CRUISING, NEW STYLE

in-Transportation interaction

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January 2016

Theme:
Smart Mobility
Project:
in-Transportation interaction DPC301

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M1.1 (old school)

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Introduction

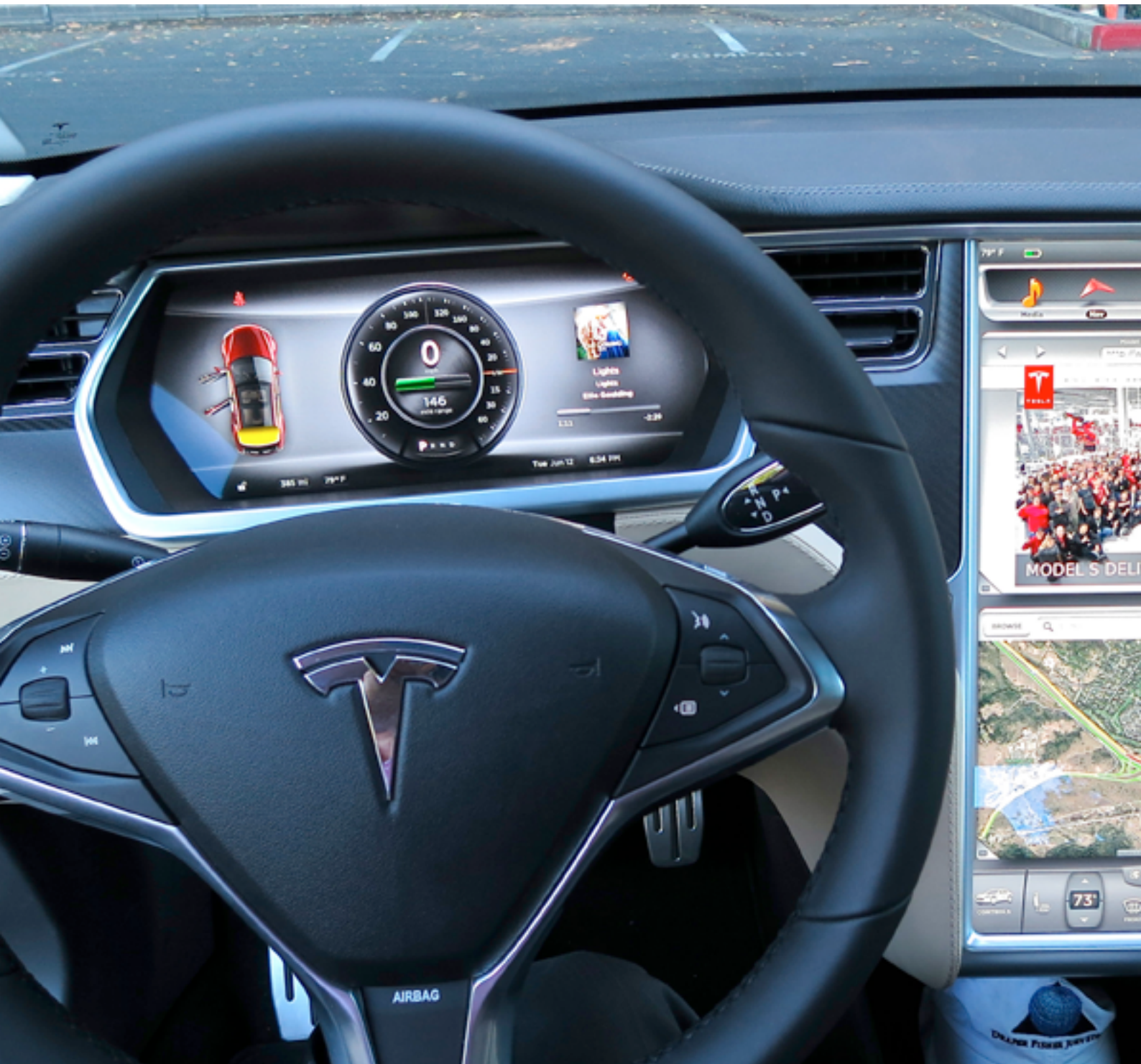
This individual design project is part of the first year of my master program. The report explains the process and results regarding the design project in squad in-Transportation interaction.

