Cylex

Defining the way we interact with an autonomous vehicle

Eindhoven Univwersity of Technology
Bachelor College Industrial Design

DDP004	Project 2. Design
Theme:	Smart Mobility
Coach:	F. Delbressine

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Introduction

Self-driving vehicles are the future. At least, that is what we think now. We imagine the world to have a safer traffic system, with computers driving cars rather than human-beings (Saltzman, 2018). Currently, there are still various levels of autonomous driving when speaking of an autonomous car, which are not yet all allowed by law. This project focusses on autonomous cars with autonomous level 5: full automation. This level means that the driver is no longer needed for controlling the car (NHTSA, 2016).

Since we wanted to take an innovative step in the design of the future self-driving vehicle, we decided to focus on a specific part of this interior: interaction between the user and the vehicle. This resulted in redesign the control panel within the car, to make it suitable for our specific user in the future. The final design is a cylindrical control system, focusing on the most-used functions of a car.

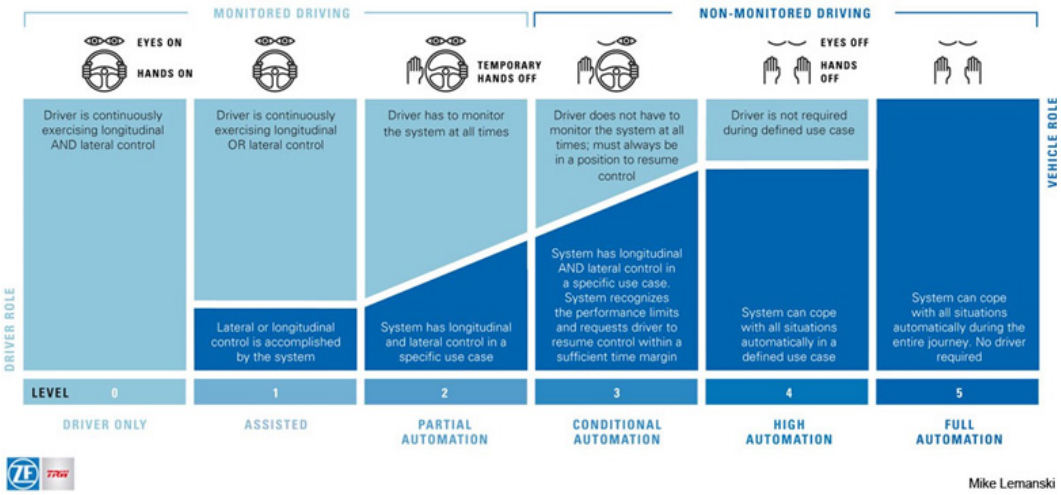

Image 1. Overview of autonomous levels of vehicles (Saltzman, 2016)

During the first semester of the academic year 2018-2019, the squad Smart Mobility was given a design-case for Daimler:

'If the car would be an autonomous pod, a private space on wheels, how would you utilize a volume of 1.60mx2.00mx1.20m (WxLxH).'

First, we designed the interior of the car: what will the car of the future look like when the steering wheel in the car is no longer needed? Considering all circumstances, such as expected user, expected use and expected costs of the vehicle, we came up with a design for the interior.

In the chapter 'Process', we discuss different concepts, ranging from traditional poke designs, advanced screen setups, to cylindrical design. This iterative approach helps to develop the final design. In 'Iterations', we relate all iterations to the project outcome (Results). This final design derives from four concepts, and four prototypes. Furthermore, user tests provide evidence to found decisions, as well as literature. To guide the project, we provide a project goal. This goal will be discussed and reflected upon in the conclusion, together with all relevant overall insights, related to the user and design functionalities.

Goal

In this project, we aim to unravel the true needs when people are driving autonomously. How will this differ from the current situation? Therefore, we conceptualize an interior design for an Autonomous Vehicle (AV). The obtained insights guide us towards a more specific objective: defining the way we interact with an AV.

The main question which was kept in mind during this project was:

Can we design a User Interface (UI) to enable rich interaction between passengers and the vehicle, providing relevant information, suitable for daily usage?

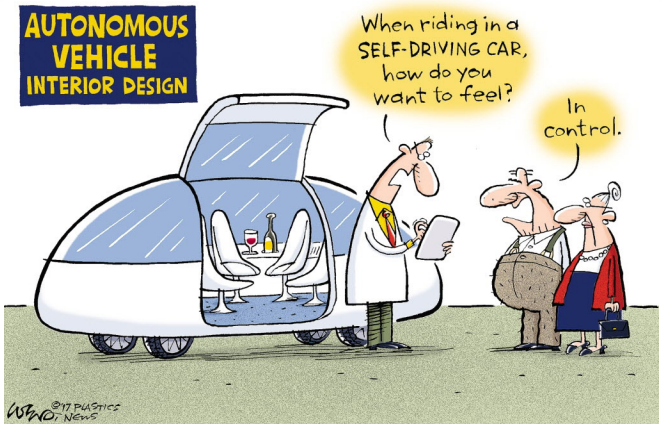

Image 2. Driven by emotion cartoon (Plastics News, 2017)

Process

Below, you can see the schematic overview of the process towards the final product (image 4.).

