

## Design Project II

# Interior design of a personal autonomous vehicle enhancing interaction and experience



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Guided by : Prof. Nishant Sharma

**IDC** School of Design  
अभिकल्प विद्यालय

## Declaration

I declare that this written report represents my own idea in my own words, and where others, ideas or words have been included, I have mentioned the original source. I also declare that I have adhered to all principles of academic honesty and integrity and have not falsified, misinterpreted or fabricated any idea, data, facts or source in my submission. I understood that any violation of the above will be cause for disciplinary action by the institute and can also penal action from the source from which proper permission has not been taken, or improperly cited.



Date: 20-12-2018

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# Approval Sheet

The Mobility & Vehicle design project report entitled “Interior design of a personal autonomous vehicle enhancing interaction and experience” by Nipurn Solanki is approved in partial fulfillment of the requirement for Master of Design degree in Mobility & Vehicle Design.

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Internal Examiner:

External Examiner:

Chairman:

Date

: 20-12-2018

## Acknowledgment

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I would like to express my gratitude to the members of IDC IIT Bombay for their kind co-operation and encouragement which help me completion of this project.

Last but not the least, my thanks and appreciations also go to my batch mates in developing the project and people who have willingly helped me out with their abilities.

A handwritten signature in blue ink, appearing to read "Rahul", is written in a cursive style. The signature is positioned below the main text of the acknowledgment.

## Abstract

Autonomous cars, electric mobility and shared mobility services are some of the cutting edge technologies which offer a great potential to be explored. Any one of these alone would be an interesting development, but all three together is a tectonic shift. Electrification and autonomy will bring new technology which will affect the package and proportions of the cars, where are we going to place the motors, how the passengers are going to seat all of that are now open to new interpretation. In future the unique selling point for cars is going to be the experience that an interior space offers. With autonomy, the notion of comfort will change. In current scenario there is a particular seat set up for driving, and the ergonomics are also set up for driving. But, with autonomous vehicles, when the use changes to an environment where people can spread out, relax, even take a nap, then the environment should adapt accordingly. The project primarily focuses on exploring different such ideas of interior for a personal autonomous vehicle.

Research phase began with a comprehension of the autonomous car evolution and the evolution of spaces within them. Different aspects of car interiors like the new technologies and features were studied along with the current trends of exterior and interior aesthetics. Research was then followed with the interviews of potential users. Based on the valuable insights gathered in the research the brief was then constructed along with the package..

Furthermore, based on the brief, persona was developed to sensitize with the user group, this was then succeeded with the concept ideations. Different concepts were then further analyzed and one was taken forward for detailing and development. The final concept offers an experience for the users which is customizable. The space and furniture within can be configured to adapt to various needs of the users such as conversation, work and entertainment. The final design is then complimented with unique features such as focused (directional) sound system, air touch dashboard and seamless device integration etc.

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# 1

## Introduction

## 1.0 Introduction

Everyone is talking about autonomous cars, electric mobility and shared mobility services. Any one of these alone would be an interesting development, but all three together is a tectonic shift. Everybody is asking questions, nobody yet has the answers, but everyone is much more open-minded and accepting than ever before. It is an observation that technology will play a bigger and bigger role in car interiors of the future. As designers, we need to understand what to do with technology, which means understanding what technology does and how it does it.

One essential thing for future of mobility is autonomy. But it is of extreme importance that we do something which is oriented towards the future. Electrification and autonomy brings new technology and that means package and proportions of the cars are going to change. Where are we going to place the motors? How the passengers are going to seat all of that are now open to new interpretation. I am trying to test out all different ways of doing it and see what could work best. In case of my project the intention is very clear and that is about interaction and experience inside the car. In this case autonomy and electrification allows you very different things you are not constrained by size and location of an engine, which opens tons of new possibilities.



Img 1 : Mercedes Benz smart vision EQ fortwo

## 1.1 Scope of the project

Consider a scenario in which a user is opting for air travel, he would most probably look for the service provider such as Vistara, Air Asia or Spice jet etc and not the aircraft he's traveling in. In most of the cases Boeing 747, Boeing 787 Dreamliner, Airbus A320 or Airbus A380 will not be of his concern while booking an air ticket. Similarly in future cars, the interior space would not be used for transportation alone, but also provides various valuable experiences as future living space. Exteriors have always been associated with love at first sight, whereas interiors are more tangible, intimate and hands-on experience.

With autonomy, the notion of comfort will change. In today's cars you've got a seat with an ergonomic setup that is suited to driving. But, with autonomous vehicles, when the use changes to an environment where you can spread out, relax, even take a nap, therefore the basic ergonomics associated with it will also change drastically. With a lot of advancements happening in the field of furniture and residential interior design, soon we will be able to see its impacts getting reflected on car interiors too. When the activities and experiences within the car interior spaces change, there is requirement for giving flexible and multi-functional spaces.

# 2

## Preliminary Research

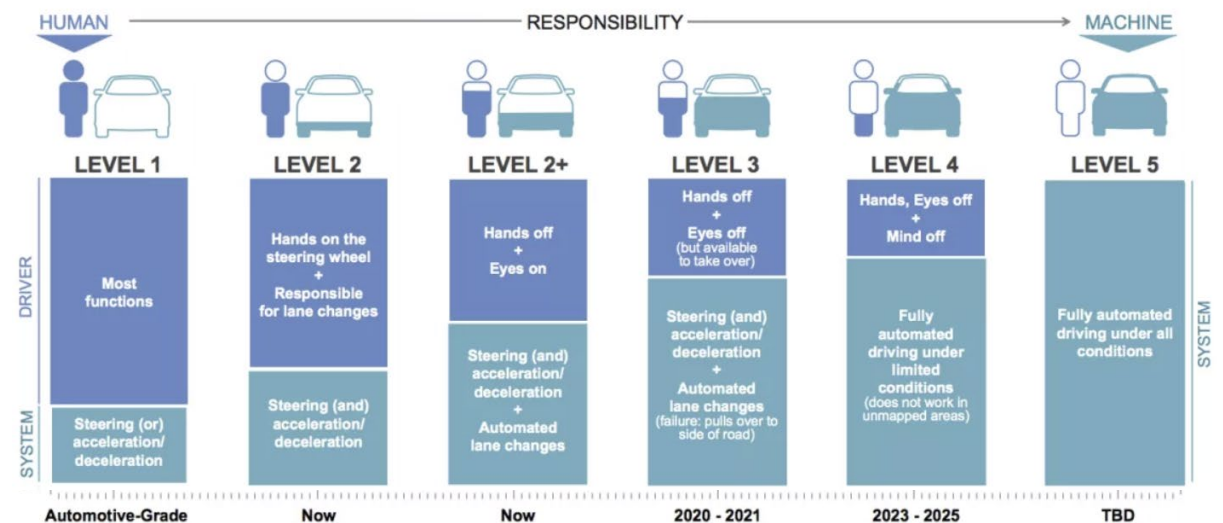
## 2.1 Evolution of Autonomous Technology

Seemingly within just a few years, autonomous cars have gone from science fiction fantasy to road-bound reality. But while it seems like this technology emerged virtually overnight, the path to self-driving vehicles has been a long and winding one.

Companies such as Ford, Mercedes and Tesla are racing to build autonomous vehicles for a radically changing consumer world. Ford, for instance, recently tripled its investment in its autonomous vehicle fleet and is testing 30 autonomous Ford Fusion hybrids in California, Michigan and Arizona.

The first big leap in introducing autonomous vehicles to the consumer market was in 2017 from Google, whose self-driving technology now costs a tenth of its original \$80,000 price tag. Every major automotive manufacturer will likely follow by the early 2020s. Many of the key pieces of technology necessary for the manufacturing of autonomous vehicles are continuing to decrease in cost as the technology is perfected.

While it's not easy to compress the history and evolution of self-driving cars into just some milestones and there are dozens of autonomous vehicle projects to look into, here are the major stops on the road that we need to know about as self-driving cars get set to change the face of transport as we know it.

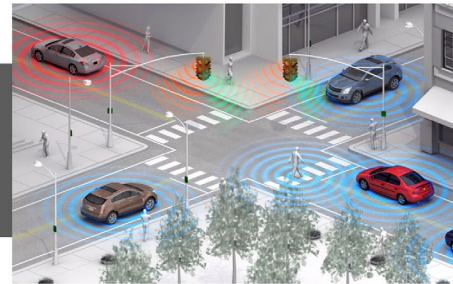


Img 2 : Different levels of autonomy with a comparable timeline

Today we create objects but in future it will be more experiential design and less of object design. With automobiles we will go more and more in the same direction in future, we will be designing exterior and interior experiences and not just physical forms.