Brief

This project addresses the interaction challenges in the transportation context. At the dawn of the introduction of disruptive technologies on the market (e.g., autonomous and connected vehicles), interaction design faces challenges renewing the roles and the activities of the passengers, and their relation with the vehicle and with the outside[1].

Summary

Drivers have to monitor an increasing amount of driver-supporting systems. Although these systems are designed to reduce the workload of the driver, they require the driver to be on standby to take action when necessary. This project is about designing controls for driver assistance systems to reduce attention dividing and help driver to regain authority over the vehicles behaviour. By linking the control to the vehicles longitudinal speed experience, drivers get back the feel of embodiment with the vehicle without interrupting the automation that has been set.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Analysis

During this project different areas were explored. Starting of with a little literature research. Some questions that raised at the start were: What are the consequences of automated driving on human machine interaction? What are the consequences of drivers using new interfaces, such as touchscreen, while driving?

Observing recent trends in dashboard development, tell us that the automobile is gaining complexity. The complexity of the vehicle is reflected on the dashboard. We can make a distinction in interfaces in the automobile. The primary controls to drive the automobile, the steering wheel, pedals and gearshift. The secondary controls to, the direction indicators, lighting controls, windshield wiper controls, etc. Instrument panel, such as speedometer, fuel gauge, etc. Advanced Driver Assistance Systems or ADAS, supporting the driver with primary driving controls. Infotainment systems, climate controls and navigation. Alerts, such as emergency brake alert, blindspot monitor and lane departure warning. External factors, such as mobile devices, wearables, navigation devices. All these interfaces are within reach of the driver and can potentially attract attention from the driver.

Complex interaction

Complexity is not wrong according to Donald A. Norman [1]. For a product as complex as an automobile, it is not desirable to use inferior controls if only for the reason of fighting complexity. Complex interfaces take time for a user to learn. The driving ability of the driver grows over time. Driving becomes easier over more experience and drivers can handle more complexity.

Attention dividing

Drivers can perform multiple tasks at the same time[3]. However, the performance of the primary task is affected when either one of the tasks becomes more demanding. The more input a driver gets the worse the performance of any of the tasks. Drivers are distracted by their phone even when they are not using it[4].

This knowledge is not new, so why does industry continue to pack their products with more and more potentially lethal distracting technology. Designers probably cannot change the OEM's course, 'features sell cars-strategy', that easily. The designer's responsibility is to valuate the different interests and design for the right balance.

Automation

Increasing heart rate and respiration show what effects a demanding situation can have on the driver[3]. With this knowledge, industry together with academia developed a new adaptive cruise control system. Instead of only keeping a fixed distance to the vehicle in front, the system also monitors the drivers workload by measuring its heart rate and respiration rate. When a higher heart rate and respiration rate is detected the system leaves more distance to the vehicle in front, consequently decreasing the workload.
This system has been proved successful in reducing workload, but at the same time, automation widens the gap between the driver and the vehicle. The technology takes implicit action based on the drivers state, without consulting the drivers intentions.

The automation trend is threatening the development of the driver. The human driver is a good driver, because it learns from experience. By raising automation level, we take the opportunity from young drivers for gaining experience from the driver[5].

Findings

The question that raises from these observations is: do we trust drivers to divide their attention to the right interface and design interiors with an increasing amount of potential distractions or is this a responsibility for the automotive industry to address?

Vision

I strongly believe that the automation trend, although improving safety and wellbeing of the driver and its surroundings, is unintentionally distracting the driver from the primary task. Driving.

