat together. Than her husband will put the child to bed and she can get some work done. After that she can spend the rest of the evening with her husband before they go to bed.

Jeff and Sarah, a couple in their mid 50's

He is a semi-retired consultant, she is a teaching academic. Jeff has a lot of meetings, while Sarah has her own place to work quietly and concentrated. They have a fixed work-break schedule, and enjoy them together.

C. CO-CONSTRUCTIVE STORYTELLING, question guide

The sensitizing phase

Goal is to sensitize the user, to make sure he/she knows what they are talking about.

Test in a space similar to a working environment at home. Give a notebook and a pen, make sure the person sits in a way he would be sitting when he would be working. Give an introduction about the context

- How does a normal working day look like?
- Can you draw your workplace? (lay-out of the room, pay attention to light!!)
- Where is the desk, windows, lamps, bookshelves etc.?
- What do you find pleasant in your home-work environment?
- Are there things you don't like about your workplace?
- What activities do you usually do when you're working at home?
- How do you plan the activities during your home-work days?
- Do you find it easy to start working at home?
- Do you find it easy to stop working at home?

The elaboration phase

Goal is to place our concept in the imagination of the user, so we can obtain information about the concept; what are the pros and cons of our concept.

Show the sketch/prototype of the concept and explain the concept

- What do you think about it? Like, don't like, first impressions
- Can you imagine yourself using this concept?

Give the participant pen and paper

- What would your work rhythm look like, using this product?
- What do you appreciate most about the concept? (added value?)
- Are there aspects you dislike? (negative points)
- Are there things you want to change? And why?
- Would you want to own and use the product? And why?

results:

Sensitizing phase

A normal working day looks like this: he gets up, take a shower and start working on the kitchen table. Here he can sit most actively, which helps him to work most actively. Usually he just begins and take a break when he wants to, also between different tasks. But the breaks take way too long according to the participant.

Preferably he has a small, concentrated light on the place where he works. This puts more emphasis on the work and creates a 'spotlight'. The room around him is darker than his workplace, so the creates a 'work-bubble' around him, that helps him to concentrate.

He tries to start working on the most urgent tasks, in a working rhythm of 45 min work, 15 min break. When he is in this flow, it is easy to keep working. When he isn't, his lack of discipline will overtake, and the breaks will get longer. It can also be quite hard to start working right at the beginning.

The elaboration phase

after introducing the concept, the first impressions were playful, beautiful and magical when the cubes will glow.
He is curious about using this product, and want to try to work with a physical representation of time. This will give him a ‘stok achter de deur’.
The flash, or marker moment can be distracting when you are in a flow and when you are working, but it can create awareness of time and is a reminder when you are having a break.
Comments: test this concept with the different atmospheres.