TODAY



TOMORROW



*Img 3: Design, Today and Tomorrow*

## 2.2 Evolution of Interior spaces in Autonomous cars

As autonomous cars started evolving form-wise, their interiors also started developing in a unique manner. The spaces, furniture, features and technology in the interiors of autonomous cars have come a long way. These criteria have evolved in different ways based on the level of autonomy achieved at that time period.

### 2.2.1 Spaces

Initially when autonomous cars became a reality, the seating layout was very similar to conventional gasoline cars. They had front facing seats, and the major difference was that a hands-free driving experience was offered. Presently, many companies like Tesla and Smart 42 still has all front facing seats in their interiors. The major change which came in the interior layout of autonomous cars was the shift from front facing seats to seats which face each other. The experience offered by this layout was more conversational and interactive.

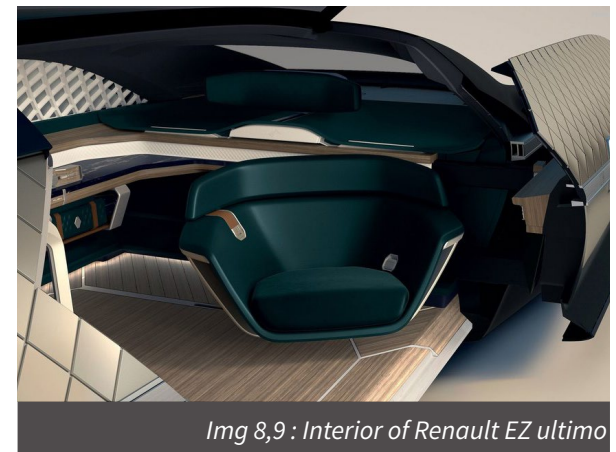


## 2.2.2 Furniture

Interior furniture started evolving from just seats to pieces of art. The idea of having fixed seating was broken with introduction of concepts like Mercedes Benz F-015, which had seats that swivel and move around by which the entire space layout and experience is changed. Armrests have evolved into deployable interactive display tables which can be shifted around as per space requirement.



Img 6,7 : Interior of Mercedes Benz F 015



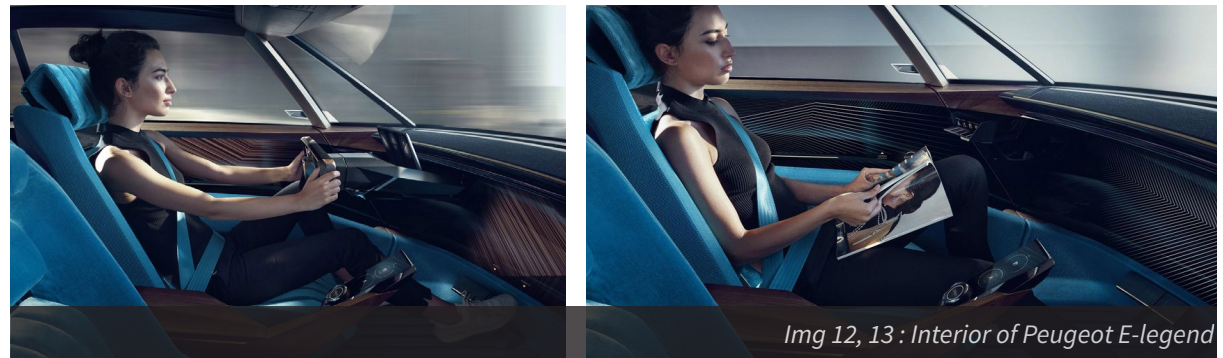
Img 8,9 : Interior of Renault EZ ultimo

### 2.2.3 Features

A feature which underwent the most changes was the steering wheel. The initial autonomous concepts had a steering wheel which was a permanent fixture. The users can sit hands-free when the autonomous mode is activated. Steering wheels then became collapsible in concepts like BMW Vision-next 100, Mercedes Benz F-015 and in concepts like Peugeot E-legend and Renault Symbioz the steering wheel can be retracted completely and stays hidden. There are concepts like Renault EZ-ultimo, Volvo 360C in which steering wheel is completely absent, offering an experience of complete relaxation to the user.



Img 10, 11 : Interior of BMW Vision Next



Img 12, 13 : Interior of Peugeot E-legend



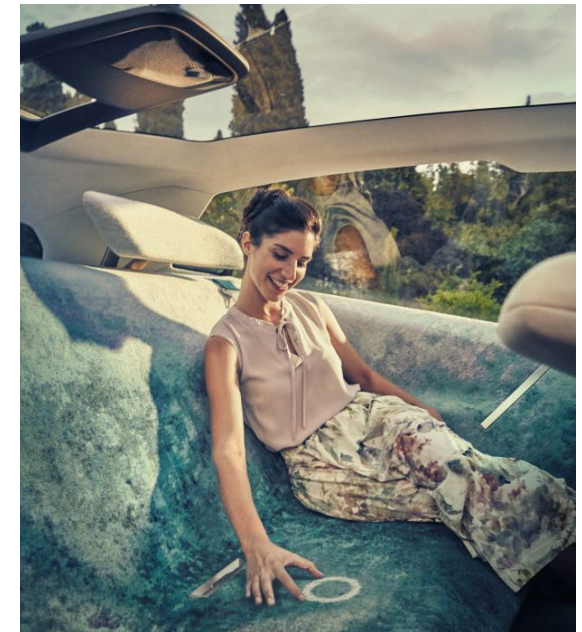
Img 14, 15 : Interior of Volvo 360c

## 2.2.4 Technology

With the introduction of autonomy in interiors, users had the option of exploring different experiences other than driving. This opened up a lot of scope for including better and immersive infotainment systems in car interiors. Smart screens, multi-layered display with haptic response, heads-up display, focused sound systems, etc are being used in car autonomous car interiors now. Smart fabrics with media control embedded into the fabric itself, and intelligent surfaces by which any surface can be converted into an interactive display are some of technological advancements being used in autonomous vehicle interiors today.



*Img 16 : Multi-layered holo-active display*



*Img 17 : Smart fabric with media control*

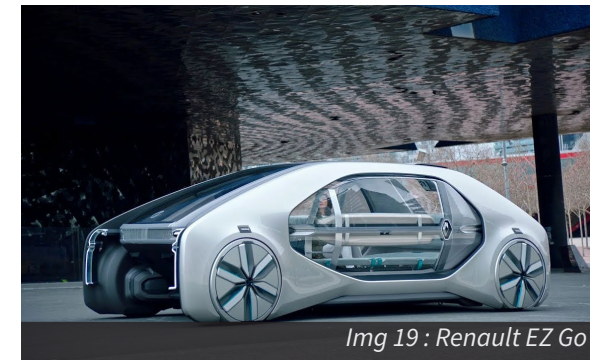
## 2.3 Exterior Design Trends

Looking at some of the recent launches in the autonomous car domain (both personal and shared) you will be able to easily figure out a developing trend in the exterior design which could be called as “the box”. The box essentially stands for pushed out wheels (increased wheelbase with same overall length) which also leads to reduced overhangs and maximized interior space. As a matter of efficiency, practicality and inevitability the box could be the future of transportation design.

It is safe to say that nobody wants future mobility solutions to look like rolling toasters. But in contrast there have been many several successful examples of the box volume in recent past. Understanding the trend would help us lock a package that we can further work upon because exterior design has its effect on the interior design and the vice versa is also true.