Project directions

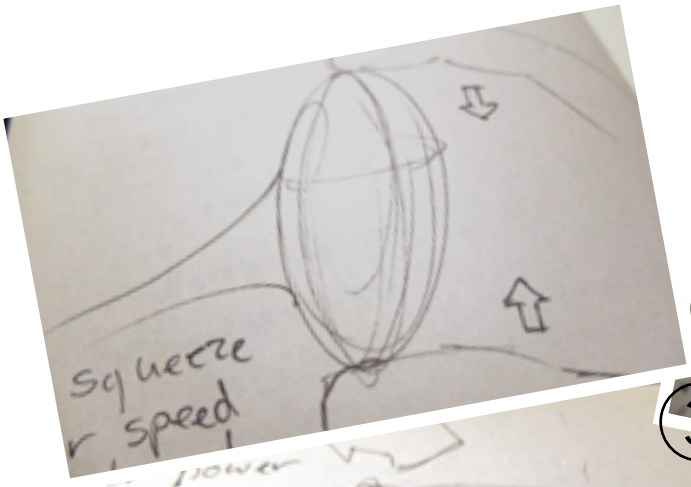
The initial two directions are improving driver assistance systems and address the driver workload problem.

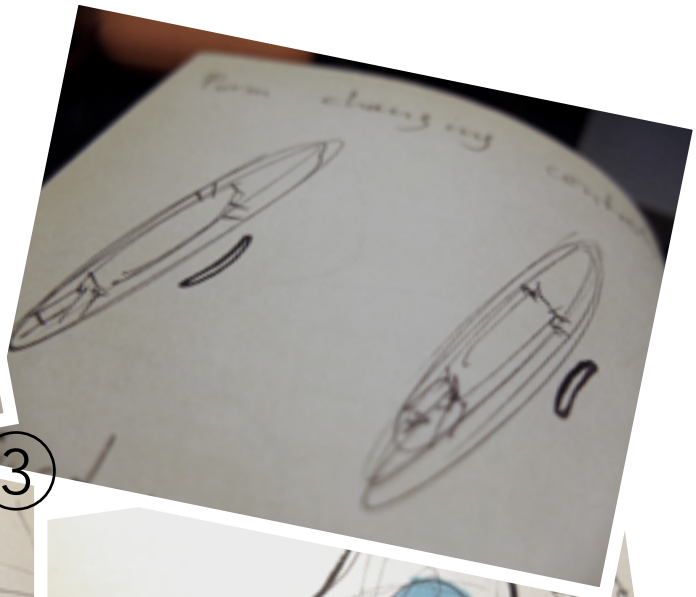
Driver assistance systems.

This direction is born from personal experience. The cruise control experience gives me the feeling that the vehicle is running of with me. I use cruise control because it is relaxing not having to look at the speedometer as often as I would have to without. However, when I resume to throttling myself I find the interaction of disabling the cruise control inappropriate to the task.

Driver workload management

The modern vehicle is getting increasingly complicated. New technology and features compete for attention from the driver. This direction is about managing driver workload by designing less intrusive secondary control interactions.





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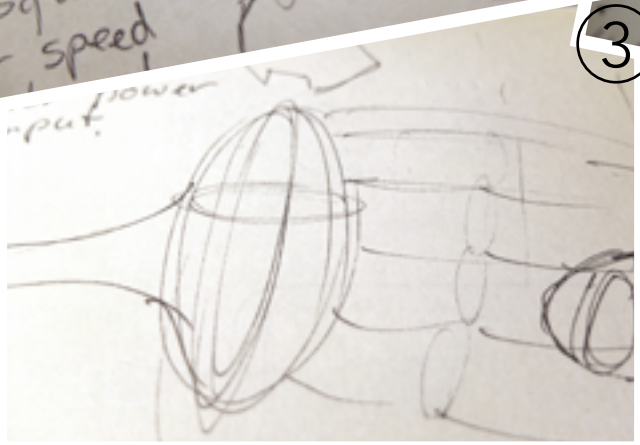