D. Arduino source code

```
/*
 * Created by Sietze van de Star and others
 *
 * Interactive lighting project 2015/2016
 *
 */

////////////////////////////////////////////////////////////////////////////////////////////

#include <Adafruit_NeoPixel.h>    //include library
#ifdef __AVR__
#include <avr/power.h>
#endif

#define Pin 2 //vermijd de 0,1 pin because of the rx and tx (Arduino)
#define numSettings 6
#define hitLast 17


////////////////////////////////////////////////////////////////////////////////////////////

Adafruit_NeoPixel strip = Adafruit_NeoPixel(6, Pin, NEO_GRB + NEO_KHZ800);

////////////////////////////////////////////////////////////////////////////////////////////

int sensorVal[numSettings] = {100, 200, 300, 400, 500, 600}; //Array values potmeter

unsigned long durations[numSettings] = {3000, 6000, 18000, 36000, 72000, 10};//Time
values

int hitValue [hitLast] = {12, 13, 14, 15, 16, 17};

////////////////////////////////////////////////////////////////////////////////////////////

int analogInPin1 = A0;       // Analog input pin that the potentiometer 1 is attached to
int analogInPin2 = A1;       // Analog input pin that the potentiometer 2 is atteched to
int sensorValue1 = 0;        // value read from the potentiometer that indicates activity
int sensorValue2 = 0;        // value read from the potentiometer that indicates duration
int previous1 = 0;           // Vorige waarde 1
int previous2 = 0;           // vorige waarde 2
int LEDPin = 0;              // LED-strip on pin 0
int TIME = 0;                // Tijd begin
int x;                    // time setting in milliseconds
int setting = 0;
int settingA = 12;
int timeID = 0;              // Voor de array
int klaar = 0;
```

```
////////////////////////////////////////////////////////////////////////////////////////////
//Accelerometer

int hits = 12; // impact count
int imPact = 1000; // impact sensitivity

////////////////////////////////////////////////////////////////////////////////////////////

int tijdGrens = 19;       //LED -> 120/20= 6

////////////////////////////////////////////////////////////////////////////////////////////

unsigned long endTime = 0;    // Stop time
unsigned long startTime;      // = the moment you set the setting, so the moment the

////////////////////////////////////////////////////////////////////////////////////////////

void setup() {
  // initialize serial communications at 9600 bps:
  Serial.begin(9600);
  strip.begin(); // Start the LED strip
  strip.show(); // Initialize all pixels to 'off'
}

int getSetting(int sensorValue1or2) //sensorValue absolute waarde

{
  int closestSetting = 0; //Array values potmeter 0,1,2,3,4,5
  int smallestDistance = 600; //Hier eindigt de getallenlijn voor allebei de sensors
  for (int i = 0; i < numSettings; i++) //int sensorVal[numSettings] = {170, 341, 512, 681, 852,
1023}; //Array values potmeter 0,1,2,3,4,5
  {
    int dist = abs(sensorValue1or2 - sensorVal[i]); //functie dist = absolute value (positive
number) of sensorValue - sensorVal [array]

    if (dist < smallestDistance)
    {
      smallestDistance = dist; // = Stores the value to the right of the equal sign in the variable
to the left of the equal sign
      closestSetting = i;
    }
  }

  return closestSetting;
}

////////////////////////////////////////////////////////////////////////////////////////////
//Accelerometer
```

