TRACEY

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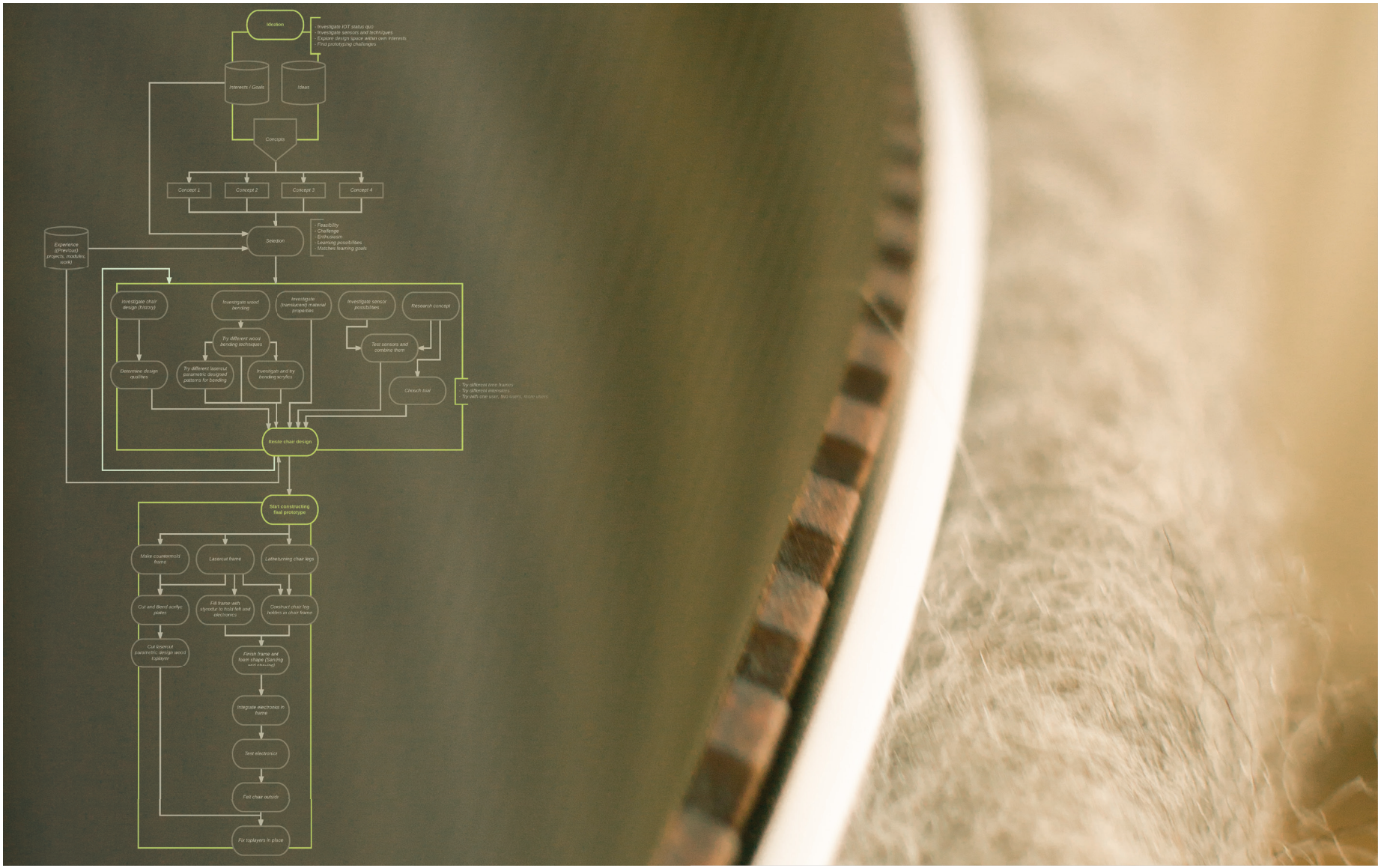
Abstract

Tracey is a chair that shows traces of its users over time by illuminating the surface seat. These traces are derived from pressure and colour of the user on the seat surface.