Img 18: Mercedes F015



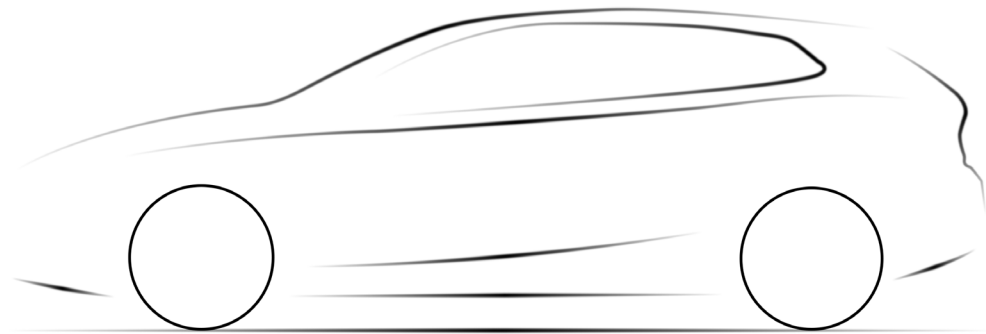
Img 19: Renault EZ Go



Img 20: Volkswagen Sedric

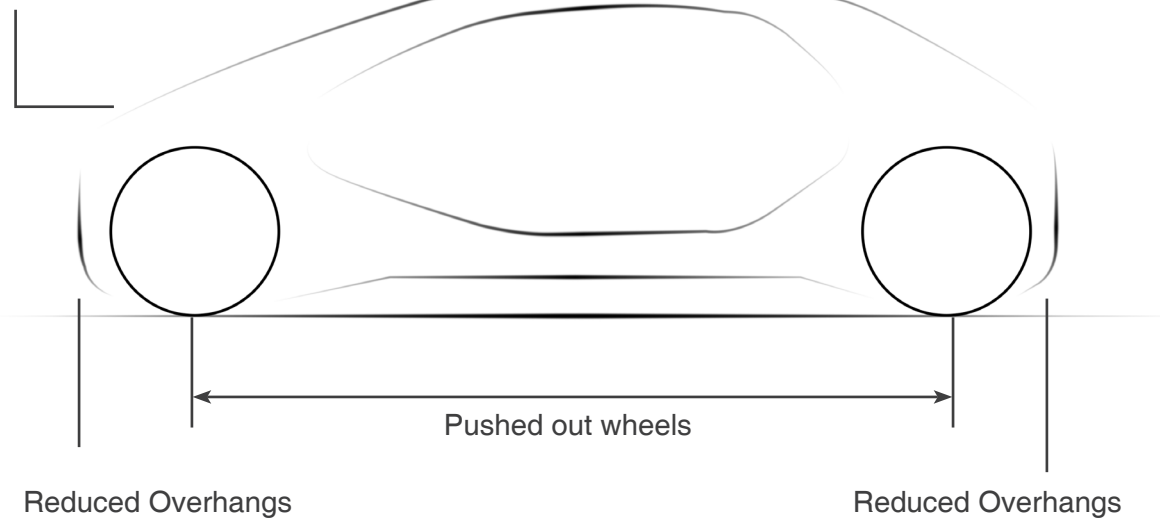


Img 21: Volvo 360c



*Img 22 : Silhouette of a conventional hatchback*

Maximized interior space



*Img 23: Silhouette of an Electric Autonomous car*

## 2.4 Existing concepts - Interior Spaces

Here is how various manufacturers have tried to enhance the experience that an interior space provides in several different ways. Not all of the following are autonomous cars but the creative approach towards creating a new spatial experience surely attracts attention towards it

### 2.4.1 Volvo 360c

Volvo as a human centered brand have actually tried to explore how fully autonomous vehicle fit into the needs of people and how it can bring quality time back into customers life.

The 360c presents four potential uses of autonomous driving vehicles – a sleeping environment, mobile office, living room and entertainment space – which all re-imagine the way people travel. Its interior, however, is styled more like the first-class sleeping section of a long-haul airliner, with several options as to configuration. The 360c represents a potentially lucrative competitor to short-haul air travel, a multi-billion-dollar industry comprising airlines, aircraft makers and other service providers. Shorter routes where the distance between origin and destination is around 300 kilometers are prime candidates for disruption by an alternative mode of travel.

What they have looked at is 4 different interior scenarios. A vehicle for instance that is your commute to work, so it picks up you in morning takes you to work. Second idea is to have an alternative to office space, so you can pick up a client and present your work, project it onto the side-screen. Third being a VIP party vehicle which takes you from hotel to restaurant. Fourth one which is the most interesting which is an alternative to air travel, it picks you from your home or work and takes you directly to another city for next day.



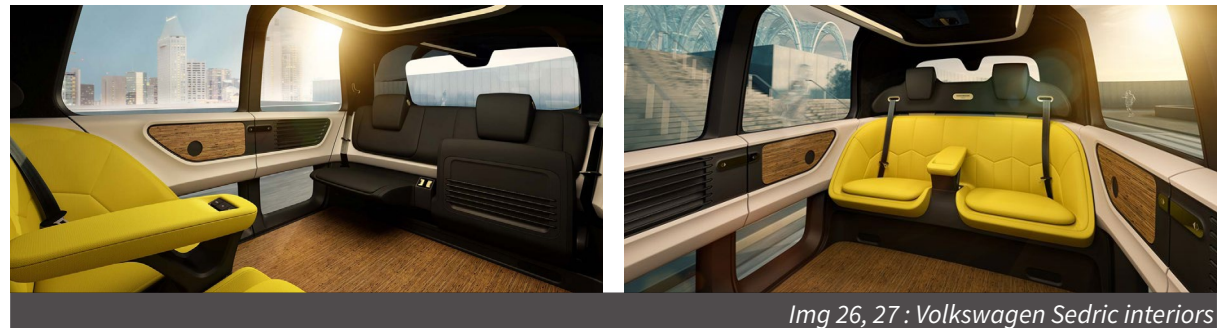
Img 24 : Volvo 360c (Daily commute mode)



Img 25 : Volvo 360c (Party mode)

## 2.4.2 Volkswagen Sedic

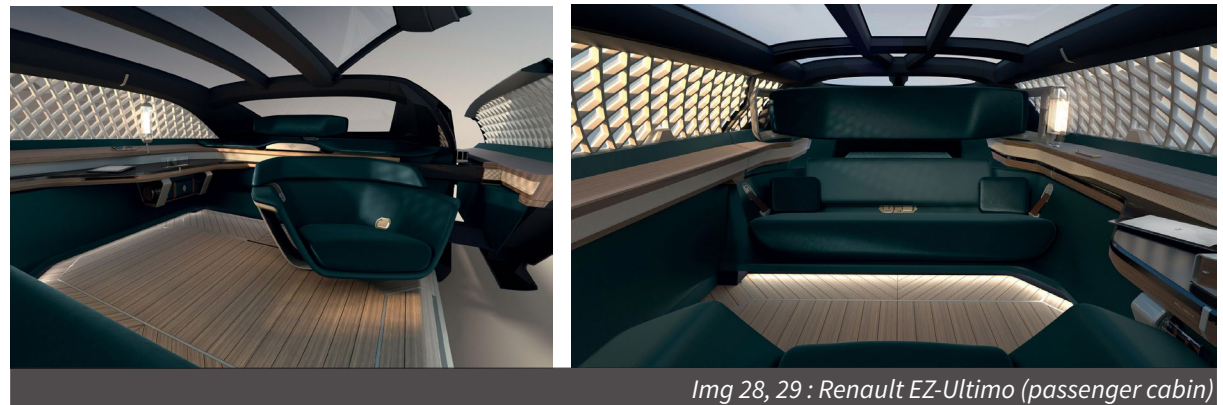
The Sedic has no dash, bonnet or boot; so almost the entire footprint translates to interior. It therefore lacks almost all human controls, lacking even vestigial steering wheel or pedals. There is a full speech recognition system, however, plus a button to call a help centre and a start button. It therefore lacks almost all human controls, lacking even vestigial steering wheel or pedals. There is a full speech recognition system, however, plus a button to call a help centre and a start button. Despite its spacious interior, the Sedic is optimized for just two. Fold-down front seats allow four to travel face-to-face, with enough hip-to-hip distance to avoid interlocking knees. The Sedic is neither sporty nor dynamic, so the interior aims for a welcoming lounge feel. It's not supposed to look overly exclusive; it's supposed to be accessible for everyone.



## 2.4.3 Renault EZ Ultimo

Renault envisions its new concept car as a mobile “first-class lounge” that serves to extend a premium experience offered by an airline, hotel, or resort. So it’s directed less at high-net-worth individuals and more toward service providers to high-net-worth individuals.

The interior of the Renault EZ-Ultimo matches the extravagant exterior with surfaces made of real marble, accompanied by wood paneling, leather, and lights with accompanying dimmer knobs. There’s one swiveling, armchair-like seat facing backwards and a bench seat opposite it. As large as the car is, it can accommodate only three people at most. The roof features segmented glass panels. The sides are clad in a lattice structure and blacked-out windows, both of which let the passengers look out to the world outside while maintaining their privacy inside. The interior is divided into distinct horizontal layers, with different surface textures and colours including a glossy white ceramic-style surface, pale natural wood and dark green leather, each stacked on top of one another. The treatment of surfaces is very modern, but it reflects a retro feel with use of specific materials.