```
int aValue (int aValue1or2)

{
  int closestA = 12;
  int smallestA = 17;
  for (int i = 0; i < hitLast; i++)

  {
    int distA = (aValue1or2 - hitValue[i]);
    if (distA < smallestA)
    {
      smallestA = distA;
      closestA = i;

    }
    return closestA;
  }
}

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////


void loop() {
  //
  //// Accelerometer data
  //  AccelerationReading accel = { 0, 0, 0 };
  //  accel = Bean.getAcceleration();
  //
  //  uint16_t aWaarde = (abs(accel.xAxis)+abs(accel.yAxis)+abs(accel.zAxis));
  //
  //
  //  int currentA = aValue(aWaarde);
  //
  //  if (currentA != settingA)
  //  {
  //
  //    Serial.println(currentA);
  //
  //      settingA = currentA;
  //  }


  // this detects impact so if you hit the bean
  // or move it very quickly, the if is true
  //  if ((aValue > imPact)) {
  //    Serial.println(hits);
  //    delay(50); // prevent duplicate detection
  //
  //    // set led colour according to impact counter
  //    if (hits == 12) { Bean.setLed(0,0,255); } // blue
```

```
//    if (hits == 13) { Bean.setLed(255,0,0); } // red
//    if (hits == 14) { Bean.setLed(0,255,0); } // green
//    if (hits == 15) { Bean.setLed(255,0,255); } // pink
//    if (hits == 16) { Bean.setLed(255,100,0); } // orange
//    if (hits == 17) { Bean.setLed(135,206,250);
//    hits = 12; } // Return count from, light blue
//    hits++; // increment counter
//  }



  ////////////////////////////////////////////////////////////////////////////////////////////////////
  //Sensor 1

  int sensorValue1 = analogRead(A0);

  int currentSetting = getSetting(sensorValue1);

  if (currentSetting != setting)
  {

    Serial.println(currentSetting);

    setting = currentSetting;
  }


  ////////////////////////////////////////////////////////////////////////////////////////////////////
  //Sensor 2

  int sensorValue2 = analogRead(A1);
  int newTimeID = getSetting(sensorValue2); //newTimeID is de waarde uit e getSetting
functie

  if (newTimeID != timeID) //newTimeID is de getSetting value, als deze niet gelijk is aan de
vorige doe dan dit:
  {
    ////////////////////////////////////////////////////////////////////
    timeID = newTimeID; //vorige x onthouden, timeID is de nieuwe waarde.
    Serial.println(timeID + 6);
    ////////////////////////////////////////////////////////////////////
    startTime = millis();
    endTime = millis() + durations[timeID]; //array time values waarde waar het tellen stopt
    ////////////////////////////////////////////////////////////////////

    strip.setBrightness(0);
    strip.show();
  }

  if (millis() > startTime && millis() < endTime)
```

```
  {
    float progressA = map(millis(), startTime, endTime, 0, 119);//Mappen van de tijd 0,600 ->
0,120

    led(progressA);
  }

}
////////////////////////////////////////////////////////////////////////////////////////////////////////////////
//LED

void led (float progress) { // float progress is 20 procent

  int brightness = int(map(int(progress) % int(tijdGrens + 1), 0, tijdGrens, 0, 255));

  int ledNummer = int(progress / (tijdGrens + 1));

  strip.setPixelColor(ledNummer, brightness, brightness, brightness);

  strip.show();

  if (ledNummer == 5 && brightness == 241) {
    Serial.println("18");
    delay(200);
    strip.setBrightness(0);
  }
  else  {
    strip.setBrightness(255);
  }
  strip.show();
}
```