The aesthetics of usage traces is enhanced by the illumination of the users behavior on the chair. The use of warm - felt and wood - materials and high-tech, provides a pleasant contrast. The illumination and the power cord at the back of the chair evoke curiosity for this otherwise regular chair. The elegant shape of the chair gives it a sense of warmth and personality

Introduction

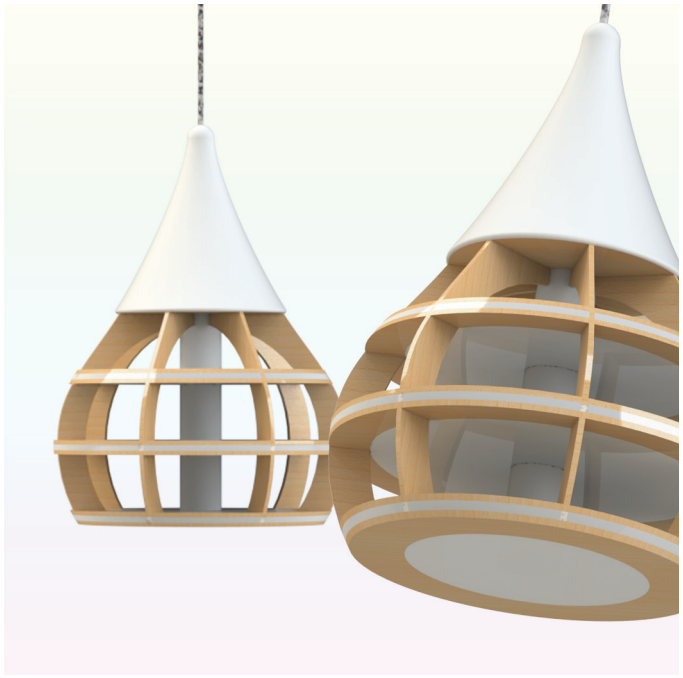
The beauty of chairs is that they are - possibly visually attractive - everyday objects that become an integral part of our homes and even our lives. A chair may move trough many spaces in the house over the years, forming a trace of past usage.

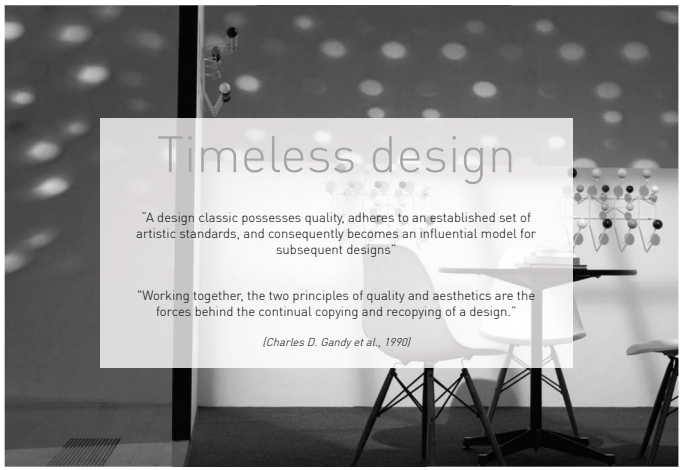

Ideation
- Investigate IOT status quo
- Investigate sensors and techniques
- Explore design space within own interests
- Find prototyping challenges
Interests / Goals
Ideas
Concepts
Concept 1
Concept 2
Concept 3
Concept 4
Selection
- Feasibility
- Challenge
- Enthusiasm
- Learning possibilities
- Matches learning goals
Experience (Previous projects, modules, work)
Investigate chair design (history)
Investigate wood bending
Investigate (translucent) material properties
Investigate sensor possibilities
Research concept
Try different wood bending techniques
Test sensors and combine them
Determine design qualities
Try different lasercut parametric designed patterns for bending
Investigate and try bending acrylics
Classch trial
- Try different time frames
- Try different intensities
- Try with one user, two users, more users
Reiste chair design
Start constructing final prototype
Make countermold frame
Lasercut frame
Latheturning chair legs
Cut and Bend acrilyc plates
Fill frame with styrodur to hold felt and electronics
Construct chair leg holders in chair frame
Cut lasercut parametric design wood toplayer
Finish frame and foam shape (Sanding and shaving)
Integrate electronics in frame
Test electronics
Felt chair outside
Fix toplayers in place

