Designing the User Interface of an Autonomous Vehicle Group Report

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ABSTRACT

Our study aims to create an interface system and suggest basic interior design for a futuristic vehicle, under the premise of that the vehicle is capable of self-driving and has no steering wheels or pedals. We identify the most important functions by the use of personas and scenarios. Our final design involves 360-degree rotatable front seats with tablets attached to their armrests. The tablets provide control options to the vehicle as well as many other functions a smartphone would provide. Information are displayed on monitors situated on the interior side of the doors or on the front dashboard. Fingerprint or facial recognition system is employed for security. Inbuilt sensors such as motion, speed sensors will be used to ensure the safety of the driving.

Keywords

Self-driving car, interaction design, futuristic technology, interface, design.

INTRODUCTION

Considering our remarkable leap in technology advancement in the past few decades, where computers were only invented, but popularized around the world nowadays, it is safe to say futuristic fantasy in car is nearer than ever. After the introduction of Tesla's self-driving cars, it is proven that many mundane tasks can be allocated safely and reliably to the machineries. Therefore, in the study, we place our faith in technology and assume that everything is possible.

Technology advancements usually focus on functionality, but the most important of all, the experience, is sometimes overlooked. People hops on the technology trend without fully understanding their potential usage. The most straightforward example being people using smartphones for only calling and messaging and having trouble understanding how to access other functionalities of the device. It is most common in the older generation where smartphones are introduced much later in their lives. Because the development of technology is much faster than the evolution of humans, there is this distinct discrepancy in the understanding of technology between the old and young generations. We believe that technology should be built to assist, not strain or stress the users, which is why it is inefficient to produce technology that cannot be comfortably or effortlessly used by the overall general population. Therefore, our aim is to create a user interface of a "smart car" that is convenient, accessible and functional to not only the younger generations, but to the entire driver population.

BACKGROUND WORK

Mercedes-Benz F015 (see Figure 1) is a concept autonomous car that integrates a multitude of features of everyday transit (Kable, 2016). The interior allows commuters can engage in activities according to their personal needs. The pivotal features include an unfixed chair position that can be rotated to suit the needs of the passengers', such as face-to-face configuration to assist better communication (see Figure 2). Another attribute of the interior is the installation of six displays on the instrument panel and walls of the car, which passengers interact with via gestures or touch (see Figure 3).

Figure 1. Mercedes-Benz F 015 interior - *Revolutionary vehicle structure*. [Digital image]. (Copyright 2003-2019 Daimler AG). Retrieved from https://www.mercedes-benz.com/en/

Figure 2. Interior - *A luxury lounge providing maximum comfort*. [Digital image]. (Copyright 2003-2019 Daimler AG). Retrieved from https://www.mercedes-benz.com/en/

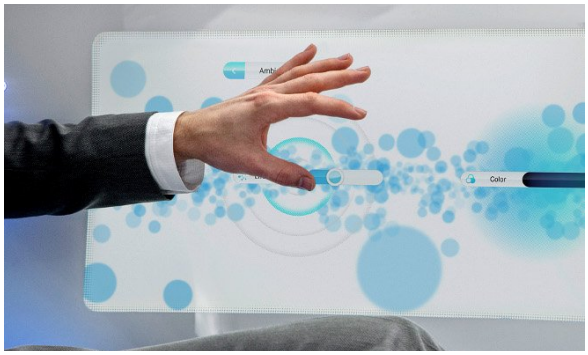

Figure 3. Touch display- *The interior as a digital living space*. [Digital image]. (Copyright 2003-2019 Daimler AG). Retrieved from https://www.mercedes-benz.com/en/

Figure 4. Family mode – *Familymode*. [Digital image]. (Copyright 2019 Yanfeng Automotive Interiors). Retrieved from

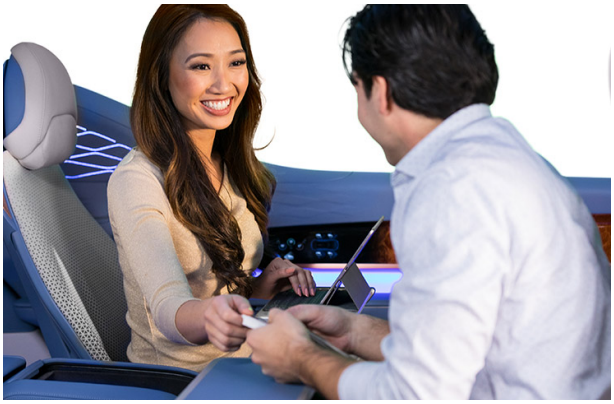

Figure 5. Meeting mode -*meetingmode*. [Digital image]. (Copyright 2019 Yanfeng Automotive Interiors). Retrieved from https://www.yfai.com/en