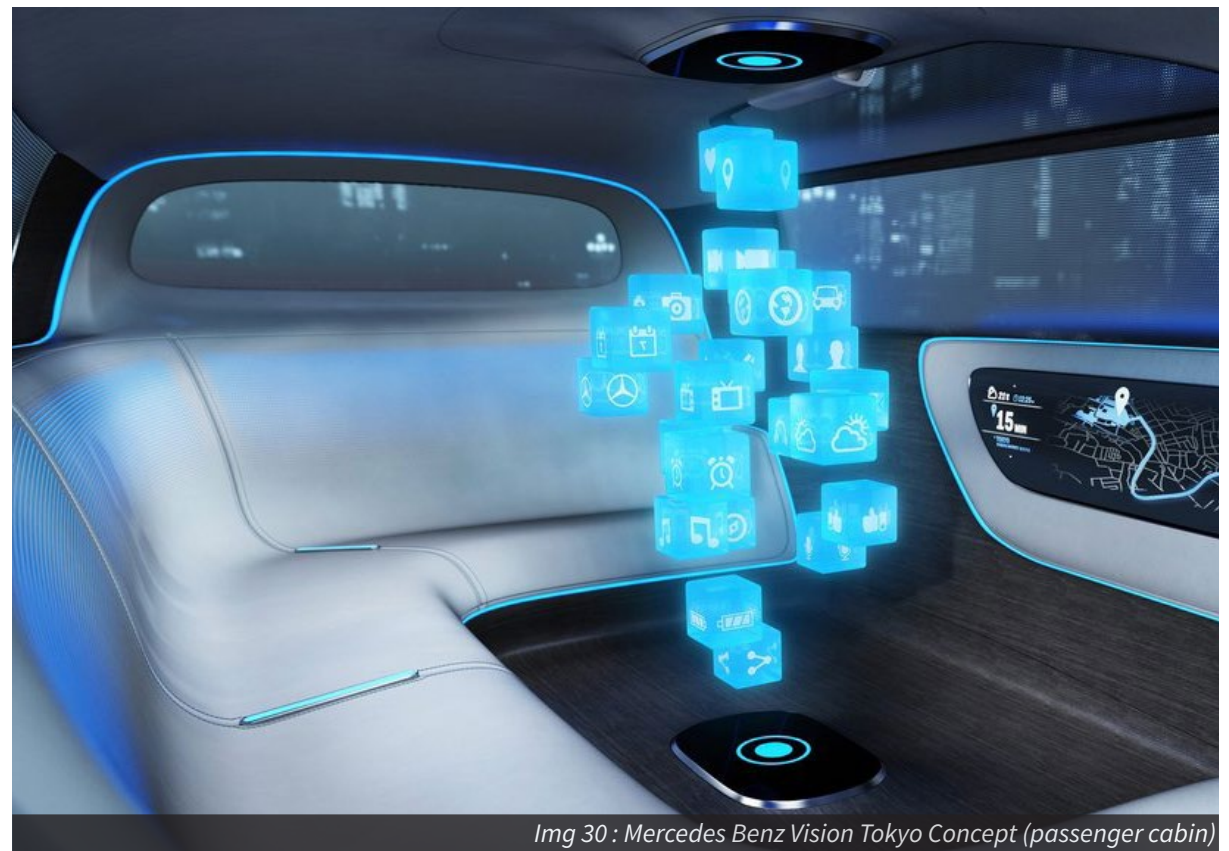


*Img 28, 29 : Renault EZ-Ultimo (passenger cabin)*

## 2.4.4 Mercedes Benz Vision Tokyo Concept

The Mercedes Benz vision Tokyo is a further exploration of the autonomous, electric, connected vehicle concept for future urban landscape.

The interior offers cossetting accommodations, laid out in an oval shaped lounge. The steering wheel and driver's seat are nothing more than secondary elements designed for occasional use. It really points towards an autonomous future where people will no longer be actively piloting their vehicles but either socializing with their friends, watching the large wraparound LED screen encircling the cabin, or interacting with apps, maps and displays presented as three dimensional holograms within the interior space.



*Img 30 : Mercedes Benz Vision Tokyo Concept (passenger cabin)*

## 2.5 Inferences

From the preliminary research done, one can see that there is a lot of scope for exploration and design possibilities in autonomous car interiors.

- Features and experience offered in autonomous vehicles are based on the type of target users - which mainly include young office going crowd who likes to relax during commute
- A lot of technological features are being added to enhance the experience which the user has inside the vehicle
- Movable seating helps rearrange the layout and help in serving multiple functions.

# 3

## Research

## | 3.1 User Research

The preliminary research dealt primarily with the evolution of spaces in autonomous vehicles. Although it gives a glimpse into the type of experiences presented to the user, one cannot proceed by assuming that the same experiences will be valid globally. Therefore, an in-depth discussion with users were essential to understand their needs and aspirations about vehicle interiors and experiences for the future. The user group was classified into four different types - family, friends, colleagues and personal use. The inferences generated from this primary research would give a better understanding and direction in generating new interior spaces for users.

The research was structured in such a way that the user is initially primed on the topic, its relevance and possibilities. Then a semi-structured questionnaire survey and a participatory design activity was done to draw out the explicit and tacit information from the users.

## 3.2 Results & Analysis

### 3.2.1 Part A - Basic Info

A total of 15 users were interviewed on which 10 were male and 5 female. People of different age groups were considered to give an insight into how their aspirations varied based on age.

	Male	Female
15-25yrs	2	0
26-35yrs	5	2
36-45yrs	2	3
46-55yrs	1	0

### 3.2.2 Part B - Question 1

“With whom do you usually travel and what is the purpose?”

Family

Friends

Colleagues

Solo

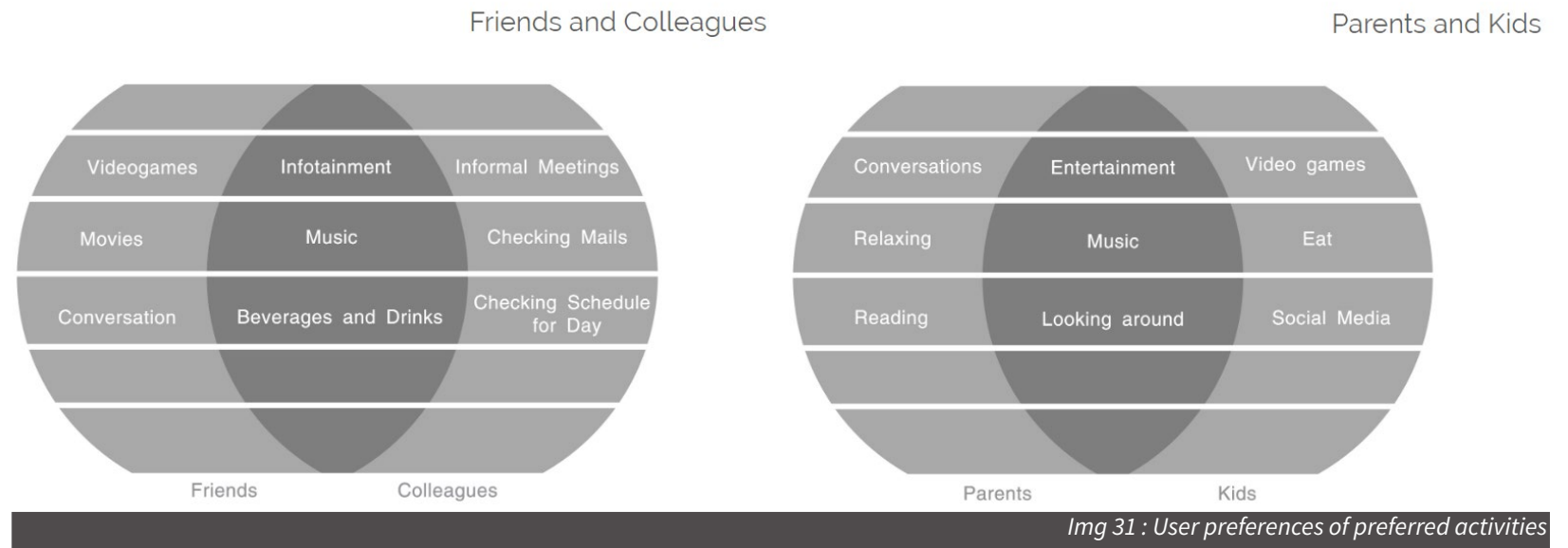
Majority of users travel needs are for daily commuting to places of work or business - primarily solo, and few users suggested that pooling was also a feasible idea. Traveling with family came next, which was followed by trips with friends.

Solo	6
Family	4
Friends	3
Colleagues	2

### 3.2.3 Part B - Question 2

Users were shown different visual clues and were asked on how would they like to spend their time during journey/commute in an autonomous vehicle if not driving?

While traveling with friends and colleagues, users preferred activities like watching movies, listening to music, having beverages as a common priority. For family trips, the priorities were sight seeing, playing games, etc.