The project started with a pressure cooker. The approach of the pressure cooker was messy and there was no real thought behind the ideas, it was a bunch of ideas thrown on the table with the characteristics of a design push. However, this resulted in an example of how the process should not be.

After the pressure cooker the approach changed. The start of this approach was to understand the expectations of the client and trying to give a suitable fulfillment. The process was research-based and formed multiple ideas. In order to convey the ideas to the rest of the group the ideas were transformed into sketches, this formed the first iteration. This iteration was formed with the use of the research of the market in which Daimler plays a role. The first iteration is an iteration which was used as a base for the following iterations.

The second iteration was formed by a combination of usertests and research. With the results of the usertests an idea was formed on what passengers do while driving in a vehicle. This was later verified by research. The result of the second iteration was the first physical prototype that was ready for user tests. The feedback of the user tests was used in order to start a new iteration.

The third iteration started with the processing of the user test data, this resulted in the approach of user-centered design in order to validate assumptions, multiple prototypes were realized that were adjusted to the user's need and preferences. With the analyzation of the final user tests the two final functional prototypes were realized in order to present to the public on demo day. See appendix A for pictures of all cylindrical prototype.

Image 3. One of the subjects during the first usertest using the first prototype (Bronwasser, 2018)

Image 4. Schematic overview of the process (Bouman, 2018)

Iterations

Iteration 1.

Introduction

The first iteration of our Daimler Project is the result of the initial research. This iteration offers basic results which can be improved in multiple ways. It consists of a layout for the interior of the autonomous vehicle in 2030. With the use of research, the interior is compiled.

Goal

The goal is to figure out what the interior of the vehicle of the future would look like and what can be improved compared to the existing interiors. The most important questions related to this are:

User: Who will use this specific autonomous vehicle?

Use: How will this specified user use the vehicle?

Needs: What will the needs in this vehicle be, considering this user and these activities?

Method

User

Since Daimler acts as our client, there is an existing user base that must be considered in order to design a successful product for Daimler. The fact that the future offers the user an easier way to choose between owning a car or sharing a car, makes a difference in the usability and the needs of the vehicle. As a base for the interior of the vehicle of the future, the decision was made to create a vehicle for two people. This choice was made because an average car has 1.42 passengers per trip (Pastorello, 2016). With this information is has been chosen to create an interior for two passengers. However, since de concept focused on a shared system, this vehicle would be part of a larger fleet, which gives the user the opportunity to order a car that has more seats when necessary. The fact that only two seats are present in the car, offers possibilities to increase the comfort of the ride.

Since the system is shared, means that the vehicle can be used by different people. However, there are certain degrees of luxury when ordering an autonomous vehicle. In order to suite the user group of Daimler, it has been chosen to stick with the user group of "middle to higher class individuals" –Daimler. (Confirmed by Zane Amiralis, Manager advanced xperience design.)

Use

The fact that the user of the vehicle does not have to focus on driving, the vehicle gives the user the opportunity to do other activities. However, research has shown that the user does not choose to drastically change activities compared to a current driving situation. (Cyganski, Fraedrich, & Lenz, 2014) The activities in the car will mainly include enjoying the ride, reading or listening to music. (Confirm with research) In order to fulfill the user's needs, it has been chosen to focus on these particular functions.

Needs

The use of the car that was mentioned before demands certain needs of the car. Therefore, the interior of the vehicle was created with these needs in mind. The main functions that are included are large windows, which has two benefits. It offers the user the ability to enjoy the environment around them and since the user can see more, the user will also be able to see upcoming traffic situations and vehicles around their vehicle, thus feeling safer(Cyganski, Fraedrich, & Lenz, 2014).
Apart from the large windows, there is also one rear-facing seat. This offers the users to have a personal conversation while driving.
Since only two seats are present and one is rear-faced, there is more space for both passengers. This is shown in figure x, by offering a seat that can be put in multiple positions, allowing the passengers to carry out different activities. This was confirmed by exploration of the seats, this can be found in appendix B.

Result

The result of the first iteration can be seen below (image 5.)

Image 5. Interior design of the autonomous vehicle (Bouman, 2018)

Iteration 2.

Introduction

In order to create a physical device that sets the vehicle apart from other vehicles, the needs of the user while using the vehicle were taken into account. As a result of the research of the first iteration, it can be concluded that the users do not differ from the current activities in a car. This made us choose for a simple and intuitive UI, that only consists of the most used functions.

Goal

The goal of this iteration is to create an operating system for the autonomous vehicle that offers multiple functions that are intuitive, even for first time users. With the use of this iteration, we can experiment with different UI's.

Method

This iteration started off by deciding on which functions should be present for the user in the operating system. By using the research of the activities in the current vehicles and combining this research with research of current functions in the car, it can be decided which functions should be present. Research has shown that the a car interface has multiple functions that are not used by the passenger. (Van Nes & Van Itegem, 1990) This is why the functions are kept as simple as possible. The first three categories of functions that had to be present in the operating system are climate, entertainment and driving behavior.

With the use of climate, the user could adjust temperature, air conditioning and seat heating. Entertainment can be used to adjust volume, choose the next video or song and pause and play. Since the autonomous vehicle is part of a shared system, the vehicle does not offer entertainment in the car itself. However, since passengers should have a mobile device to order the car, the user can connect this mobile device to the system of the car and enjoy entertainment via their mobile device. The last function involves driving behavior, although the car is level 5 autonomous the user does want to have control over the driving behavior of the car. This category consists of three different driving modes that influences the speed and behavior towards other road users (giving priority to other users of the road).