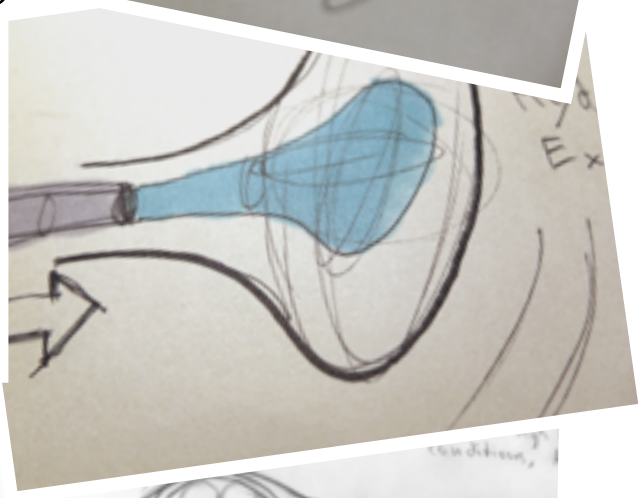

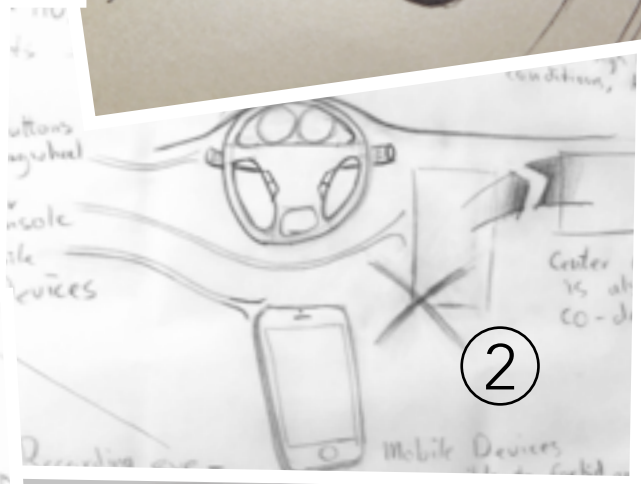

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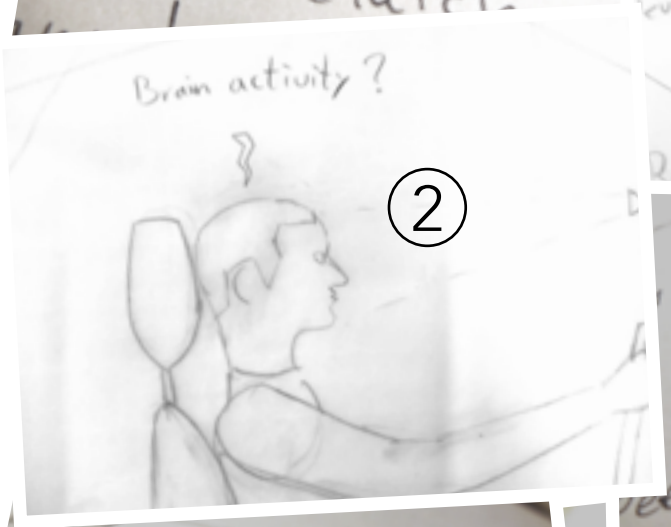