Figure 6. Lounge mode – *loungemode*. . [Digital image]. (Copyright 2019 Yanfeng Automotive Interiors). Retrieved from https://www.yfai.com/en

XiM17

The XiM17 is another concept of a driverless car by Yanfeng Automotive Interiors (Buchholz, 2017). The main focus of this interior is the flexibility of chair configuration to suit multiple ways to engage within the car. There are four main layouts, firstly, the standard traditional driving mode. Secondly, family mode (see Figure 4) where the middle console is pushed forward and the two rear seats merge together. This allows full view of the front display to the rear passengers. Thirdly, meeting mode (see Figure 5) is created by turning one of the front seats 180 degrees around, which transforms the car into a miniature office. In this mode the floor console can either be used separately or merged together to create a large workspace. Lastly is lounge mode (see Figure 6), the front seats are slid to the back and the rear seats are folded away.

Volvo 360c

Volvo's 360c concept car emphasises passengers making the most of their time (Lekach, 2018). The interior design can be arranged a mobile office (see Figure 7), entertainment area (see Figure 8) or bedroom (see Figure 9). Volvo's goal is to create a car that facilitates the needs of passengers beyond the capabilities of a human driven car. The introduction of a space that converts into a bedroom will allow passengers to travel over longer distances within their own car. Ultimately replacing short domestic flights, for example Melbourne to Sydney.

Figure 7. Mobile office - *Work*. [Digital image]. (Copyright 2019 Volvo Car). Retrieved from https://www.volvocars.com/intl

Figure 8. Entertainment on the go - *Enjoy*. [Digital image]. (Copyright 2019 Volvo Car). Retrieved from https://www.volvocars.com/intl

Figure 9. Bedroom conversion. *Sleep*. [Digital image]. (Copyright 2019 Volvo Car). Retrieved from https://www.volvocars.com/intl

Rolls-Royce 103EX

Rolls-Royce a concept driverless car that will be designed as a harmonious unique space (see Figure 10)("*A Grand Vision of The Future of Luxury Mobility",* 2016). The approach to the interior design resembles a small lounge room, consisting of a large television and a sofa-like seamless passenger seat (see Figure 11). Above, there is a large glass canopy that acts as passengers "panoramic observatory" to connect with the surroundings. Passengers interact with the features of the car through an artificially intelligent virtual assistant, namely the Voice of Eleanor.

Figure 10. 103EX overview and canopy - *Grand arrival*. [Digital image]. (Copyright 2019 Rolls-Royce Motor Cars). Retrieved from https://www.rolls-roycemotorcars.com/en-GB/home.html

Figure 11. Display and lounge zone – *Enter serenity*. [Digital image]. (Copyright 2019 Rolls-Royce Motor Cars). Retrieved from https://www.rolls-roycemotorcars.com/en-

DESCRIPTION OF YOUR METHOD/SYSTEM

Initial discussions and research

To begin our group research, each group member had to conduct individual searches into what makes a good vehicle user interface. After browsing through tech blogs, news articles and discussions of our background and personal experiences with currently available user interface systems, we came to a consensus. As a part of our initial discussions, each group member contributed ideal functions through the use of a brainstorm (see Figure. 12).

Creating personas

To narrow down essential functions of our interface, we designed three personas of potential users for our interface. (see Figure. 13) The three personas were not designed

Figure 12. Brainstorm

based on gender, instead they were selected for their age, occupation, and needs. Given that the vehicle is fully automated without the need for steering or pedals, we believe that our user interface will not be used solely by the adults with licenses. This is why we have included Kyla. For each persona we have noted their use of the internet or technology, this is so that we can identify what essential functions should be included. The personas created helped us answer these questions:

- What are our users looking for?
- What will our users want in our interface?
- How will our users use the interface?

By answering these questions, our group were able to advance into conceptual design and thus idea development began.

Conceptual Design

To move forward, we derived one goal for each persona.

1. Kevin wishes to stop using rideshare applications to complete his daily commute to and from work. So, he is hoping to purchase an automated vehicle that allows him to reply to his emails and complete his work during the commute.
2. Mia wants to answer her business calls in comfort and style.
3. Kyla has recently discovered a new television series. She wishes to watch the series on her way to school in the mornings.

During the discussion we discovered scenarios that raised considerations for our design.