At the **ideation phase** I elaborated on three concepts and the abstract notion of **timeless design**.
The starting point for all of the concepts was beauty and visual aesthetics in the living room. Timeless design is a way to enhance this and to allow people to integrate products in their interior for a long time. This is of course about the looks of the product itself but also became to be more and more about the beauty in the presence of the user.

The **first concept** was about leaving a heat signature on a table that was then being projected on a 'painting' nearby.
The **second concept**, a lamp, showed the users online presence by using several light colors.

The **third concept**, that I fully elaborated, is **a chair that reflects the beauty of the user and its habits. It does this by showing traces of the user and usage trough illumination**.
This idea started out from a design chair that I have for several years now and that has been owned by my parents before. I enjoy the visual aesthetics of the chair but mostly its just there. It became an integral part of my house and even my life. The chair has moved trough several spaces in my house over the years. Scratches and patina reflect my usage and that of my parents before.
Though this chair may mostly be 'just there', I wouldn't want it not to be there. Trough owning it and using it I has originated a close relationship between me and this chair. This is enhanced by showing traces trough illumination.

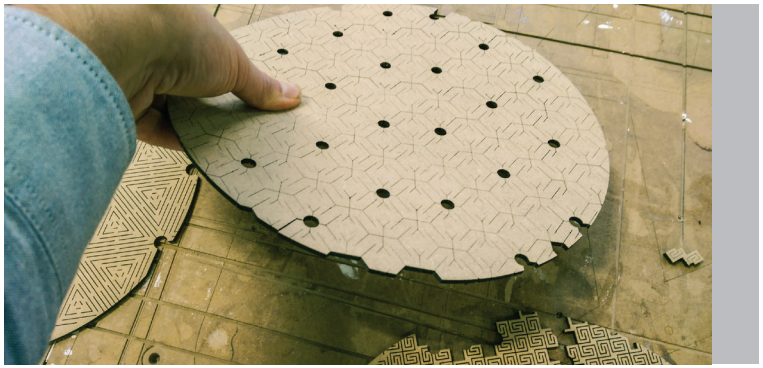




I have always been very attracted to **bend wood** products. This was even strengthened when I started to look into chair design.
Since my one my learning goals was to achieve **visual aesthetics in prototyping**. I decided to make (part) of the chair out of bend wood.

Therefore I explored several **wood bending techniques**: Laminating, steam box bending, burning, kerfing and the vacuum press.

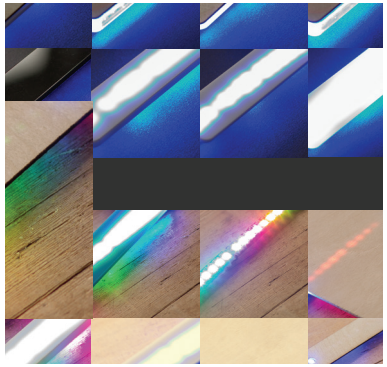
I have been a little to eager to wanting to keep the bend wood in. It took me until about 3/4th of the project to agree with myself that I had to let it go.
Due to the scale of a chair, a lack of proper wood bending tools and financial constraints I realized I was not able to get it at the quality level I strived for.



Due to limitations in wood bending I also explored a modern interpretation of the kerfing technique; **parametric laser kerf wood bending**, or lattice hinges.