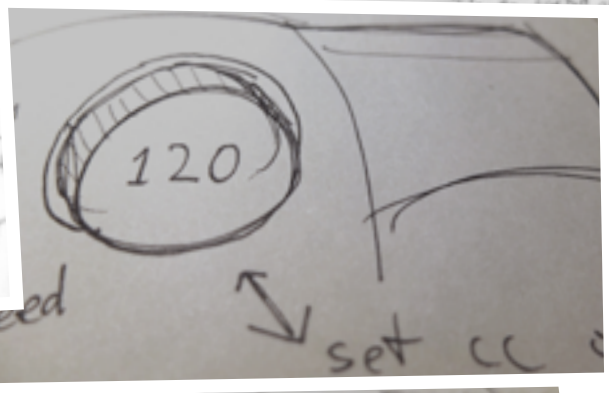

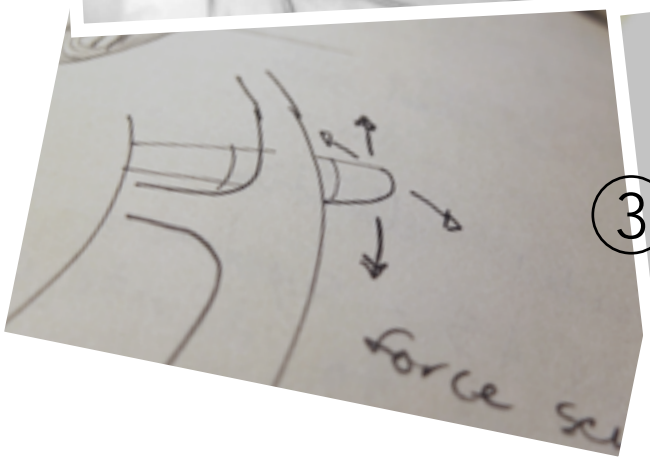

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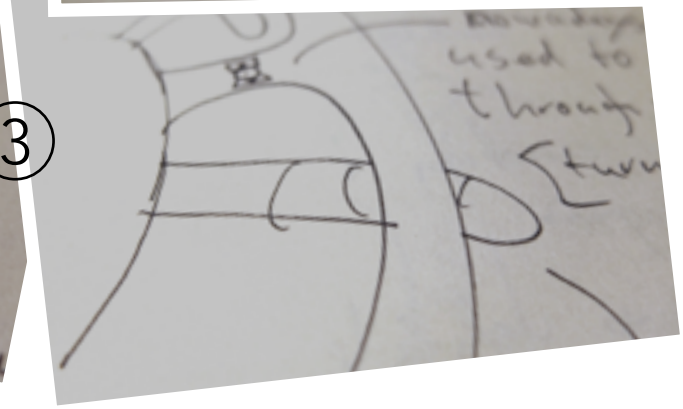


Ideas

How can we design for a better acceleration experience in e-mobility? The advantage of an electric drivetrain is the immediate availability of torque from zero rounds per minute. This allows for a powerful acceleration experience that is unlike any conventional drivetrain, but is it also as rewarding as the acceleration experience of a conventional drivetrain. The awareness of speed is less. This has to do with the effortless power delivery. It seems as if the car does not have to deliver so much power anymore. In someway the experience has become less exhilarating. Using a gearshift gives the driver a feeling of the accelerating progress made. The delicateness of distributing the power from the combustion engine to the wheels by engaging the clutch, gives the driver a feeling of authority over power delivery(1). How can we introduce enjoyment in the acceleration of electric vehicles?

How can we design for a holistic workload management system? To address the workload issue, the vehicle has to know what is currently the best task for the driver to spend their attention on, considering the current situation and the near future situation(2). For example, if the situation is very demanding because of heavy traffic, the system might postpone showing the traffic update for a few miles ahead.

What would be a suitable interaction device to enhance the enjoyment of controlling power of electric vehicles? Why do we have an accelerator pedal and not a button to control the throttle? Because buttons are in this case not suitable for the task(3).

Peripheral Attention

We do not need to look at the steering wheel to interact with it. We can operate it in the periphery of our attention. We feel how the vehicle reacts to our input. The same thing cannot be said for a lot of current cruise control interfaces. You can learn over time which button does what and the vehicle reacts to the action, but the interface only allows for stepped input. The interaction is not as direct as it could be and takes place in the focus of our attention[7].

Final Direction

The final direction tries to answer to both improving driving assistance systems as well as improving driving workload management. Both topics are connected. The way drivers interact with supporting systems has consequences for the workload.
One semester is not enough to design a complete interior. One of the most important advanced driving assistance systems is cruise control. Due to improvements of technology, the level of automation in cruise control is increasing. The interaction however, has not changed very much.

Concept

The starting position of the prototype is a set cruise speed. By pulling the lever towards the steering wheel the driver reduces power input of the vehicle, which results in reducing the vehicle speed. Relieving the lever results in gradually accelerating until set speed is reached.