- During a family's long journey, their child Kyla has suddenly fallen sick. She needs to be taken to a restroom along the road. Kyla's father who initially entered their destination on his tablet interface, places his fingerprint to unlock his tablet

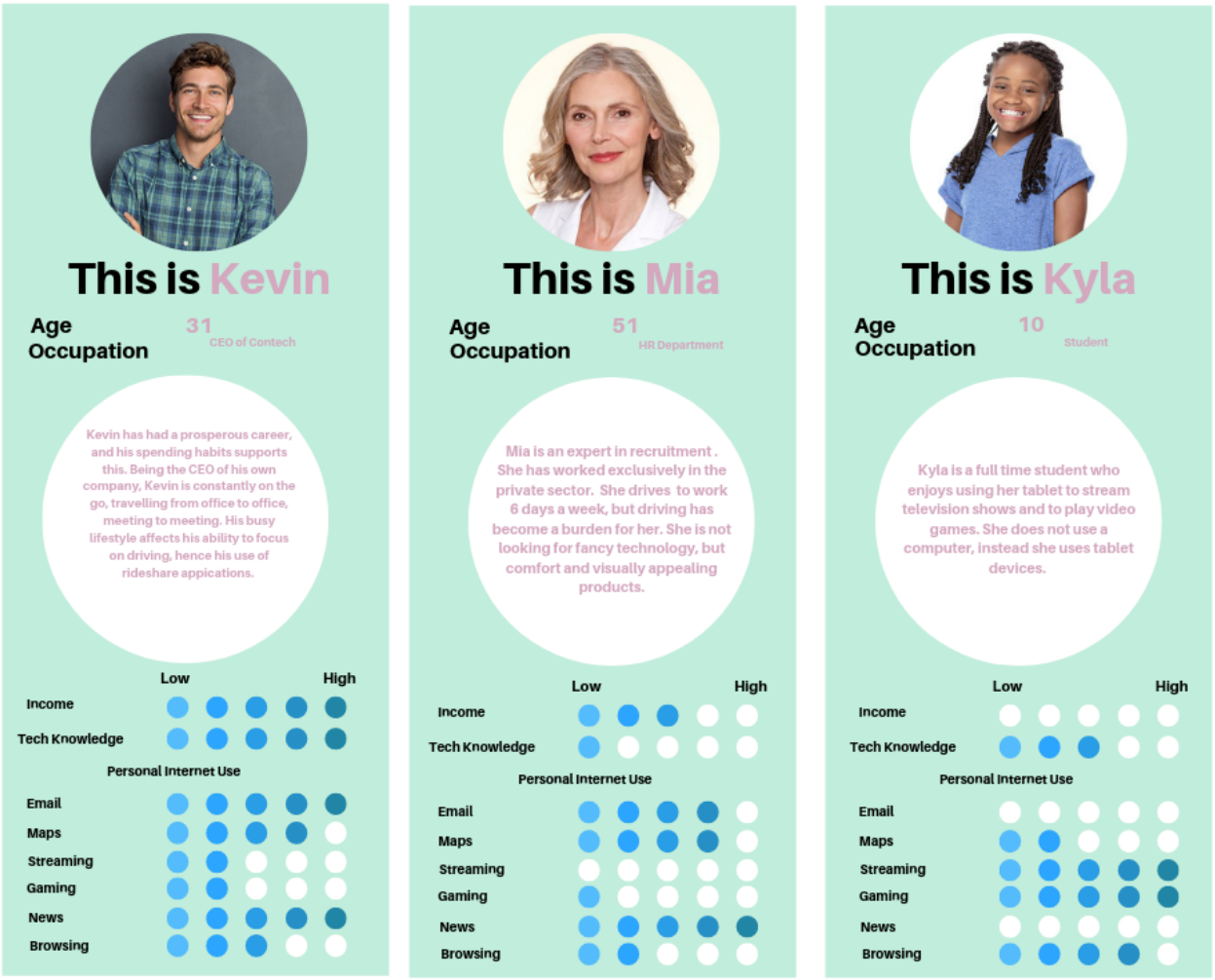

Figure 13. Personas

and heads into the map application. He types in 'nearest restroom' and tablet shows possible locations, he can then select one which will revise the route. In case of a software malfunction, there will be a physical emergency button that will immediately stop the car and automatically contact the nearest emergency roadside assistance.

The scenario above mentions sudden detours that passengers may wish to take, therefore a suitable function to allow navigation remapping should be designed into the interface. Scenarios help for a more focused design that should lead to greater real-life usability of the interface.

Use cases

Our proposed user interface should be a convenient tablet like construct. Ideal ways of using the system would be the use of satellite navigation, accessing mail, browsing the internet and providing a platform for existing web developers to integrate their applications to our system.

With the integration of external applications such as streaming sites, it may result in third party customer service representatives from the web developers to carry out troubleshooting should our users encounter any issues. It might also be ideal to have our interface be connected to emergency services in the event of emergencies. This will require another user in the background of our system.

RESULTS

All seats are able to recline, but the two front seats will have to ability to turn 360 degrees. There will be a detachable tablet per seat (see Figure 14), and similarly to a lecture hall chair, (see Figure 15) it will be stored like a fold-away table.