In order to keep these functions easy to operate, the decision has been made to use a clutch in order to navigate the different functions (Image 6.). These clutches offer the user to keep control over every category. In order to switch between categories, the user is to move the clutch itself. With the use of user test is has been discovered that this solution is not very intuitive. These clutches do not represent the fact that it contained functions for the interior of the car. In order to create a more suiting clutch, a different form is used.

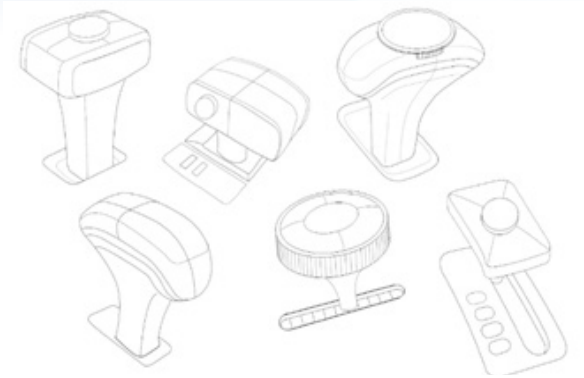

Image 6. Exploration of clutches (Bouman, 2018)

Result

The result of this iteration is a clutch that shows the functions of a category when put in the right spot. There were a few problems with this result. First of all, the ergonomics of this clutch were not optimal for the user's hand. Secondly, the device can only be accessed pleasantly for one user, the other user would have mirrored controls.

Image 7. Detailing of clutch, exploration (Bouman 2018)

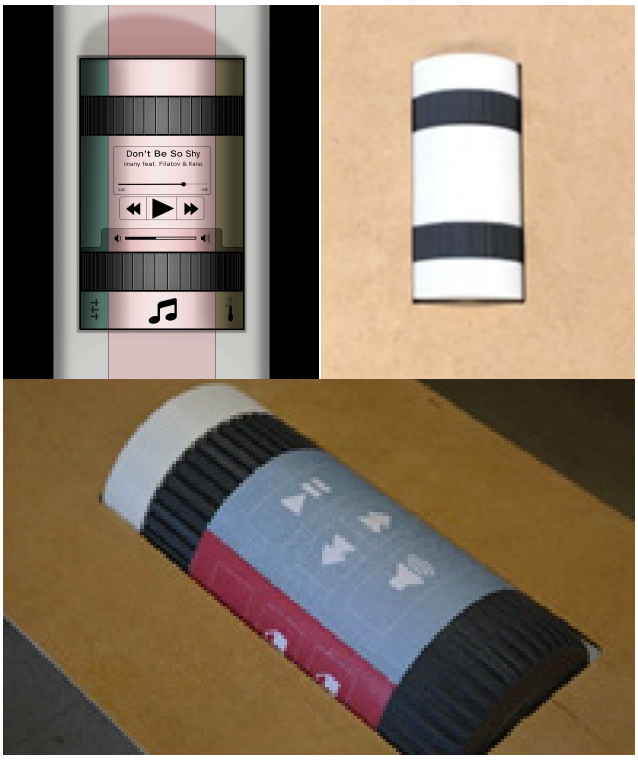

Image 8. Evolution of product during iteration 3. (Bouman & Bronwasser, 2018)

Iteration 3.

Introduction

The third iteration consists of the exploration of a cylindrical operation system that can be operated equally from both sides. With the use of multiple user test there was decided on shape, size, features and categories.

Goal

The goal of this iteration was to create a different shape for the operating system that had good ergonomics and was intuitive. This iteration should have a solution to the accessibility from both sides of the device and should include the positioning of the device itself.

Method

Shape

The start of this iteration began with shape exploration that fit the previously given demands, which were good affordance, good ergonomics and consisted out of only one degree of freedom. The shape that fit the demand was a cylindrical shape. This cylindrical shape has categories on four sides, this gives the user the ability to rotate the cylinder and choose the right category of functions. To show the physical working of the cylinder the first prototype was created. The prototype is depicted in (figure X), what can be seen is the large white area, which will contain the functions, the black rotary knobs, that can adjust values of functions and the white rotary knobs that can rotate the cylinder. With the use of user tests the affordance and ergonomics of this prototype was tested. The result of this user test was that the white rotary knobs confused a lot of users, therefore another prototype was created(figure X), this time without a white rotary knob. According to the users this worked better, but meant that the large white cylinder should also be used as rotating mechanism for the user.

Categories

With the use of the new shape, the categories were revised. A user test was conducted in order to see which functions were used most often by the passengers. This can be seen in appendix c The conclusion of this user test was that, windows should be added to the existing functions, driving behavior, climate and entertainment. The functions would each be present one fourth of the cylinder.

Position

Since there are two opposite faced seats in the vehicle and the device should be accessible for both passengers the position of the device is of great importance. The fact that the functions that not all functions are valid for the entirety of the vehicle means that both passengers should be able to adjust individual preferences, for example the intensity of the air condition. However since most of the functions are shared a two-way input system may cause confusion. That is why the device will be placed in the middle of the vehicle. Both passengers will have access to the system. The procedure of interaction is as follows, the user moves its hand towards the system, the device will detect from which side the user approaches the device, the interface will be faced towards the user. The user can rotate the device to the preferred category and adjust the function.