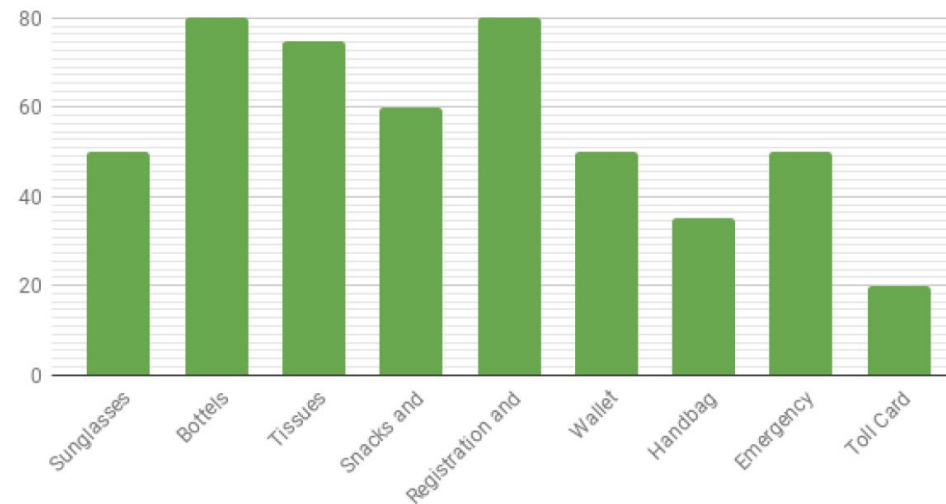
### 3.2.4 Part B - Question 3

What are some items which you would always keep in your car storage while traveling (Storage is spaces other than boot space)?

Cell phone, sunglasses, bottles/cups, wallet, handbag, notebook/laptop, pen and paper, coins, umbrellas, maintenance manual, critical medical information, emergency contact numbers, flashlight, tissue/hand sanitizer, high-energy snacks, trash, toll card, etc

It was found that majority of users store food and beverages as primary items.

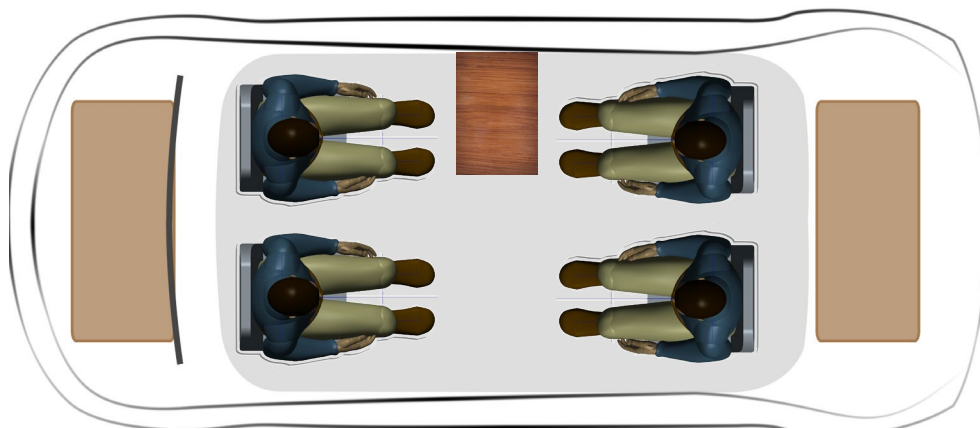
Common items people store



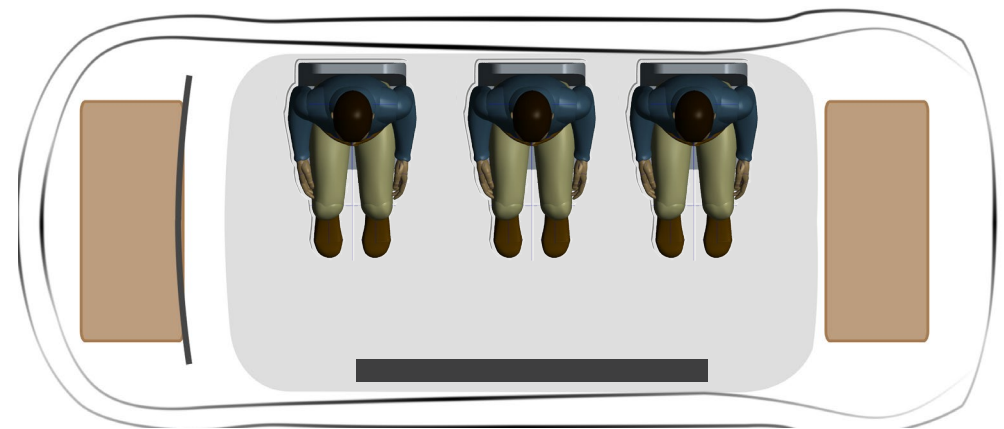
Img 32 : User preferences of items they regularly store in cars

### 3.2.5 Part B - Question 4

Based on the above preferences kindly arrange the space with the given kit based on different usage scenario



*Preferred Conversation / Work Mode*



*Preferred Entertainment Mode*

### 3.2.6 Part B - Miscellaneous

Mention if you have any specific requirements

The requirements of users included tinted windows with an opacity control feature, hassle free connectivity between mobile device and vehicle infotainment system, customizable interior lighting, interactive display tables, refrigerated storage space for beverages.

These set of requirements show that the users need a space which is flexible, adaptable, and offers them a new experience while taking aid from the latest technology .

## 3.3 Inferences

From the study it was understood that users want a space in which multiple types of activities can happen. The space needs to be flexible and multi-functional to suit the user needs. These needs vary from time to time and the interior has to meet all these needs specifically also.

- Need for a flexible interior space which can be re-arranged easily as per user needs
  - + Working environment
  - + Infotainment oriented environment
  - + Conversation and interaction focused environment
  - + Rest and relaxation oriented environment
- Need for an interactive centralized system by which user can control infotainment, temperature and interior lighting

# 4

## Design Brief

## 4.0 Design Brief

To conceptualize and design the interior space of a personal autonomous vehicle for year 2030.

The major requirements include:

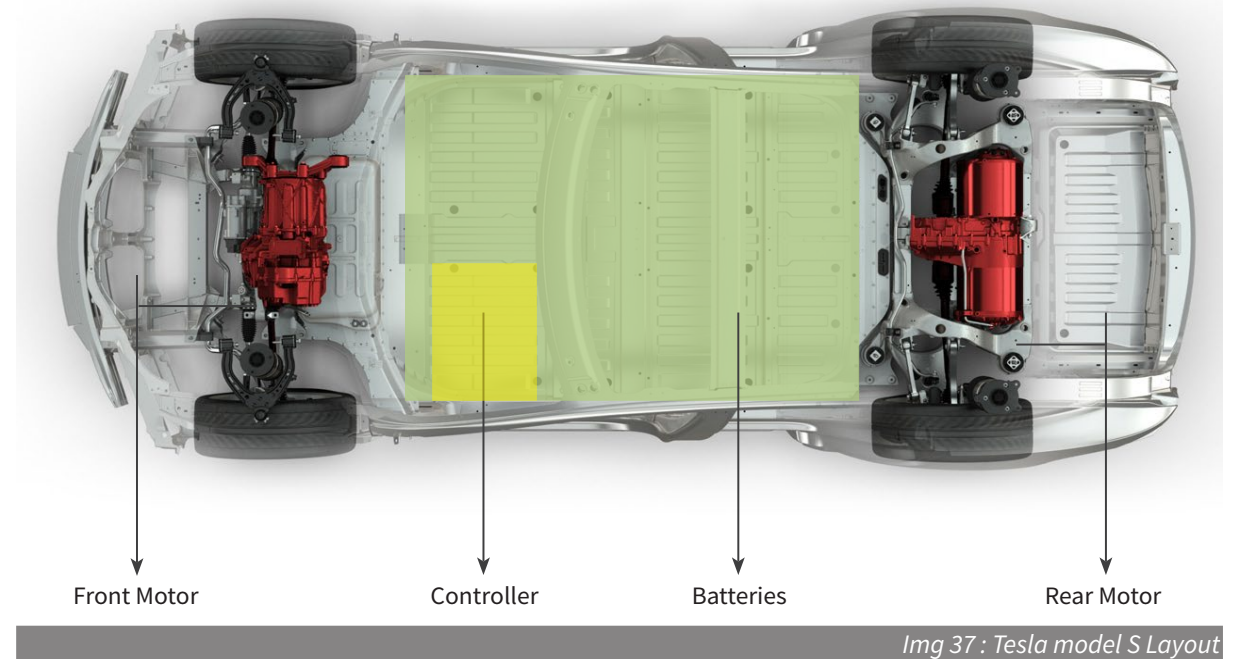
- Design of an interior space based on the platform of Maruti Baleno, with movable seating which caters to multiple functions like - seating, relaxing and resting
- Integration of latest trends and technology to provide the user with an immersive experience and highly user friendly interface
- The interior would feature, a multi-layered display, focused sound system, storage for snacks, beverages, and other personal effects.
- Interiors should take advantage of autonomous technology and electric drive system.
- It should cater to seating 4 passengers.