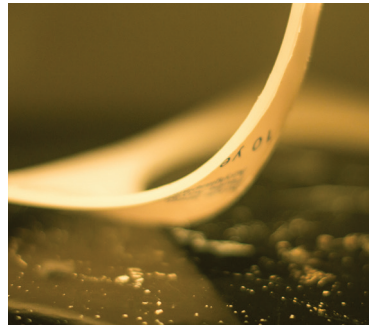
> "Lattice hinges are formed when a set of parallel, overlapping cuts divide a flat sheet into thinner, linked sections that can deform more easily than the solid sheet. By dividing the sheet into an array of parallel columns, each column can twist along its own length to let the sheet form a bend by twisting around the axis of these torsional links. Flexibility of the joint is determined by the material properties of the plate and the geometry (length of the overlapping cuts and cross sectional area) of the torsional links." [1]

30 different materials and thicknesses have been test on how it disperses and shows a LED light source underneath.



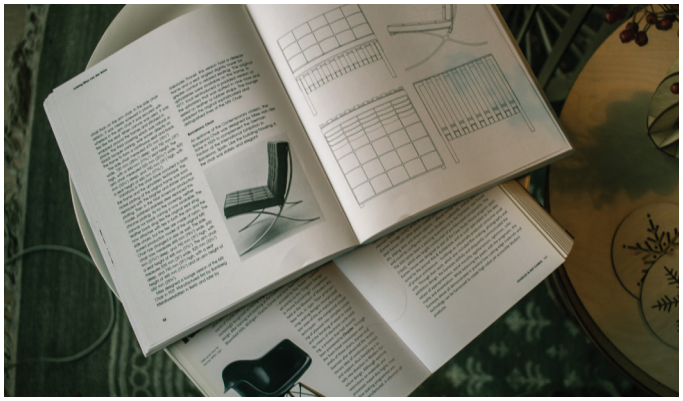
Since my initial chair designs had double curved surface the pattern had to allow for bending in more than one direction. This meant finding a pattern that has parallel overlapping cuts in at least one direction.
Holes had to be distributed over the pattern to allow the sensors to 'peak trough'.
These holes made some of the patterns break very easily. Most patterns that I have tried are far to rigid for small bend radi.

Because the material illumination exploration showed the beautiful **light dispersion of opaque acrylics** I wanted to put this in front of the LED light source. This meant the acrylic has to follow the shape of the chair frame.

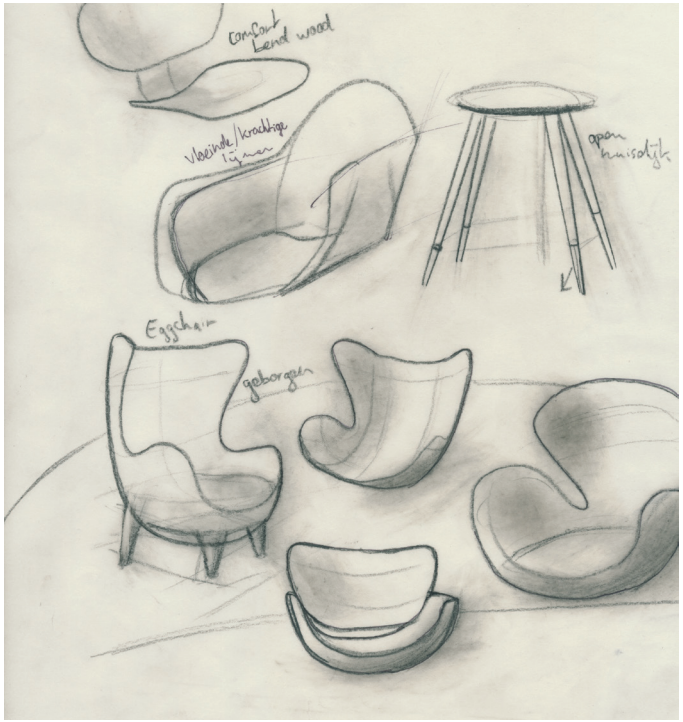


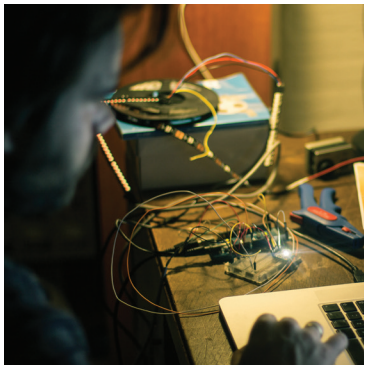
Therefore the acrylics had to be bent as well. After finding out **acrylics bend** easily at 160 degrees C, I did some trials on a stove with a huge pan for heat dispersion.