Physical interaction

In order to give the user haptic feedback, the functions have physical buttons, these buttons will click when the function is activated. The placement of the buttons is symmetrical per category, this will give the users the same experience from both sides of the device. Apart from the buttons, the rotary knob on the sides of the device influence the functions. The rotary knob functions for the volume and temperature, the user can click the correct button on the device and adjust the value with the rotary knob. The connection between the cooperating functions is emphasized through mapping.

Mapping

Each category of functions contains different types of input, which varies between ordinal, categorical and Boolean. For the Boolean function light will be emitted for the different functions, red light will be emitted when the function is off and white light when the function is on. This is the same for the categorical functions, however when for example function one is active, two and three will be in active. For the interval functions the mapping the rotary knob will be activated when the connected function is selected. When this function is activated it will light up in the same color as the rotary knob, this makes it clear for the user that these functions are connected.

Overall Results

The main results of our project include the four prototypes and the concept as shown on the posters. This concept sets the stage for the prototypes. It shows the context.

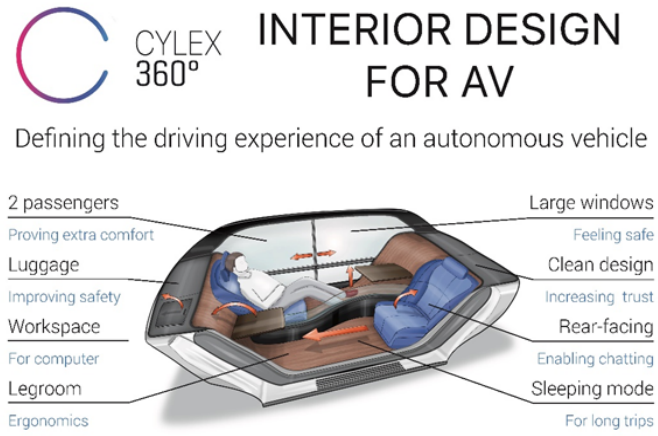

Image 9. Interior design of an AV, providing a stage for the final concept (Bouman, 2018)

The first prototype aims to discover the cylindrical element of the concept. The second implements relevant UI and the third includes working buttons. Finally, a fourth prototype demonstrates a visual more appealing design. Also, a video demonstrates a user scenario.

Cylex is a cylinder with four sides, each with its distinct functionality. The following overall functionality is key to make Cylex work and connect the sides: adaptive lights, wake-up, and quick settings.

The first allows users to immediately interact with the system. The UI is always orientated towards the user, using lighting. When no one is interacting, the device goes to sleep. As soon as someone is reaching to the interface again, the UI will active in the right orientation. Quick settings involve immediate interaction with the small cylinder, since the most important function per category is always active. For example, when in the music category, volume can instantly be adjusted using the small cylinder. The same holds for temperature, driving behavior, and windows in the respective category.

Furthermore, the buttons are tangible, providing instant feedback. The lighting also helps to guide the eyes of the user. In order to prevent misalignment, a magnetic snap to position system is integrated.

User tests show that little effort is required to get used to the UI, since the cylindric aspect brings a certain affordance to the design, which is very easy to get the hang of.

Image 10. Main functionality of Cylex, displayed in a poster format (Bouman, 2018)

Conclusion

Project goal:

Can we design a User Interface (UI) to enable rich interaction between passengers and the vehicle, providing relevant information, suitable for daily usage?

As seen in the Overall Results (p. 10), the User Interface that was designed during this project consists out of multiple elements to fulfill the requirements we set for the UI to be a 'rich interaction'. Especially the cylindrical shape of the product has the objective to be intuitive. The user is limited to one degree of freedom (rotation), which makes it intuitive to interact with the system. As seen during the user tests and demoday(s), the UI is therefore not only intuitive, it also invites to be used. People are tempted to touch the product, often indicating that they enjoy rotating the product, due to the resistance of the turning motion and magnetic 'snapping back into position' of the categories.

The goal to provide only relevant information with the User Interface, comes with the consequence of having little options to choose from. The product's purpose is to minimalize the amount of choices the user must make, also minimalizing the user's options while using Cylex. Daimler's target customers, being middle to high class working individuals, make this design choice questionable. Because of this 'only relevant information' principle, the user might feel displeased with just the options the product offers, which might not reflect the premium price point of the vehicle.

In conclusion, Cylex is a UI that is rich in interaction, meeting the requirements we set for this term. Also, the concept merely provides relevant information, which can also have the downside of limiting flexibility while using the interface. Being tangible, adaptive and easy-to-use as seen in the results, it can be concluded that Cylex is indeed suitable for daily use. Therefore, the Project Goal is met.

Image 11. Final look of Cylex (Bronwasser, 2018)

References

Images

Image 1. Overview of autonomous levels of vehicles (Birmingham University, 2016) - p. 3
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Individual Reflections

N. L. J. Bouman

During project 2, I have been able to work on many areas of expertise. For example, I worked on presenting the product (e.g. posters, sketches, renders, digital impressions, visuals, and logos), but also carried out literature research and user tests.

