LIVING ZONE

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MFA in Transportation Design - Degree Project
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The great advancements in technology are transforming cars into the next digital frontier, redefining people’s lifestyle around mobility. The thesis intended to push further on this trend, exploring new interaction paradigms and creating delightful experiences in future self-driving vehicles. With a cross-discipline scope, the formula is to blend digital information into physical form and material, blurring the boundary between the car’s interior and interface. As the conclusion, I learned that a constant harmony between virtual and physical world is the key for designers to create natural and intuitive experiences with technology.

The final result is an autonomous interior concept with multi-sensory user experiences. The core interface, as the physical manifestation of the car’s artificial intelligence, interact with users emotionally, offering its amazing capability in assistance. The in-car environment is evolved with sensors and displays, providing intuitive access to dedicated functions and immersive content.
INTRODUCTION
What if the software merged with the hardware?
Looking back at the history of automotive interior, it hasn’t been a radical change since the beginning. The layout is centered around forward driving experience, with safety regulation as the first priority. Technologies and functions were slowly getting into the car, in a spatial arrangement of the knobs, switches and sliders, providing simple control and direct mechanical feedback to occupants, allowing for a mental map of the interaction to be developed over time and built into user’s muscle memory.

The modern human machine interface (HMI) is a totally different story, there are many more controllable elements within cars — navigation systems, telematics, ride control and infotainment systems and so on. The increasing complexity requires new interaction modality. The mainstream solution is a mix of both physical and graphical user interfaces (GUI), with the GUI behaving as the major source of feedback with multiple modes for different functions and systems. Elements within the GUI can be controlled either indirectly via remote control devices. More progressively, big size touch screen began to take a place on car’s dashboard, offering more possibilities with its highly flexible display and intuitive touch interaction.
INTERACTING WITH OBJECTS

The Internet of Things is enriching the way we interact with daily objects. Cloud computing and embedded sensors evolve physical form with digital intelligence, making all things networked and accessible over the Internet, and these objects not only become input modalities to the Internet but also manifest parts of the Internet, allowing user to perform dedicated functions in a more natural and tangible way. It brings with a promise to dissolve the gap between our physical and digital worlds with the potential to integrate elements of computing with just about any everyday activity, location, or object.

It is a whole new playground for designers, as now we have the opportunity to design product in both virtual and physical dimension. Go beyond designing shapes and form, we craft the user experience, and the experience becomes the final product. Therefore I see a opportunity to break the boundary between physical interior and digital interface, blending digital interactivity and information into car environment for a better experience.
The emerging display technologies such as augmented reality, virtual reality and holographic computing offer more possibilities for visualizing interactive and informative content. Instead of overloading information within a piece of glass and giving people more than they might need, we can now distribute them around the user, overlapping with physical form, material and space in the way that we use to perceive our real world. The information should be contextual and in the right position, reduced as core messages according to user’s real-time demand, keeping them informed in a subtle and flexible way. The rich content, such as visual graphics and multi-media, should stay rich and immersive, embracing people into a digital environment with delightful ambience.

When it comes to cars, we can then look beyond screens, thinking all interior surfaces as display media as long as it makes sense for its information and function. The windshield and side window are becoming the major display of augmented reality information, enhancing the driving experience and connectivity with its high-resolution projection and eye tracking sensors. The ambient lighting system in car has the potential to evolve from a mood enabler to a secondary display, providing subtle guidance and feedback so user will sense the context in a way that is not distracting, but is aesthetically pleasing, and tangible to varying degrees.
Artificial intelligence is redefining our relationship with technology, various digital devices start to talk with people in natural languages, assisting us in daily tasks with their powerful capabilities in computation and connectivity, with our lives been made so much easier than ever before. Machine learning methods and big data together bring a holistic understanding on user’s preferences and demands, blurring the boundaries between each applications on smart devices, so instead of interacting with overwhelming functionalities to fulfill a certain purpose, users are able to sit back with a predicative experience from the intelligence to satisfy their needs.

Self-driving cars are all about AI, they can see us, think for us and drive for us, behaving as moving robots in our society. Yet the technology is lacking of humanistic value, for this big shift of role as full autonomous vehicles to be widely accepted, people need to fully understand and trust the system in a natural sense. The challenge is to humanize autonomous intelligence with tangible communication capabilities, creating a emotional connection between the car, the user, and the surroundings.
Hi, I’m Cortana.
Autonomous vehicles have the great potential to reshape the entire traffic system as we know for a century. It is fundamentally different than human driving in every aspect — 360 degree computer vision, perfect safety, great efficiency and many more. To maximize the capabilities of self-driving cars, a whole new system has to be established to evolve the current vehicle architecture, infrastructure and traffic pattern.