The reasoning behind the concept is that the action is more directly linked to the longitudinal motion of the vehicle and therefor requires less attention to operate than conventional cruise control. The goal of the controller is to give back the driver's feeling of authority over power control. At the same time it allows the driver to relieve the task of speed control to the vehicle. A mechanical working prototype was made to demonstrate the concept. Experts from the automobile industry were guest and used the prototype.

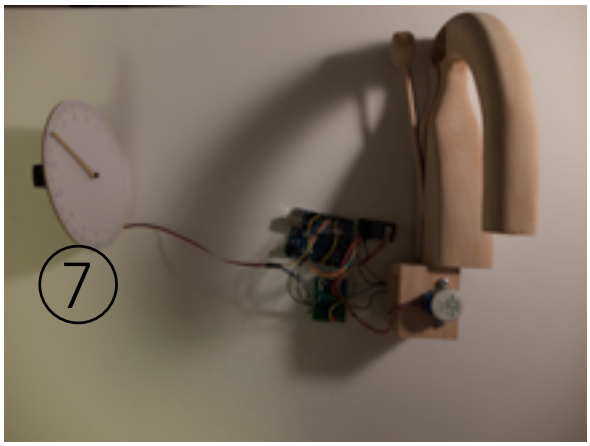
Final Prototype

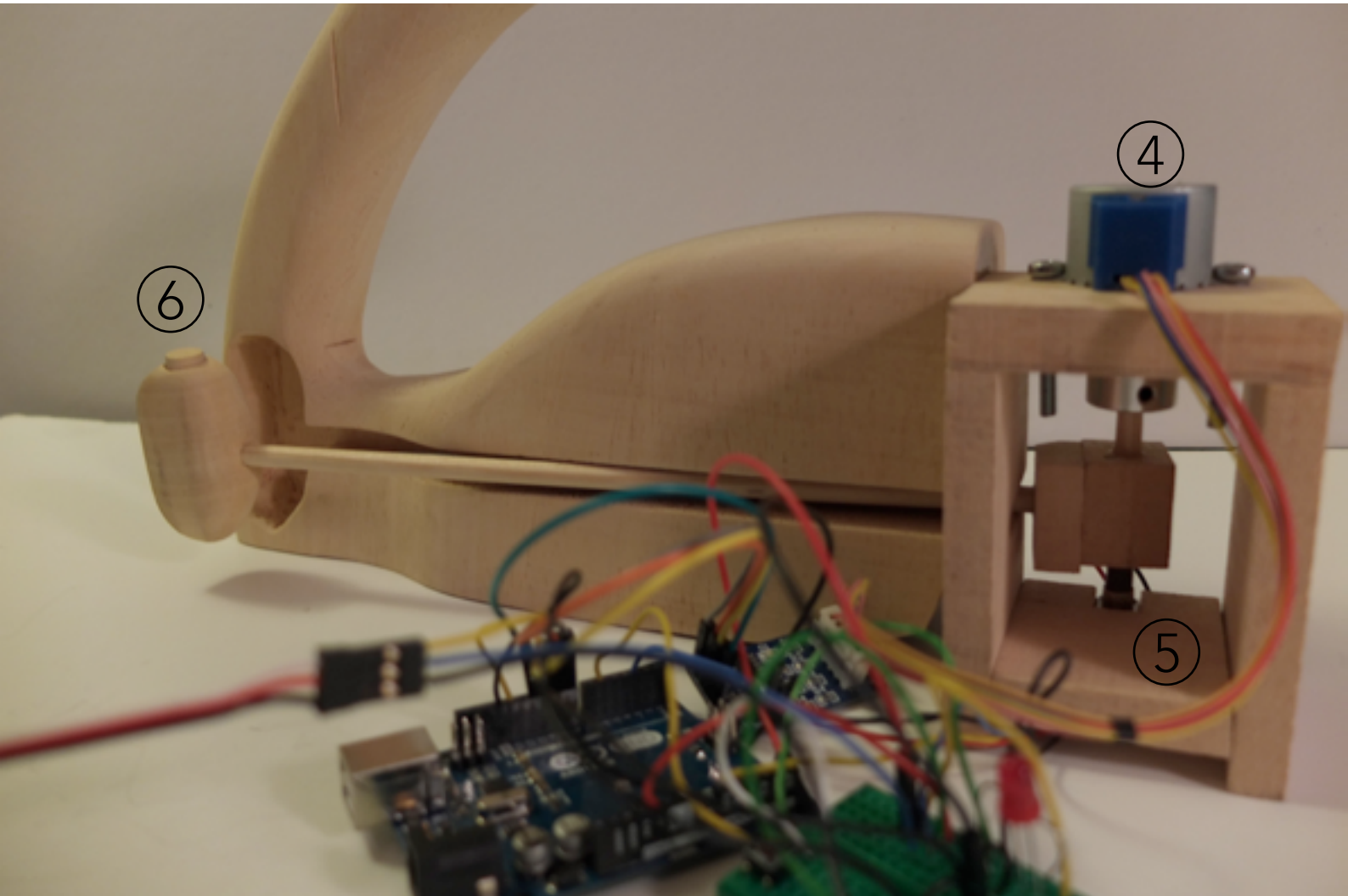
With the right direction set, it is time to go deeper. The mechanical prototype mapped the input from the lever directly to the speedometer. This means that the lever controls the speed and not the power input as desired. The only way to communicate the desired experience is to build an electronic prototype. The first mechanical prototype explains the concept quite well, but lacks detail in the response.