Meanwhile, Paul and Tygo have worked on building the four prototypes, assembling the mechanical structure, and working on the electronics. Charlotte has taken care of the agenda, and prepared the user testing, in addition to tasks that we have carried out together. In total, we have organized three user tests and obtained valuable insights. The user test proved to be really helpful. We were able to implement insights quite well.

Making sketches of our idea did not go very well at first. We were struggling with defining our focus. After the first few concepts, much more became clear about what we wanted for our product. I have invested much time in visualizing the ideas digitally, and some visuals turned out quite well. Visualizing a concept was one of my smart-goals.

The current prototype, which is our fourth, is not suitable as an end product. The final prototype should be better next time. Therefore, we have also worked on visualizing what a next prototype might look like, indicating what should be improved, e.g. the mechanics, the light distribution, the implementation of physical buttons, and the product as a whole into a car interior. Solutions for these problems are presented in this report.

For future projects, I want to be able to found concept ideas using scientific research, not only to provide evidence, but also to obtain insights. Also, I wasn't able to prototype during this project, so next time I try to be more focussed on prototyping. Prototyping in our project can probably be improved by dividing different elements of a prototype, and assembling later, allowing simultaneous work on prototypes.
We received feedback on our midterm demo-day presentation. Our table was not really appealing. So for the final demo day, we have improved our table lay-out and posters.

Group

My team functioned very well. All team members have contributed equally to the project. Everyone knew what to do. There's a good dynamic within the team. Furthermore, we were all able to work on different areas of expertise, and obtained new skills and knowledge this way. I am satisfied with the function I had within my team. It fits my interests and my learning goals. My goals for this project included obtaining experience with visual exploration, and presenting our work effectively.

During this project, I have also obtained insights in the field of automotive design. This was also my first experience with working for a client in a team. The group dynamics were excellent during these client meetings. We were critical at each other's work, and helped each other.

One team member was skilled using cameras. I was able to visualize the ideas of the team in an accurate way. Everyone has a well developed skill.

Before the demoday, two of our team members, myself included, weren't able to help sufficiently with the demo day setup, because of illness and unexpected obligations. That was unfortunate. The work wasn't always evenly distributed on a weekly basis, because sometimes work of other team members had to be finished first (visuals, prototypes). This was not really a problem, but something to take into account. Since we needed to wait until the final prototype was made, we couldn't make visuals to better represent our concept. That is unfortunate.

C. J. Bronwasser

Last year, I chose Smart Mobility as project 2. squad, because one of my goals I set in my Personal Development Plan was that I wanted to shape a design that is available and usable for a broad spectrum of users. This, because my belief as a designer is that a design is a good design when a lot of users can utilize it. Mobility is in my opinion, a category in design which has to speak to a lot of people from different ages and backgrounds. This makes this project the perfect fit for my first goal. My other goal was to create a new user experience that is pleasing and interesting for the user. Such that, the user feels invited to use the design and feels that the design pleases his or her needs, as I believe that is what good design should be able to do. This specific goal is not directly linked to Smart Mobility, but I hoped to integrate it in my second project.

During my second project, I was involved in the design of an User Interface (UI) for a future level 5. autonomous vehicle commissioned by Daimler. Their assignment was focused on the interior of the car. While designing this interior for Daimler, we had been told that they already have a specific user which was defined as an economical group, based on income. I then had to deflect from my original goal as set before the project started: instead of designing for a broad spectrum of users, we started to design for distinguished users within this specified group of users. Size of hands became more important than for example age, adaptivity was therefore on of our main focus points. This thought me that even if you specify a user, you can still define different users within a user group.

As said, my team specified the project to a product within the interior of the autonomous vehicle. This made it possible for me to please my other goals to create a new user experience. Since we were focusing on the look and feel of the product, it was interesting for me to be involved in user tests and use that data to redesign our concept. Exploring these renewed designs became my main focus during this project. In the end, our team managed to design a product that was intuitive, inviting and new.

In the past semester I developed to be a designer which can now distinguish different users with each specific needs within a user defined as group. I also found that making an interesting and inviting product includes a continuous cycle of user testing and redesigning. This will both be skills I will be able to use in upcoming design assignments. Next time, I want to be more involved in actually creating the design we sketched, so the creating phase of the project. I also want to become a better documenter during the project, since we made a lot of decisions we often forgot to write down or really had to look for while making the report.

T. G. Hendricx

Starting with this project I had some goals in mind that I wanted to reach in this project.
In project 1 I was focussing on designing the product, so for project 2 I wanted to realize the product itself by focussing on the production process. Apart from the realization I wanted to focus more on user tests. In project 1 I conducted one big user tests, but this was late in the process, I wanted to divide more user test throughout the project. These two main goals contribute to my improve my competencies user and society and technology and realization.

Experience
The improvement of the realization of the prototype went rough, because I underestimated the multiple stages that were needed for the finalization of the product. The fact that there were multiple outputs needed in order to get a good working prototype caused that other stages were delayed or rushed. What did go well is that I managed to conduct multiple user tests with a plan and an expected outcome. During the product I could convey the task of the user better, which resulted in better user test results. I believe that my contribution to the project became increasingly better.