On the highway, Safe Road Trains for the Environment program, funded by the European Commission and Volvo Car Group, aims to develop strategies and technologies to allow vehicle platoons operating on normal public highways with significant environmental, safety and comfort benefits. A lead vehicle with a professional driver will take responsibility for a platoon. Following vehicles will enter a semi-autonomous control mode that gives the freedom to drivers of the following vehicle to do
other things without safety concern. Autonomous platooning can significantly reduce the distance between cars, allowing high density and speed to make the highway traffic much more efficient.

As for the urban environment, it is important to look into the impact of self-driving vehicles at the city scale. Vehicle-to-Vehicle communication technology will play a central role to build a fully autonomous system. Researchers at MIT came up with the idea for a smart intersection algorithm called Light Traffic. It uses sensors to keep driver-less cars at a safe distance from each other and allocate each car with a crossing slot as it approaches at a junction. Speeds can be automatically adjusted on entrance to ensure the vehicles take it in turns to pass across without having to stop. This would help greatly reducing congestion, extend the lifespan of current infrastructure and cut down the need for new roads.
VALUE OF VOLVO

“At Volvo, everything we do starts with people. So our mission to make people’s lives easier, safer and better is something that comes naturally to us. It’s the Volvo way. Today, we’re still as focused as ever on our three core values: safety, quality and care for the environment. Protecting what’s important. Making people feel special. And taking pride in helping the world become a better place for all.”

What identifies Volvo as a unique car company is its human centric value, practiced by the Scandinavian design philosophy. Starting everything with people, their mission always has been making easier, safer and well-being life for the user, and helping the world become a better place. Today, they believe that autonomous driving is the one essential technology to fulfill their values in safety, quality and care for the environment.
As a hybrid between transportation and interaction design, my goal for the thesis was to consider mobility system as a whole and applying holistic thinking through analyzing human needs, balancing the benefits of relevant technologies and define meaningful experience in both digital and physical way.

For the process, I dived deep into vehicle interior space and boosted my understanding around automotive context, from software to hardware, from aesthetics to functionality, from ergonomics to usability, I planed to carry out the user centric design approach to unify the physical interior and digital interface in one, demonstrating the best from two worlds. Furthermore, I explored the exterior form factor of self-driving cars, challenging the traditional car design principle with a logical, efficient and inside-out approach.

For the result, I hoped it will be shown in convincing ways such as interactive prototype, physical model, virtual reality viewing and storytelling animation. So in the end I may prove to car industry that if the exterior, interior and interaction design teams work together from the very outset, this unified aspiration of best in-car experience is achievable.
Process
TANGIBLE HMI

Navigation

Wellbeing

Entertainment

Productivity

Autonomous Driving

Time control

Notification

Turning on Speed

Climate

Air

Setting

Users

Haptic

Media

Smart devices

Creativity

Waiting

Stop by

Pickup

Ambience

Communication

Data Visualization

Services to car

Material

Interactive

natural material

leather.wood.fabric.system

Wellbeing

sensing

heating.

 MASSAGE

adjustment

user profile

Driving

Timeline

Air

clean zone

temperature °C +

Scent.
power.direction.
defreeze.remove

Temper.
delay.

firewall

.trim

.maintenance

.product

.delivery

.fuel

.rapid

.maintenance

Material

Interactive

natural material

leather.wood.fabric.system

Content Consumption

streaming

Streaming

VR

Gaming

Social

call

feeds

nearby

text

share

VR

Media

volume

Mute

play/pause

shuffle

Source

playlist

Smart devices

connectivity

projection

Sync

Table

Creativity

painting

modeling

play instruments
Starting from the big picture, the first intention was to define the vehicle architecture, traffic pattern and corresponding infrastructure that can maximize the potential of autonomous system. All driverless cars work as individual units with virtual connection to each other, they travel in single, dual or platooning mode depends on the purpose, with omni-directional movements in greater agility.
Autonomous vehicles bring the opportunity to redefine its architecture. Instead of conventional 4-seater package, I went for a 2-seater compact pod with a face to face layout, creating flexible space to support two passengers with different activities, and one car can be docked with another during the platooning, further expanding the room to connect more people, encouraging a social atmosphere between vehicles.

Functional components, such as head-up display, sound speaker, and air vents, are repositioned on the side panel as the new dashboard. To get the best ergonomics and usability, I played with different layouts, distributing them around people in the place that makes the most sense.
Artificial intelligence is the soul for autonomous vehicle, and it has the potential to empower people within the car to do almost everything. Therefore I took it as the core interface of the user experience, tried to manifest the digital intelligence into a robotic form, creating a tangible and emotional relationship between the car and the passengers, so people would feel comfortable and trust-worthy to the technology. Different sketch proposals were made for its physical body, playing with clean material, round volume and light effects, to make it into a high-tech jewelry element.