# 5

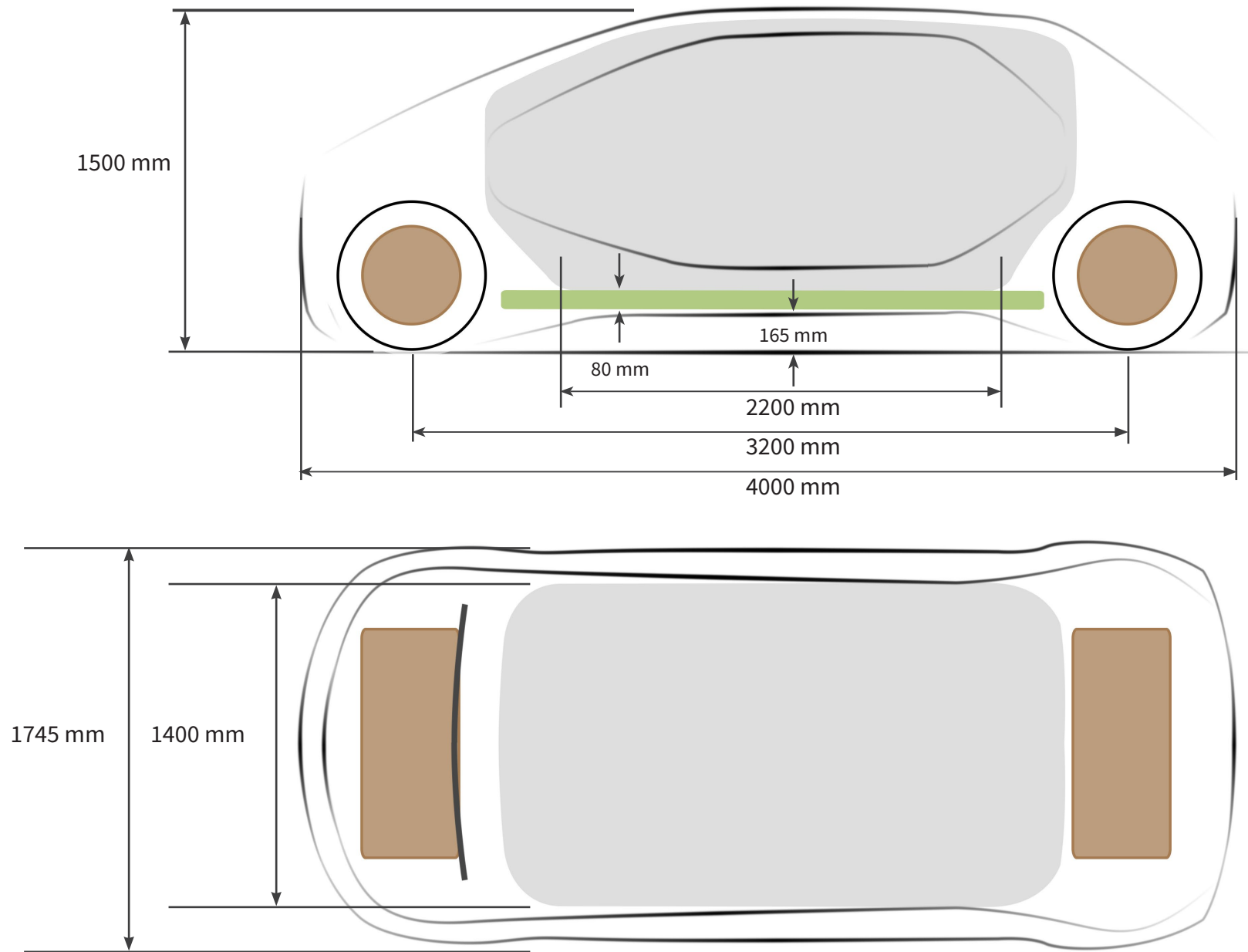
## Package Development

## 5.1 Packaging

Unlike conventional gasoline vehicles, electric vehicles have very few components. As it is powered by electricity, charge is stored in Lithium ion batteries which are placed across the floor of the vehicle. Based on the requirements, one or two motors can be used to power the vehicle. A controller regulates the power output to the motors and other systems. As of today, along with these components, power steering system, airbags and other essential mechanisms and sensors occupy some space in the car. Absence of conventional engines, and supporting systems frees up more space which can be included into the interior of the vehicle. As cars get autonomous in the future, Interior spaces are going to be crucial.



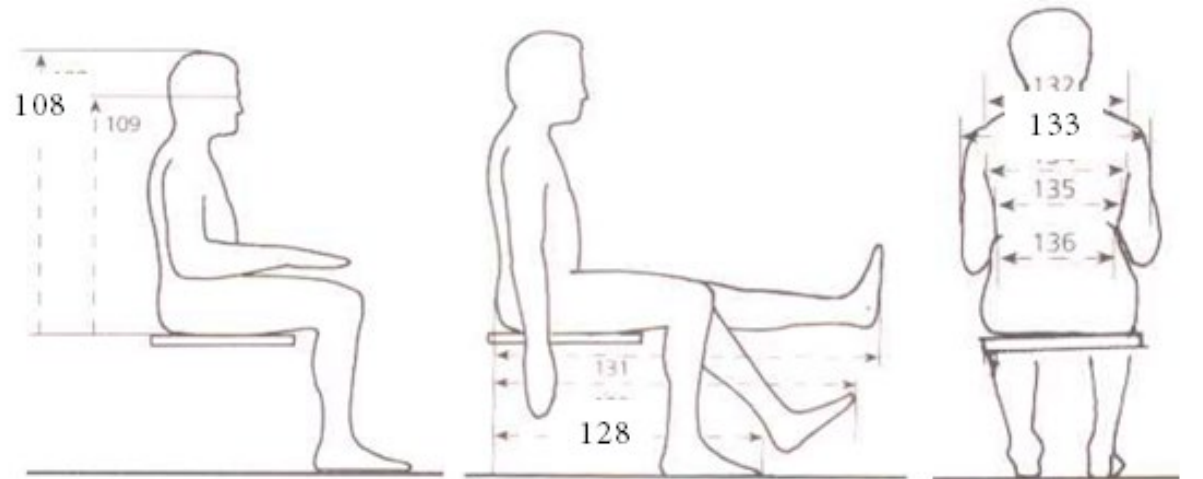
Premium hatchback and utility vehicle segment are expected to grow (in terms of sales) as numbers of Indians with higher disposable incomes opt for bigger automobiles. This growth is going to be dominated by premium hatchback segment for the next decade and half. Maruti Suzuki Baleno is one of the most popular amongst them and therefore Baleno's overall dimensions are benchmarked.



Img 38 : Dimensions of the final package

## 5.2 Ergonomics and Anthropometric Dimensions

For Indian seating dimensions the following references are taken from Indian anthropometry dimensions data book – Debkumar Chakrabarti (National Institute of design)



Img 39: Anthropometric dimensions in Indian context

Ref No 108 – stretched sitting – Top of the sitting stretched posture (fig.2.4.2)