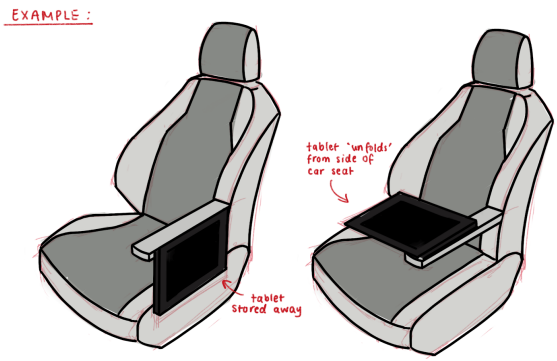

Figure 14. Seat concept

Figure 15. Seat inspiration

All touch screens will have access to entertainment, such as movies, games and other applications. However, the 'driver's' touch screen will also serve as the main control system where you manage the car, change the temperature settings, play music, control GPS, etc. Tablets can be paired to your Bluetooth and phone, allowing you to send text messages, accept calls, or access iOS/Android/mobile specific apps such as Apple Music, Siri, Google Maps and Spotify.

The passenger will need to log into their account with a password or touch/face id to access such programs. The database will document your activity and save each passengers unique preferences, providing a personalised interface for each passenger. For example, children will most likely have games and video applications while adults will have more news and work-related programs.

A main monitor will be displayed on the interior of the car, either on the doors or the dashboard (see Figure 16). This is not touch activated as it is a screen that displays information such as time, temperature, music playlist, GPS/current location and route to destination, car speedometer, odometer and petrol gauge.

Finger-print access or facial recognition will be installed for security purposes. If you need to operate the car, you will need to pre-register your fingerprint or face to obtain access to driver functions (similar to Apple iPhone's touch/face id). This will hopefully prevent any robberies and avert children from controlling the car.

The car will have several in-built sensors - proximity sensors to prevent collisions, speed sensors to control how slow/fast the car drives, distance sensors to record car mileage and motion sensors which detects movement (if the car is moved/tilted/broken into) that will trigger an alarm if there was a potential theft.

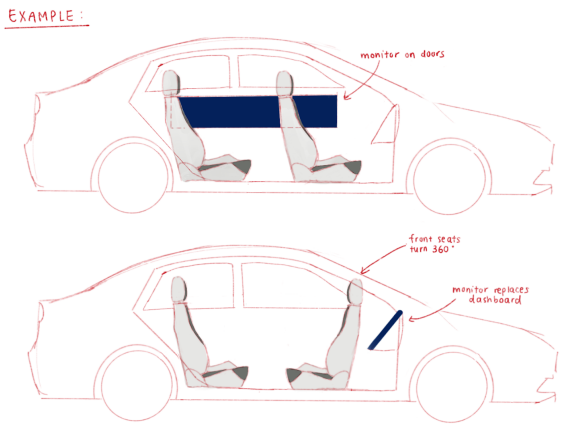

Figure 16. Car interior concept

DISSCUSSION

Our design result is the outcome of research, different ideation methods and various discussions. Every group member had different expectations for the project. Consequently, this increased the amount and varieties of the ideas. To reach a general agreement we had to discuss about the strong points and weaknesses of every design possibility to disqualify those ideas that were not reasonable. Furthermore, we also had to consider different features of possible design outcomes and discuss which ones are the most important and therefore should be prioritized. The discussions covered various topics, although most of them can be grouped into three main points of discussions: feasibility, ergonomics and user experience.

After much deliberation, it was decided to lean towards a design outcome that would prioritize feasibility rather than exploring fictional or speculative options where there is little existing precedent. We agreed to base our design on examples of contemporary autonomous vehicles like the Mercedes-Benz F 015 Luxury in Motion and other concept cars. This is one of the main reasons the design outcome is so similar to many research prototypes of the automotive production industry. Nonetheless, small adjustments were made as it was decided to implement features and technologies typical of smaller devices, like face recognition and fingerprint sensors (frequently found in nowadays' smartphones) and a 'drivers' tablet that would have greater control over the car than the rest of passengers' tablets. This is similar to 'Player1' in Nintendo Wii.

We also gathered together after we have decided on the design outcome to discuss about the results. It was agreed that the results we obtained were close to what was expected. This is most likely due to basing the design on already existing autonomous cars and concepts and prototypes. Furthermore, issues and limitations in our design project were identified. Firstly, it is worth noting that the two front chairs can be rotated, however it has not been resolved if there is enough space for passengers' knees to fit during the turning mechanism. Additionally, the screens on the doors might make it harder to clean the car, since screens are more sensitive to chemicals and impacts that would cause cracks. Also, it would be harder to replace the screen of the doors since they have to custom made for the car. Lastly, it was realized that there is not a working surface for passengers to work on their computers or write something down in the car. This could be resolved by implementing folding tables.

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