When it comes to self-driving experience, it is crucial to make people understand what is going on and be truly relaxed and enjoy the time. To convey the key information of the journey, the AI element behaves as your personal driver, physically sliding from one end to the other across the light bar, indicating the current speed, remaining time and distance. It is a more intuitive and subtle way of showing the traveling, without too much distracting. It also suggests the right applications based on real-time needs, keeping users well-informed with active notification about severe events, and providing strategic controls between best alternatives.
• A intuitive sense of time and distance

• Strategic control to the journey
To evolve the user experience beyond graphical interface and touch screen, I explored tangible interaction modal for common in-car functions, distributing interactivity from the center display to the original hardware. Taking the speaker as an example, the mesh surface is touch-sensitive with integrated sensors. Users are able to swipe directly on the mesh to control the sound system. The interaction gestures were made to follow user’s intuition, and with the illuminated light graphic, people can get both a feedforward and feedback for better semantics and usability.
Virtual reality is the future way of consuming content, simulating a holistic sensation around the user to build up a truly immersive experience just like how we perceive the real world. To apply this exciting technology into our cars, I imagined all window surfaces been made in transparent displays, creating a three dimensional space with digital senses in visual, sound, and haptic.
• WELLBEING CLIMATE PROGRAM

Reykjavík, Iceland

-1 °C | °F
Precipitation: 0%
Humidity: 69%
Wind: 6 m/s

• TURN ON • TURN OFF
User testing is an essential part of experience design, in parallel with my concept ideation and form development, I ran a few tests with selected user groups to validate the usability of the interfaces. A real-size one simulation of the car’s interior space has been built up around passengers, together with the projected content on the wall, users can take the seats and experience the entire journey flow with all interactive features.
Mock-up

Touch prototype
To develop an interior theme for the best autonomous experience, I defined first the layout with two face-to-face seats, crafting around the AI element with physical aesthetics and digital robotics. Other secondary components are blended into the surfaces around passenger seats, making sure of ergonomics and usability.
EXTERIOR
RESULT
The final concept is a self-driving mobility service powered by hundreds of thousands autonomous pods for people to commute around urban area. These units travel in platoons on highway in mix with human drivers, and connect to each other in city roads to have the fluid and seamless traffic.
HIGHWAY PLATOONING

SMART INTERSECTION
Hello, there.

CONVERSATIONAL INTERFACE

play
on
call

ON-THE-GO INFO
To start the day, you step into the car and talk first with the AI interface, planning the trip with the map details on the window display. After the decision has been made, the complex information fades out, the AI element behaves as your personal drive, sliding from A to B to deliver an intuitive sense of remaining time and distance. Only relevant applications and content will be suggested to you on the go, simplifying the user experience with predictions.
The panorama window work as transparent display all around the interior, bringing the virtual reality content into automotive context. Users can easily immerse theirselves within this four-dimensional virtual ambience, yet at the meantime stay synchronized with the car’s driving intention with the surrounding light indicating subtly the next move.
MANEUVER INDICATION

EXTENDED SPACE
The final interior design is a true embodiment of Scandinavian lounge atmosphere, everything is designed around people. Two lounge seats create a roomy and cozy nest for passengers. The AI interface always standby on the side empowering the users in great ways, the panorama window showcase the contextual content they might need.
The final exhibition is a unique sitting area with the interactive interior sculpture and projected animation on the side, creating a real sense of being in the car’s interior and interacting with the interfaces. With the proximity sensor and LED light integrated inside, the AI element wakes up and start to breath with light every time when someone approaches to it.
CONCLUSION
In the beginning of the thesis, I had the ambition to break the boundary between interior design and user experience, proving to the professional car design world that things can be done in a different way. As the result, the project demonstrates this holistic vision of a unified design concept between the car’s exterior, interior and interface. The conclusion is that with the undergoing revolution in car industry, the core competence in automotive industry are moving away from faster engine speed, stylish exterior sheet-metal and luxurious interior material, to autonomous intelligence, digital connectivity and meaningful in-car experience. This shift of focus challenges traditional car designers to look beyond form and shapes, to think about technology and users, and to design cars as a holistic mobility experience.

During my study in Umeå Institute of Design (UID), the most valuable things I learned are the user centric approach and cross-discipline scope, bringing together different perspectives and skills to leverage between humanity and technology to create most meaningful outcome. Looking back to the point when I made the decision to apply for transportation design, it was because these unique qualities of UID changed my concept about car design, for the first time I realized that it is not only about sketching crazy surfaces, there are so many innovations in various aspects can be made to improve people’s actual life. As a perfect match with my personal pursuit, the UID way of thinking and design is something I would love to carry on into the industry, balancing the academic aspiration with realistic environment, and always pushing forward for the innovation, from all angles, and with all people.
REFERENCES
APPENDIX
## Timetable

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