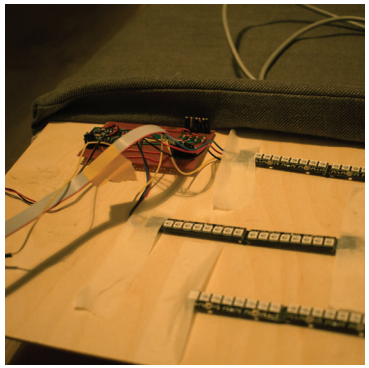
Designing a chair makes one realize that you are designing in a **rich history of furniture design**. I explored this design history using several books [2][3] and by visiting design shops and museums. This provided a lot of insight and inspiration in potential design qualities and the shape and construction of the chair



Using these qualities and (partial) shapes, I started making **chair designs using sketches and renderings**. In time also insights on material possibilities and new insights on the overall concept where incorporated.
The design must show it is a combination of being part of the rich chair design history and the high tech inside. The **use of warm** - cozy - **materials and high-tech** looking materials should provide a pleasant combination of this contrast. The illumination and the power cord at the back of the chair evoke curiosity for this otherwise regular chair. The chair must have a highly elegant shape to give it a sense of warmth and personality





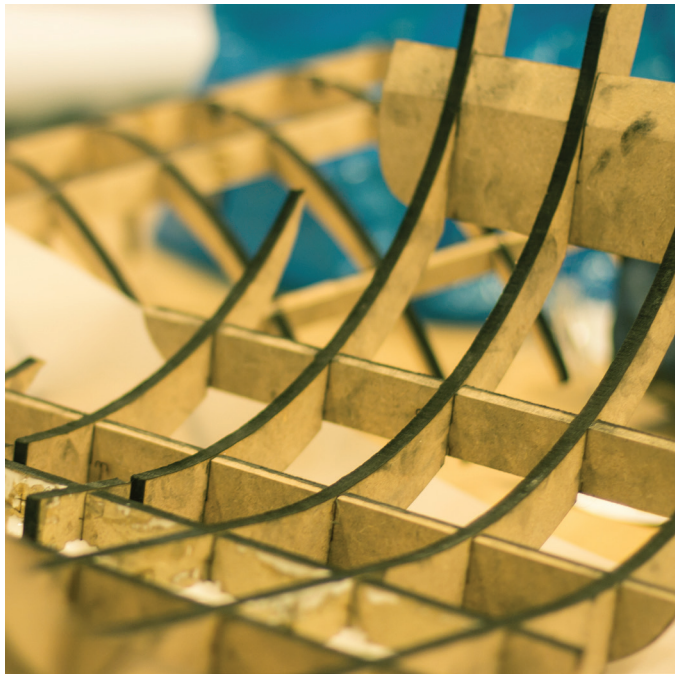


Sensors are explored to determine which are most suitable for sensing the users presence, pressure and color. Also potential problems with combining the sensors and LEDs are ruled out.

The **concept is being explored and tested using a simple prototype on the couch**. This has been in there for 1.5 week. It was tested by living with it to gain rich insights of experiences of living with this concept prototype over some time.

This especially provided insight in how different time frames affect the experience, the balance between intensity and subtlety, and how the number of users affects the experience.