Before the midterm demo day the core of the process was to understand what the client wanted and was the right fulfillment for this. In order to do this we got to work with a professional from Daimler. This experience helped me by the combination of the user's needs and the demands of the client. After the midterm this shifted to creating the product and multiple iterations, this suited me better, so fulfilling the demands of the client is something I want to improve on.

As mentioned before my own performance gradually improved throughout the project, I contributed a lot in order to finalize the product, I improved on my electronic qualities and made sure that the prototypes were neatly finished and working in order to present to the public during demo day. Through this way I learned more about the influence of materials and the different purposes for different materials and combining them.

Group

The group of this project was diverse and therefore we could learn from each other, I was inspired by the designs and sketches of some group members and the creation of 3D models. Form both members I learn to improve my own skills in this field.
At times some members of the group were absent during critical moments, especially before the demo day. In the week before the demo day there were multiple tasks that needed to be completed, in order to have an overview of who was going to do what. However, not everybody contributed well to this, which caused delay in a critical week. This was a contrast to the weeks before the demo day, in which everybody was available and ready to work on the project, so this week was a bummer. Luckily, when this was mentioned the workflow from the start returned in order to create the report of the project. For the report I worked on the process and the iterations.

Future

This project I worked on the realization and the project before on the design. For the upcoming project I want to focus more on the first part of the project, which means fulfilling the clients need and coming more in contact with professionals in the industry in order to make the project more real to the world. Apart from that I also want to improve my ability to create professional visuals. I did improve on my sketching skills, but this lacked professionalism in order to use this for deliverables.

P. I. M. Roelen

In my PDP for this project I had some goals in mind. The most important ones were that I wanted to improve my 3d modelling and printing, in order to iterate faster, improve efficiency and be able to show people the physical form of an idea, to improve the perception of the idea.
I think I really improved on that. I practiced a lot with making 3D models. Whereas I first was constantly solving problems, I now know about the possibilities in the program and I am more focusing on really making shapes and forms. I also bought the 3D printer to practice with the printing itself. I am still learning new things and ways to solve problems every model. I found out that even small models can take quite long to print. Printing more and more models also improved my efficiency in iterating. Making samples and small slices of prints can give an insight in the quality of the final print. When something is wrong you can see the flaws faster.
Furthermore I wanted to proof our work more consistent and more often than before. I think this already improved a lot since we actually used the findings of other researches to validate our own thoughts. I did this a lot more than in previous projects and courses. Although both the quality and quantity of the researches can be improved we did build upon existing scientific researches.

Experiences

Next to the goals I set in the beginning of the project I came across other problems during the project. One of them has to do with our electronic circuit in one of the prototypes. The circuit contained a rotary encoder. One of the tasks of the prototype was to perceive a voltage when the rotary encoder was rotated. Because of small potentials in the air the prototype did not only respond to the voltage emitted by the rotary encoder but also to the small potentials in the air. This made the circuit inconsistent and malfunctioning sometimes. For the next time I want to make use of the Arduino built-in pullup resistors. This makes it possible to turn the working of the circuit around. Where board is grounded and searching for a voltage in the first place, it is searching for a ground and powered. This prevents small potentials in the air to influence the circuit. Besides I want to use helping components if a certain component isn't built to use in a pullup resistor circuit.
Furthermore we got feedback on the presentation of our idea during the midterm demo-day. The coach said our table was not very attractive and appealing. I agreed that the amount of text and the way of presenting the product was not really inviting. In order to improve that we worked on visuals and simplicity during the final demo-day. And again at the final demo-day we talked to visitors that told us that, because of the large amount of tables, a table should look quite appealing to them in order to visit it. For the next time I want to reserve some time to take a look at the simplicity of the presentation.
The group
The project on its own was quite interesting. I got introduced in the field of automotive and I was quite surprised by the topics of the different projects. The group dynamics were excellent, I had the idea that everyone could bring the best out of each other. One group member was experienced with sketching and could visualize the ideas of the others in an accurate way. Another team member was skillful with camera's. And in a similar way everyone could add up on each other.
Up to the last week before the demo-day the groups dynamics went desirable smooth. Despite that the last week was less positive since 2 out of 4 group members lacked in communication and sometimes didn't even respond to messages. They didn't help a lot and even were unavailable for 2 out of 3 days, days of which we said we would reserve for the finishing touch. In my opinion this is not the team spirit. This was fixed afterwards when working on the report, but in my opinion a pity. The work wasn't always distributed in an even way because sometimes a visual had to be made and that costed a lot of time at that moment. Another reason is that I offered to make the 3D-models, do the 3D-printing, to design and solder the electrical circuits and to make the prototypes. This took a lot more time than I thought in the beginning. Besides I find it hard to give work out of hands and ask for help and since I already worked on both the physical (including electronics) and the computer models before and thus I also wanted to finish it.
Especially the 3D-models and printing needed a lot of iterations, because a lot of options can be adjusted. The prototyping was a lot of work because I was struggling a lot with the small potentials in the sky and I didn't know the problem was located in that area. I tried to replace all the components, different boards and controllers. This took a lot of effort and eventually hadn't made any progress. However, I now know what the problem is for my next circuit.
One of the things that I would've liked to do this project is to make a really visual report. Now all the information is well described. But there might have been some room to visualize the information to make it clearer and more attractive to take a look at.