E. Processing source code

```
/**
 * Hue Workshop Server
 *
 * Created by Serge Offermans (s.a.m.offermans@tue.nl)
 * Intelligent Lighting Institute (ILI), Eindhoven University of Technology
 *
 * Contributions by Remco Magielse and Dzmitry Aliakseyeu
 *
 *Altered and edited by Sietze van de Star for the Interactive Ligthing project 2015/2016
 *
**/

// Include Networking things required for the hue
import org.apache.http.HttpEntity;
import org.apache.http.HttpResponse;
import org.apache.http.client.methods.HttpPut;
import org.apache.http.impl.client.DefaultHttpClient;
import java.io.*;
import java.awt.*;
import java.lang.Object.*;
import java.util.Date;
import processing.serial.*;

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

int slider = 0;
int brightness = 0;
int [] intensity = {0, 42, 85, 127, 170, 250};
int value1, value2, value3; // var to hold hold serial data from Bean


int lf = 10;  // linefeed in ASCII
String myString = null; //var to hold war serial data
int value; // var to hold hold serial data from Bean
Serial myPort;  // the serial port


String a = "Brightness"; //Date
String b = "Saturation"; //Name Artist, artwork n293*
String c = "Something else";


/* EDIT THIS TO MATCH YOUR HUE BRIDGE */
final static String HUE_KEY = "17328ac3b7dbf6f131eb8842911db07";
final static String HUE_IP  = "192.168.1.101";

PFont font;
```

```
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

void setup()
{

  background(0);
  //setup stage
  size(400, 400);
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

  println(Serial.list()); // list all ports, just FYI.
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

// Set up the hue
  setupHue();
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
// Set up a font so you can display some values on screen
  font = loadFont("Aharoni-Bold-24.vlw");
  textFont(font, 24);
  smooth();
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

  int connectTo = 0;
  for (int i=0; i < Serial.list ().length; i++) {
    println("Checking Serial Port " + Serial.list()[i]);
    if ( Serial.list()[i].indexOf("/dev/cu.usbmodem1411") != -1 ) {
      connectTo = i;
      println("Found LB");
      break;
    }
  }
  myPort = new Serial(this, Serial.list()[connectTo], 9600);
  println("Connected to: " + Serial.list()[connectTo]);
  myPort.clear();
  //throw out the first reading, in case we started reading
  //in the middle of a string from the sender.
   myString = myPort.readStringUntil(lf);
   myString = null;
}
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

void draw()
{

  while (myPort.available() > 0) {
    myString = myPort.readStringUntil(lf);
    if (myString != null) {
      myString = trim(myString);
```

```
value = int(myString);
println(value);

// P1 Activity
if (value == 0) {
  sendBrightnessToHue(1, (10));
  sendHueToHue(1, 10000);
  sendSaturationToHue(1, 76);
}
if (value == 1) {
  sendBrightnessToHue(1, (40));
  sendHueToHue(1, 33000);
  sendSaturationToHue(1, 254);
}
if (value == 2) {
  sendBrightnessToHue(1, (80));
  sendHueToHue(1, 10000);
  sendSaturationToHue(1, 30);
}
if (value == 3) {
  sendBrightnessToHue(1, (120));
  sendHueToHue(1, 15000);
  sendSaturationToHue(1, 70);
}
if (value == 4) {
  sendBrightnessToHue(1, (160));
  sendHueToHue(1, 47000);
  sendSaturationToHue(1, 254);
}
if (value == 5) {
  sendBrightnessToHue(1, (200));
  sendHueToHue(1, 27000);
  sendSaturationToHue(1, 80);
}

// Ac brightness
if (value == 12) {
  sendBrightnessToHue(1, (10));
}
if (value == 13) {
  sendBrightnessToHue(1, (40));
}
if (value == 14) {
  sendBrightnessToHue(1, (80));
}
if (value == 15) {
  sendBrightnessToHue(1, (120));
}
if (value == 16) {
  sendBrightnessToHue(1, (160));
```

```
      }
      if (value == 17) {
        sendBrightnessToHue(1, (250));
      }

      //Markermoment
      if (value == 18) {
        sendBrightnessToHue(1, (10));
        sendBrightnessToHue(1, (200));
        sendBrightnessToHue(1, (10));
        sendBrightnessToHue(1, (200));
      }
    }
  }
}
////////////////////////////////////////////////////////////////////////////////////////////////////////////////////


void acc (int intensity) {

  sendBrightnessToHue(1, intensity);
  sendBrightnessToHue(1, intensity);
  sendBrightnessToHue(1, intensity);
  println(intensity);
}

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

void activityP1hue (int hue) {
  sendHueToHue(1, hue);
  sendHueToHue(1, hue);
  sendHueToHue(1, hue);
  println(hue);
}

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////

void activityP1sat(int saturation) {
  sendSaturationToHue(1, saturation);
  sendSaturationToHue(1, saturation);
  sendSaturationToHue(1, saturation);
  println(saturation);
}

////////////////////////////////////////////////////////////////////////////////////////////////////////////////////
```