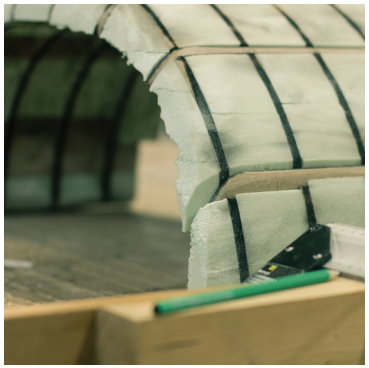
I for instance thought it would be nice for this to be a very slow interaction. *(After a few days of putting pressure at the same area, the light intensity increases slowly in that area. Also the color is an average of what you wear over time in a couple of days.)* Though the slow interaction in pressure -> intensity is very nice, the slow interaction in color is not. Especially when several persons use the seat. When the color update speed was adjusted to 10 minutes, the results where most enjoyable. When arriving at home I could for instance see what color of clothes my wife was wearing that morning when she sat on the couch. [4]



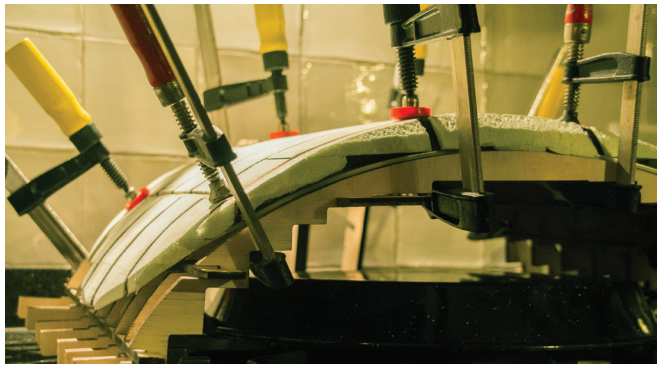
Because I refrained from the use of bent wood in the end, I needed something else to provide a rigid base with a curved shape. This is made using a **lasercut frame** for both the seating and back of the chair. This frame is made out of 8mm MDF. The holes in the frame provide room for the chair leg holders and all electronics.

Due to the wish for - cozy - warm materials, I chose to finish the chair with felt. To provide a base for the felt the holes in the chair frame are **filled with styrodur foam**.

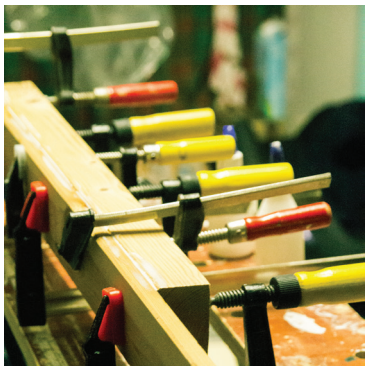
To get the right final shape for the chair frame and the foam, many hours of **shaving and sanding** where required. After a few days of messing around with sand paper and rasps I luckily got my hands on some power tools.



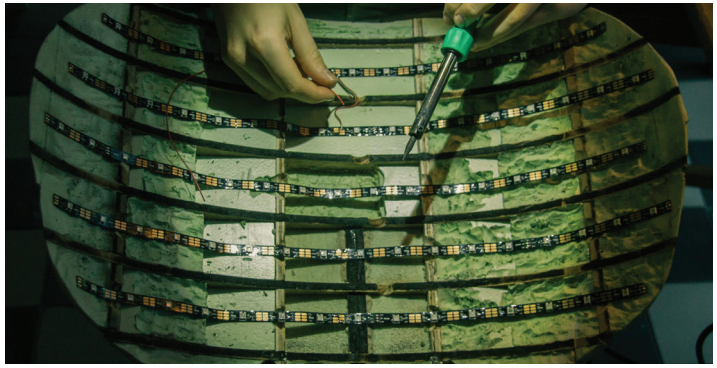
To make **opaque acrylics layer** in front of the LEDs follow the chair frame, it had to be bent. This has been done **using the chair frame itself and a lasercut countermold**. Since I had no huge oven at my disposal I was not able to disperse the heat well enough. Therefore the seating layer failed at the small radi. I tried to fix it by clamping and ironing, though this only made it warp and in the end made it crack.