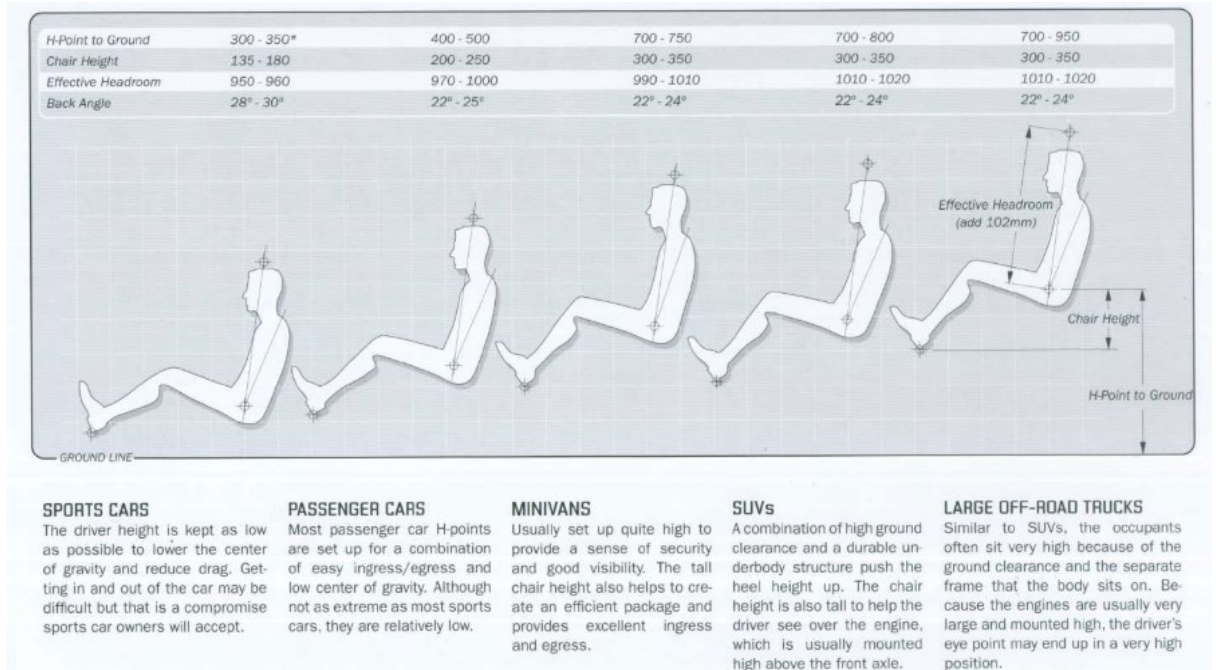
Ref No 128 – Buttock to leg toe in normal sitting (fig. 2.4.3)

Ref No 133 – Maximum horizontal distance over the shoulder deltoid muscles (fig.2.4.4)

Ref No 137 – Maximum horizontal distance across the hips (fig.2.4.5)

## 5.3 H-Point

H-Point and SAE International ergonomic standards are referred for efficient packaging, better visibility and for easy ingress and egress



Img 40 : H-Point and other dimensions

# 6

## Ideations

## 6.1 User Persona



### Shivya Nath (Travel Enthusiast)

Age: 32

Profession: Entrepreneur (owns a local food chain)

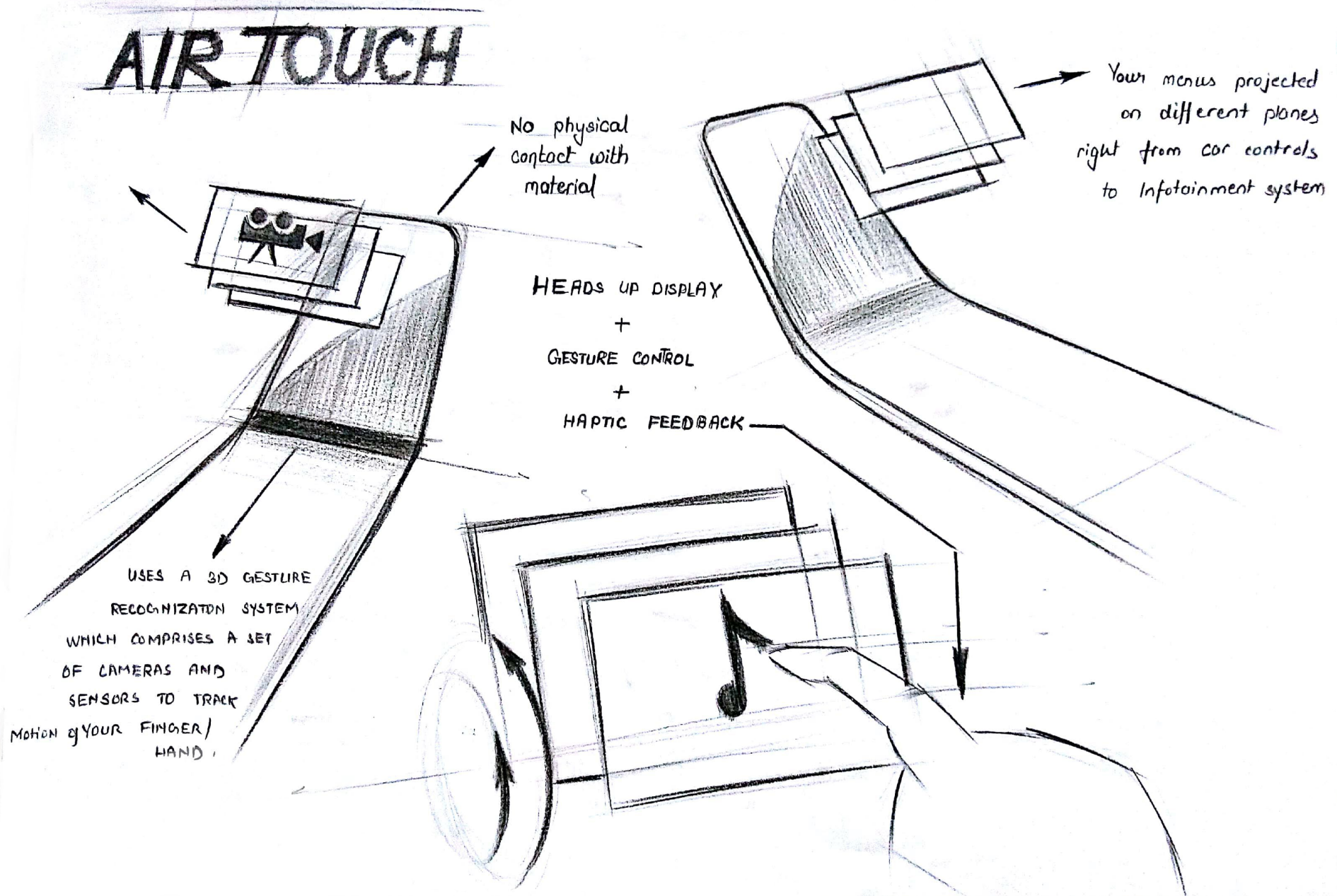
Location: Mumbai

Shivya is a Successful Entrepreneur and also a mother, in the midst of chaotic life of mega-city Mumbai. She is also a travel enthusiast. Capturing stories is her thing. She loves to travel with her family for weekend outings to nearby locations. Reading books is her getaway from the hectic schedule she has.