Learning intentions

For the future project I want to ground my ideas even more with scientific research and if needed adjust them. I also want to do more research on electrical components before I am planning to use them. Because only knowing how they work might not always be enough, as seen in this project. Preparing a little more can save a lot of time further on in the project.
Furthermore I want to improve the finishing touch of the prototypes. The circuit and the looks were quite satisfying in my opinion but the casing and the appearing of the prototype in a whole was a bit sloppy. Making this smoother will make the prototypes more attractive, interesting and unambiguous and thus clearer. I also want to make sure tasks are more even divided in the future if needed work on it together, especially because I find it quite hard sometimes to give tasks out of hand.

Appendix

Appendix A.

Appendix B.

Appendix C.

Appendix I

User Test - Lights

1. **Staat die op pauze of op play?**
2. **Licht intensiteit?**
3. **Welke knop is actief?**
4. **Zet muziek aan**
5. **Kleuren?**
6. **Grootte van de knoppen?**
7. **Touch**
8. **Feedback**
9. **Zonder te kijken, druk op de knoppen**
10. **Intensiteit actieve knop**

Resultaat 1.
Pauze, rooie licht
Delay licht wat langer
Licht beter in symbool
Standaard knop feel
Meer tegendruk (langzaam omhoog)

Resultaat 2.
Pauze, rood licht is stop
Alle knoppen zijn actief, omdat ze allemaal licht uitstralen
Muziek aanzetten is makkelijk
Grootte is goed, omdat mn vinger erin past.
Twee klikken zijn verwarrend
Blindeling ging goed
Wit is feller

Resultaat 3.
Pauze, rood licht
Geen
Alle knoppen te gebruiken want licht(koppel dus actieve knop met draaier
Delay, vloeiende begin
Of de knoppen aan uit zijn is niet super duidelijk (als op pauze staat en is rood, niet duidelijk dat t actief is)

Resultaat 4.
Pauze, rood licht
Licht pauze kan duidelijker
Afstand tussen vorige en volgende relatief klein
Play pause knop zit iets lager
Click laat weten dat functie ingezet is

Appendix II

Results Usertest - Shape

Voor toevoegen strip:
1x: kies voor niet smooth (dit was wel na uitleg dat de witte strip alleen meebeweegt met grote gedeelte, dus dat wil zeggen, apart deel om strip te bewegen), omdat t op extra functie lijkt gelijk er aan draaien en dichtsbijzijnd van user

4x wel smooth gebruiken, algemene opmerkingen: geluid is ook intuitive om te klikken op knop, dus als je op meest linker bolletje klikt geluid t hardst. Zelfde geldt voor de blower, als je op de blower klikt komt er extra blower dus meer blow kracht. Beste is als de zwarte rotators los zitten van de witte, dan is t duidelijk dat ze aparte functies hebben(dus 1 communication naar auto en andere van), maar is ook de bedoeling alleen print niet ultra accuraat.

Na toevoegen strip:
8x: niet smooth, opmerkingen: duidelijker welke functie, sneller zicht, wel lijkt t nu op ook n icoontje, same als t middenconsole, dus is de gelijk interactie dat daar ook op kan worden gedrukt(dit kan in uiteindelijke prototype namelijk duidelijker worden gemaakt dat daar geen knop is en midden wel, dus extra verschil) . Driving styles niet duidelijk genoeg, gebruik sws sport mode omdat dat nu algemeen bekend is als vlot rijden. Medium en comfort niet duidelijk verschil. Strip aan zijkant geeft makkelijker besturing aangezien dichterbij de user zit.groote van ding is opzich prima, kan ietsje groter maar niet kleiner iig

3x wel smooth: extra ding maakt t drukker, draait beter(maar komt door printfout), icoontje route niet super duidelijk

Algemene conclussie: kies voor de strip, dit zorgt voor meer duidelijkheid over de categorie en interfereert niet met de knoppen bij t draaien, icoontje onder de functies(dus dat idee wat ik op de app zei) is niet duidelijk genoeg en zorgt voor verwarring, niet doen dus.

Appendix III

Results Usertest - Function in car

Set-up user test:

Which functions in the car do you use the most?
Please control just mentioned function(s). Does it seem logical?
Which side of the interface is user-friendly/most convenient and why?
What size would please you the most? Shared or single use?
Any other suggestions, tips, tricks?

4 user-test, all subjects were in the age-range in between 18-25 years old.

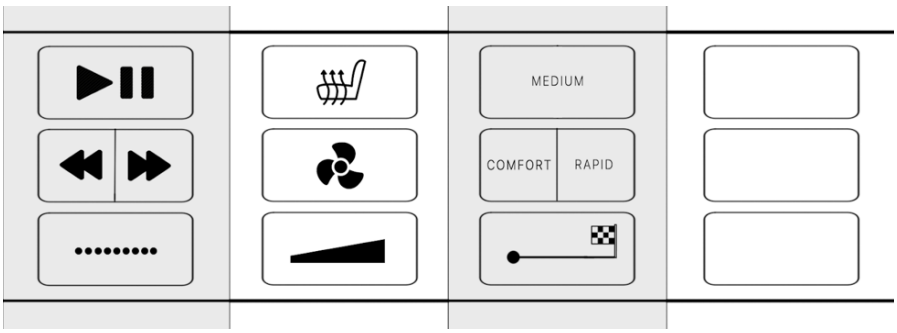
Which functions in the car do you use the most?