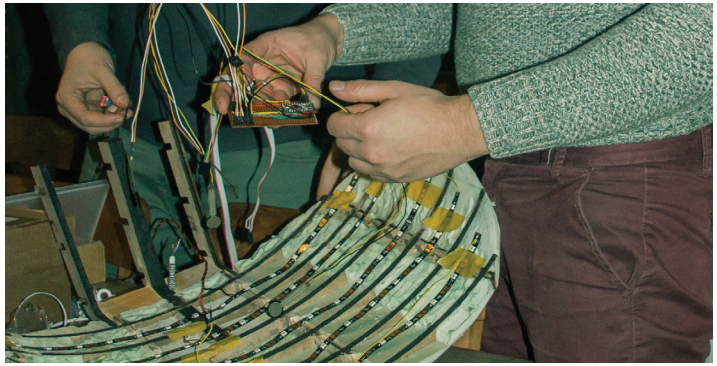


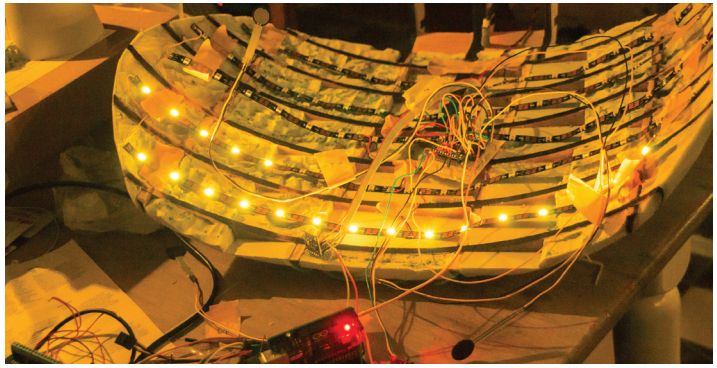
The **chair legs** are made of a solid wood sticks. They have been finished using lathe turning. The base of the legs is made is a laminated block of wood that fits tightly in the seating frame holes.

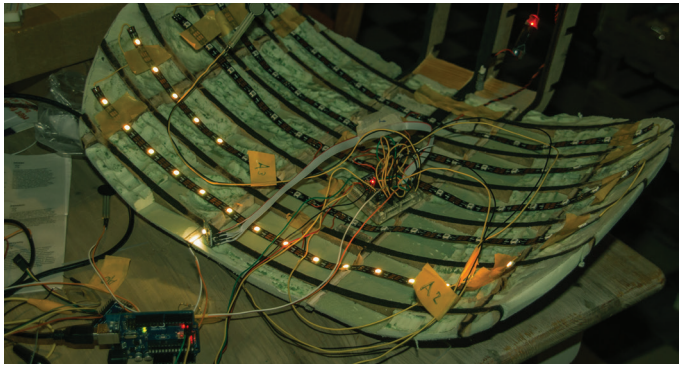


The **electronics** fit in tightly. In total two Arduino Pro mini's, twelve force sensitive resistors, seven color sensors and six meters of RGB LED strips are squeezed in. They are soldered into place and tested directly because it won't be accessible when the chair is finished.







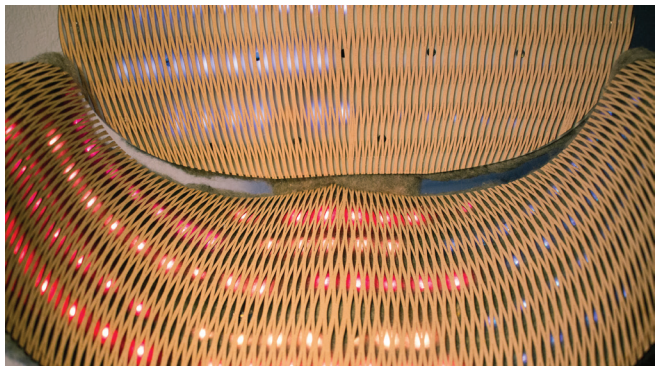


The best way to get a crisp felt layer is wet felting using water and soap. I didn't dare to do this though - considering the wooden frame and all electronics. Therefore I used **felt stabbing** to lock the felt in place and even it out. The styrodur foam provides a good base for this. An additional advantage of this technique is that it is very flexible and allows for errors to be fixed easily.