How it works

Electronics

The lever is connected to a stepper motor(4) to move the lever back to the position (fig. 2) when the driver relieves the lever. The position is read by a potentiometer(5) connected to the shaft of the stepper motor. The speedometer is powered by servomotor(7). The button(6) in combination with moving the lever changes the cruise control speed setting.





Use

1. The off-position (fig. 1) of the lever is inside the steering wheel.
2. When the cruise control is engaged, by squeezing the lever further into the steering wheel, the lever will extend from the back of the steering wheel.
3. To reduce power input the lever is squeezed from position (fig. 2) to position (fig. 3). The deceleration rate is linked to how far the lever is squeezed.

The advantage of the new interaction over the conventional controller, is that it would be more suitable to use in heavy traffic context, because it is easier to change the longitudinal motion of the vehicle and therefor enables drivers to blend in with the traffic. It would make driving more relaxed, because drivers have the benefits of cruise control, so there is no need to look at the speedometer. Without the need for a speedometer, drivers are able to keep their visual attention to the road.

Discussion

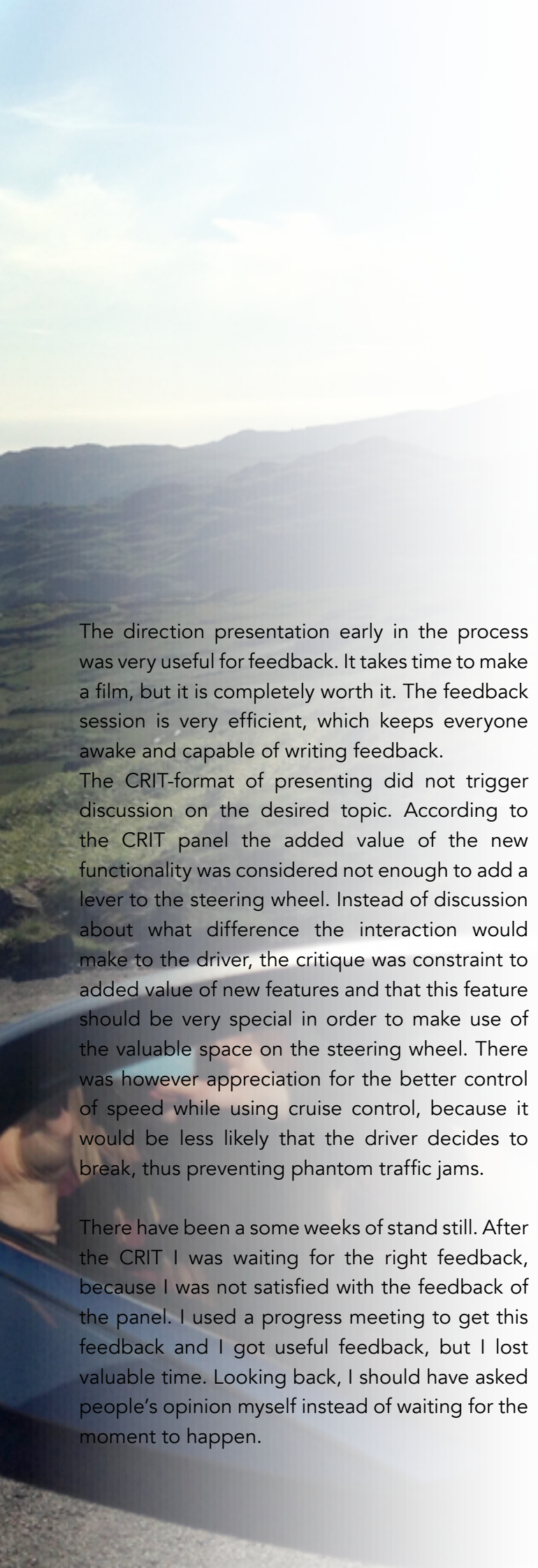
There is some doubt about the worthiness of the concept. The industry expert panel stated that the added value of the new functionality might not be enough to add a lever to the steering wheel. There was however appreciation for the better control of speed while using cruise control, because it would be less likely that the driver decides to break, thus preventing phantom traffic jams.

Users commented on the distance between the lever and the steering wheel. For drivers with small hands it would be difficult to reach to the lever.

The mapping of the lever to the power input could be refined further. When drivers abruptly pul the lever, the vehicle should respond differently then drivers pulling gently.

Future

The foundation for a new cruise control interaction has been created. The next step would be to connect the prototype to a driving simulator. To execute a proper interaction study, it would be desirable to use a driving simulator that can simulate G-forces. Only then can the driver experience the interaction as it is meant to feel. It would be interesting to see if Cruising New Style would really reduce workload for drivers. An ergonomics study is recommended and could improve the interaction.



Reflection