- Alle users in de usertest hadden een voorkeur voor het grotere model, om verschillende redenen: waaronder mensen met een bril die het kleine model té klein vinden.
- Laat de (nu zwarte) cylinder alleen oplichten als hij bruikbaar is.
- Dus er is maar één cylinder opgelicht: de dichtstbijzijnde.
- De onderste knop per categorie is standaard opgelicht: belangrijkste functie.
- Deze functie is direct te bedienen via de cylinder.
- Als je binnen een categorie een andere functie wil bedienden via de cylinder, klik je daarop (deze licht nu op).
- Per categorie: onderste en middelste via cilinder, en bovenste knop is I/O knop.
- De knoppen hebben een geïntegreerd schermpje, waardoor het icoon draait.
- Standaard alles zwart: licht op de juiste manier op afhankelijk van de richting van de gebruiker.
- Meeste gebruikers vinden smooth cylinder aan het einde fijner. Categorie gedeelte volgt hierna pas. (Best of both worlds).
- Knoppen hebben travel, met ingebouwd scherm indien mogelijk, anders symmetrisch icoon.

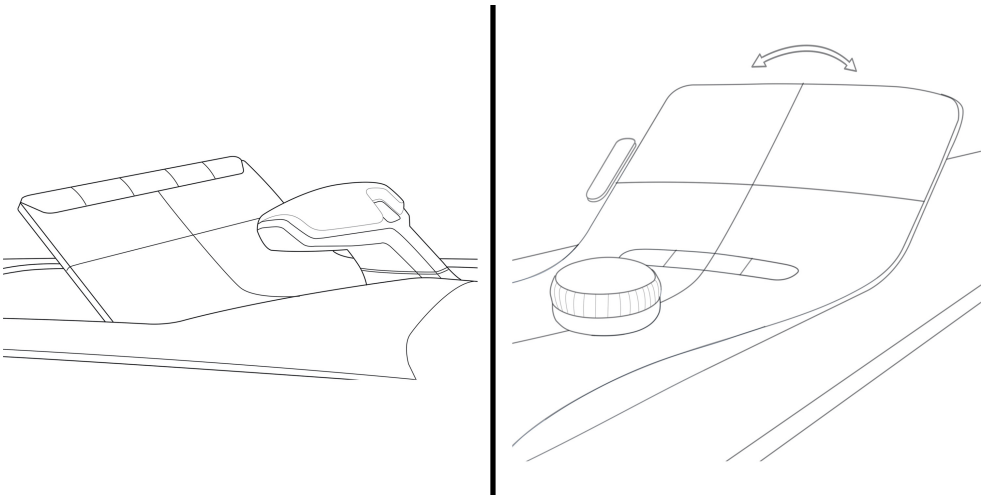
Appendix IV

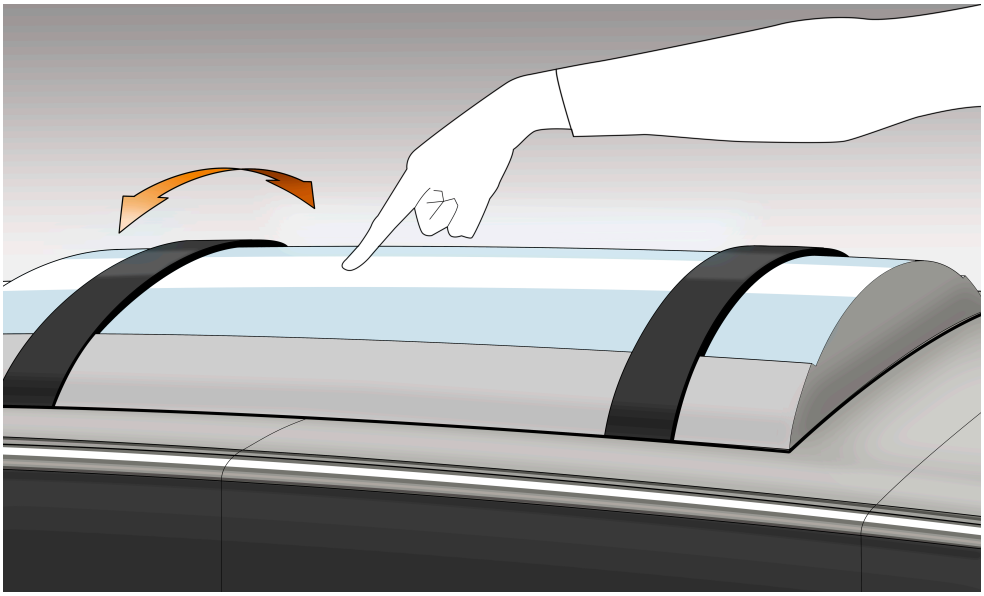

9:41
ALL
21°C
COMFORT
RAPID
9:41
ALL
21°C
COMFORT
RAPID


Don't Be So Shy
Imany feat. Filatov & Karas


MEDIUM
COMFORT
RAPID

Appendix V





Appendix VI

CYLEX
EXPERIENCE 360°

CYLEX
Connecting

CYLEX
360°

CYLEX
360°