Since one of my main goals this semester was to achieve visual aesthetics in my prototypes I put as much **attention to details** as possible. For instance: I did not just drill a hole for the power cord at the back of the chair but used a good looking cord and tried several cord outlets.

Testing: When pressing for half a minute or longer at one spot the light intensity gets higher in this area and it shows the color of the 'object' on top.

The chair 'shining' in demo mode at the ID **Final Demo day**. I did not dare to allow anyone to sit on it yet. (Though it proved to be strong enough after this)



After the demo day me and my family lived with the chair for three weeks. In the beginning the this was hard for me since it really felt like this prototype I worked on for so long. I therefore used it very cautiously.
After a few days already it started to feel more and more like a 'normal' chair and it started to integrate in my daily live. I stopped checking it and looking at it all the time.
Since the rest of the living room and tv are on one side, this started to show clearly after a few days of use. This side was clearly more intensely illuminated. The color trace sometimes provided a nice flashback - "oh thats right! I was wearing blue yesterday.".
After 1.5 week it became more and more apparent that the illumination of the chair should be way more subtle. Especially since the chair is already quite notable due to the lasercut toplayer.
Visitors loved the chair. Especially for the color changing. The nice thing is that them trying out the chair did not influence the intensity pattern to much since they used it relatively short.
Even when turned of the chair attracted a lot of attention of visitors due to the design which they liked quite a lot, due to the lasercut toplayer and due to the curious cord coming out of the back.

Acknowledgements
I would like to thank my project coach, Bart Hengeveld, for initiating this project and giving the extensive feedback at the midterm that got me going. The elective To make is to Grasp which was also given by Bart Hengeveld has been very apparent in my project process. I would also like to thank my wife for giving me time and space to conduct this project and to allow me to test it within our living room.

References
[1] Patrick Fenner. (2011) deferredprocrastination. [Online]. http://www.deferredprocrastination.co.uk/blog/category/def-proc/lattice-hinges/
[2] Charles D. Gandy, Contemporary Classics.: Watson-Guptill, 1978.
[3] Charlotte Fiell, Industrial Design A-Z.: Taschen, 2006.
[4] Ron Wakkary William Odom, "Intersecting with Unaware Objects," 2015.

Reflection
My most important goal this semester was to be able to show a visually appealing prototype that is finished in great detail at the end. The elective 'To make is to grasp: from sketch to 3D', really helped help me to quickly iterate me trough ideation and sketching to 3D mockups and prototypes and provided me some new prototyping techniques that became very apparent in my project.

Because my previous semester was characterized by a lot of technological issues I wanted this project to be focused less on technology (Integrated Technology) and more on visual design. *(Form & Senses)* Also because I think there is lot more for me to learn on design due to my more technical previous education.

Because my vision is to bring beautiful design into normal households I designed a chair. This opened up a world of rich furniture design history. *(Social Cultural Awareness)* This really opened my eyes to how furniture designs are derived - each on its own way in its own era - and what potential qualities arise from different designs. There is so much more to style and culture, shape, materials and technological advancements than I ever imagined. You don't just draw a chair and put it together. In a proper (chair) design all these aspects come together to enhance the intended qualities as much as possible. Knowing about design history allows for well informed design and inspiration. This is something I find very important to incorporate in all my future projects. *(Social Cultural Awareness)*

During the ideation phase of this project I discovered there is much more to beauty than just the outer shell of the project. Things like patina, traces of use reflect the user in the product. This beauty in use really became the focus of this project next to having a beautifully finished prototype.
Aesthetics is in this way strongly linked to Social Cultural Awareness. The aesthetics of the bond you get with a product once you start using it, the traces this leaves and the memories that are coupled to it really enhance the overall experience of product usage. The user becomes more aware of the product and its beauty but also gets more aware of him or herself intersecting with the product. *(Social Cultural Awareness)*

With my new developed knowledge and skills I expect that in the future I will have a greater design and prototype quality. Also my future designs will be much more informed by design history.