F. User test setup iteration 3

Test our concept in real life.
Since our prototype is finished now, it is ready to be tested in context. A final test, to see if our concept and prototype work out the way we assumed. how we are going to do this:

find a home working professional
install philips hue light in his work space
explain our prototype:

Cel allows you to control light from your desk, but it's also a tool that aims to help you balancing the work and home life.
On one knob you can chose the activity; the light setting in which you want to work. On the other side you choose the duration of this task. How long do you want to spend on this task? one's set, the devices shows the progress in time, so you know where you are in time. When time is over, the lighting system will let you know.

let him/her work with the prototype for one day. Just work like they normally would do, but ask them to use Cel to organize their time.

interview him/her afterwards on the use of the prototype

Interview:

Main question: Does Cel help home-workers to enhance their working rhythm?

interview questions:

Behaviour

Can you describe a normal working day at home?
what tasks do you do, how long do they take, how do you plan your day, do you actually plan your day, when do you take breaks, and how do you decide to take a break?

compare this situation to the day using CEL
Where their differences in planning the workday?
What were the differences?

Experience

can you talk a through the way you used CEL today?
Which settings did you use, what durations did you choose, (did you choose durations?)
What do you think of CEL?
How did you experience working with cel?
Was it a positive awddition to your work day? Did you like using it? why yes or no
What were negatives of using CEL?
The aim of cel is to help home-workers to enhance their working rhythm. Do you think Cel exceeded? Why yes or no?

Form

Was the device clear? did you understand how to use CEL?
What do you think of the feel of the device? heavy, black, etc.
What would you like to improve according to the appearance of the device?

G. Final user test outcomes, iteration 3

Normal work day

Wake up, small breakfast, check email laptop, to do list, execute to do list, face meetings in the agenda, 6-10 hours behind the workspace.

Planning the work day differences

Reminder to take a brake. Gave a lot of energy throughout the day.

Did you used cel only for brakes?

The nice lighting of my workspace is an extra added benefit.

Which settings, durations?

Played with all settings, enjoyed the work and relaxation the most. Half and two hours intervals were used the most during the work day.

Can there be improvements in terms of setting?

No from this point it is good, it is a nice design type of gadget anyone would like to have, the weight is to much.

Any other thoughts for improvement?

Yes you should minimise the size of the object, but leave the design appearance intact because it is a nice thing, it is to heavy, add start button, feedback change led to matrix led to show all the information simultaneously in one blow and also when you turn the knob and when you pushed the button the chose theme starts. It

would also be nice to have already sequenced preset for a whole day otherwise I have to keep on turning the whole day. To personalise the product even more I would like to save my explored settings that fit me the best. Otherwise I keep on turning the whole day. Don't make it to complicated nor over engineer it and simplify the object.

Was it a positive addition to your work day?

When available at what price?

Did you encountered some negative parts of the design?

It took me a bit of time to understand how the different settings could be set up, it is not self explanatory and you cannot see when the current settings is.

Did you liked the timer aspect, as in the LEDS shows you a peripheral information about the time that is past?

Well, they don't add to much value, it also took away my concentration when is was working, what could be a nice alternative is showing a countdown led in a nice colour connected to the theme. Digits. I would also use it in a presentation.

Very often a product can look pretty but that doesn't mean the interaction will also work flawlessly as planned. LED matrix, with full colour, push the potentiometer to start the timer and setting with the preferred light condition. Because the start button is missing, I didn't know how to use it.

How would CEL fit in your home setting?

I don't know, the possibility to control the colour of the light is new to me, I like it and I think it really can add value. It also has a positive effect on my mood and therefore my well-being

H. Departmental admission board letter

Technische Universiteit
Eindhoven
University of Technology

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Industrial Design

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Sietze van de Star
Vinkenburgestraat 15D
3512 AA UTRECHT

Subject
Your application to the master

Date
2 June 2015

Contact
T 040 247 8337

Our reference
FTC/15.136/sj

Your reference

Dear Sietze,

Your previous education is a good basis for our Master program. However, in our opinion some of your skills are not yet at the required level. In particular, since your knowledge and skills in the area of technology (electronics and computer science) and user research are not yet sufficiently developed, we do believe a pre-master (duration of 1 semester) is necessary.

At the end of this pre-master you will get an assessment in which an independent assessor judges whether or not you are ready to enter the Master of Industrial Design. If you are not able to be promoted to the Master after 1 semester, you can't redo the pre-master. This may sound more harsh than it actually is, as we only admit students to the pre-master if we are convinced that they have a good chance of finalizing the pre-master and the master successfully.

Could you please inform us directly if you're planning to accept this offer at id.ftc@tue.nl.

Kind regards Jacques Terken

Dr. J.M.B. Terken
Chairman Departmental Admission Board

Copy: C. Sepers – STU TU/e
B. Viveen - STU TU/e

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I. Development Sietze van de Star

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