The direction presentation early in the process was very useful for feedback. It takes time to make a film, but it is completely worth it. The feedback session is very efficient, which keeps everyone awake and capable of writing feedback.
The CRIT-format of presenting did not trigger discussion on the desired topic. According to the CRIT panel the added value of the new functionality was considered not enough to add a lever to the steering wheel. Instead of discussion about what difference the interaction would make to the driver, the critique was constraint to added value of new features and that this feature should be very special in order to make use of the valuable space on the steering wheel. There was however appreciation for the better control of speed while using cruise control, because it would be less likely that the driver decides to break, thus preventing phantom traffic jams.

There have been a some weeks of stand still. After the CRIT I was waiting for the right feedback, because I was not satisfied with the feedback of the panel. I used a progress meeting to get this feedback and I got useful feedback, but I lost valuable time. Looking back, I should have asked people's opinion myself instead of waiting for the moment to happen.

The project squad in-Transportation interaction is a very strong one. The students and staff are enthusiastic. This results in high quality work. I have had discussions with many students, which helped me to form an opinion on the subject and to reflect on my work.

The higher I get in my studying career, my awareness of high level around me grows. I want to deliver high quality work, but wanting so blocks me in getting my ideas out. Only when I believe my ideas worthy enough to share, will I finally share them. This project has forced me to physically build my ideas. I find this very liberating. Even though I will not always get it right the first time. There is still room for improvement, but the insight has sunken in.

Working with electronics s new to me. I did some tutorials during my premaster, but never at this level. I have pushed the boundaries of my electronic abilities. I am amazed by the amount of components necessary to create the desired experience.

This project has been satisfying, regarding the achievement of learning goals. Most goals have been met, some to a greater extend then others.

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Inspiration

Adaptive cruise control interactions

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Future visions

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