### Life Style



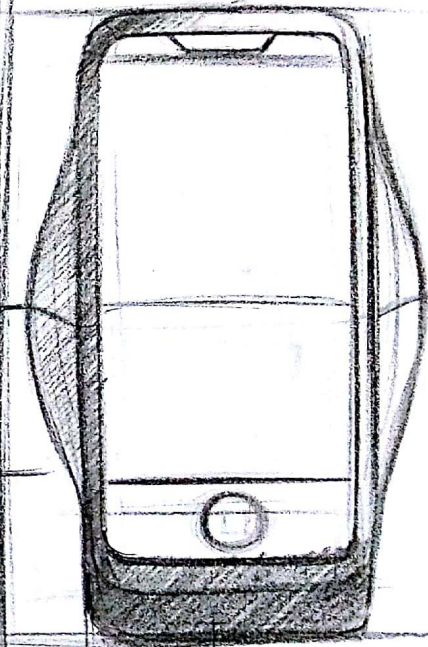
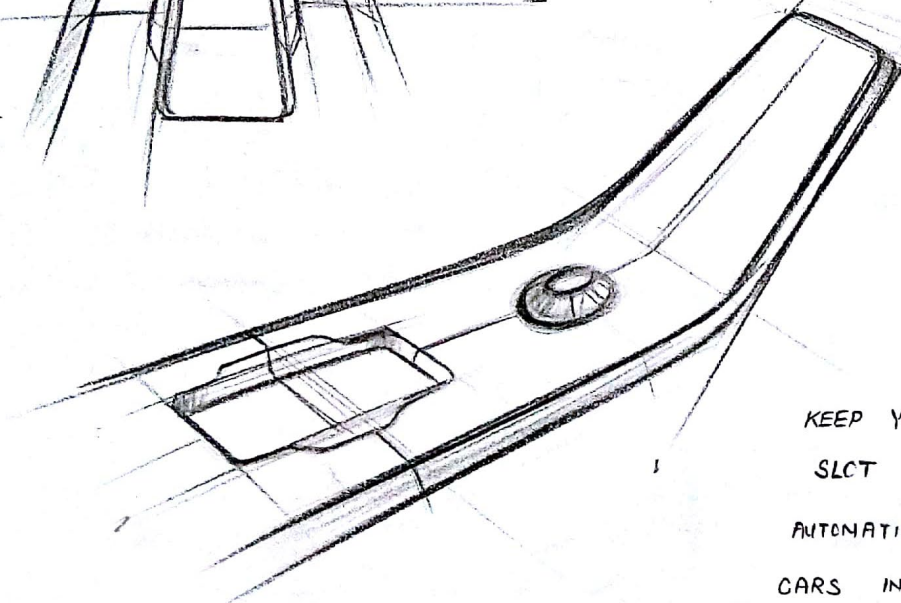
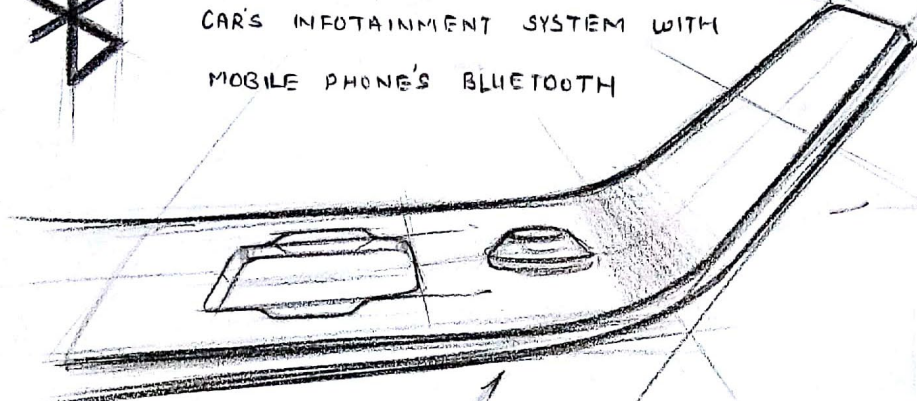
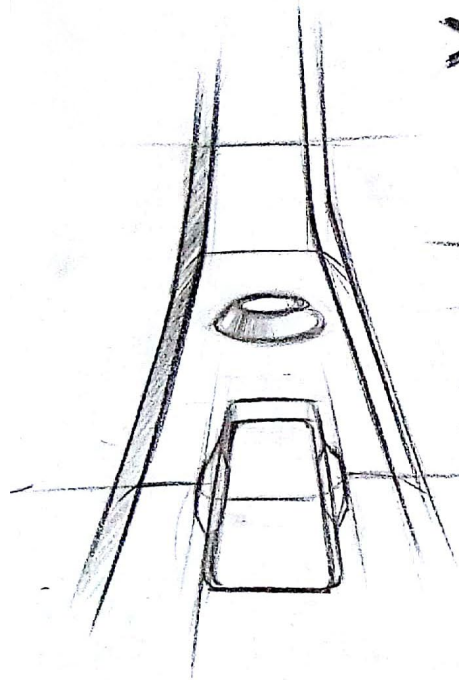
## 6.2 Ideations



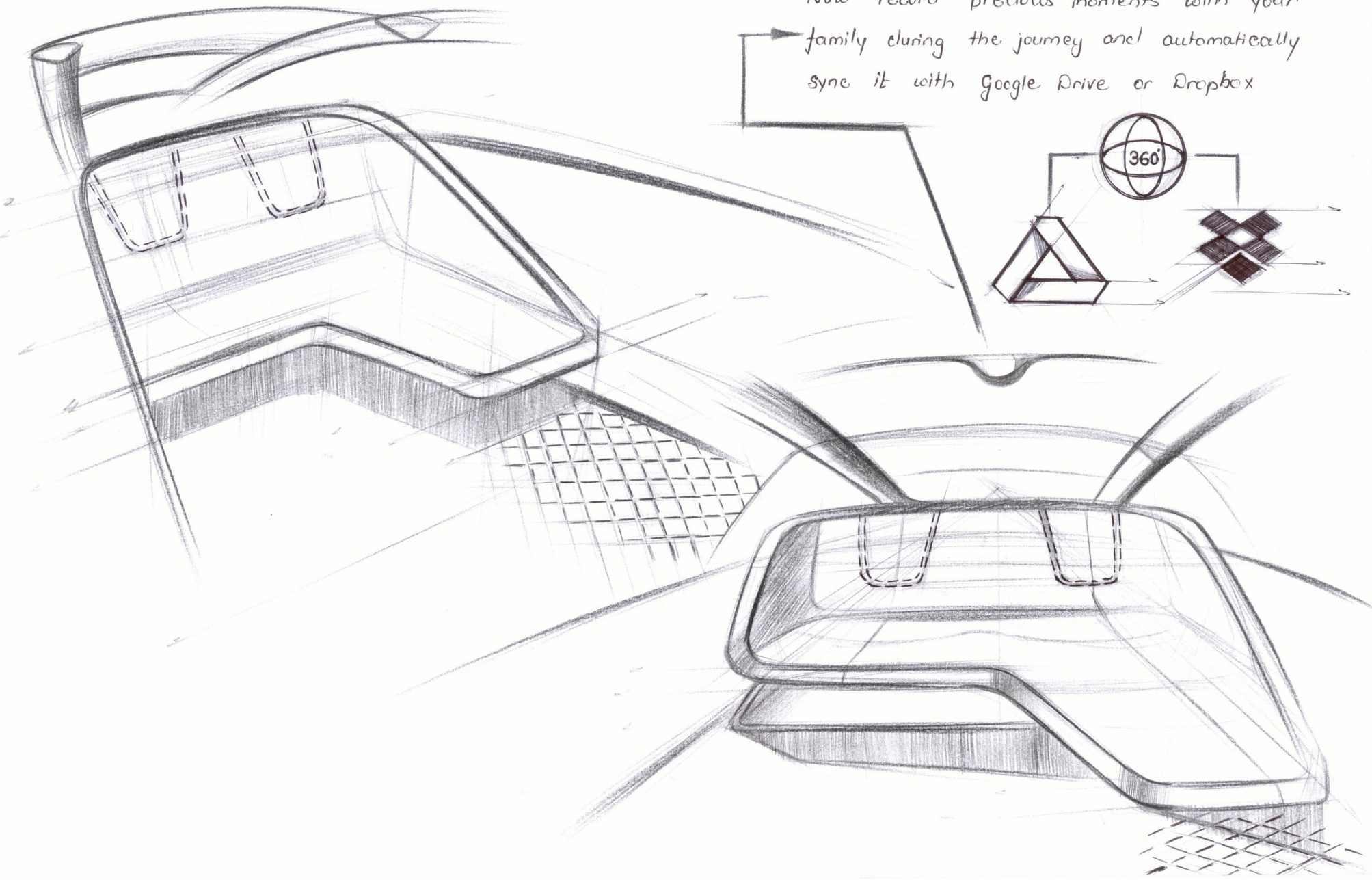
# SEAMLESS TECH INTEGRATION



NO MORE HASSLE WITH PAIRING  
CAR'S INFOTAINMENT SYSTEM WITH  
MOBILE PHONE'S BLUETOOTH



KEEP YOUR MOBILE PHONE ON  
SLCT AND IN 3 SECONDS IT  
AUTOMATICALLY CONNECTS TO YOUR  
CARS INFOTAINMENT SYSTEM



Now record precious moments with your family during the journey and automatically sync it with Google Drive or Dropbox

Directs Sound Bubble towards you through a beam (sensing motion of your head with help of cameras)

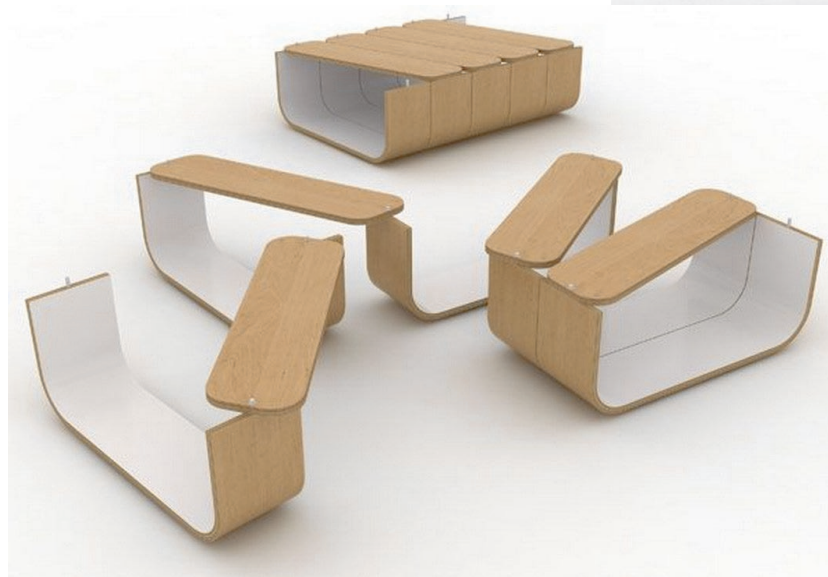
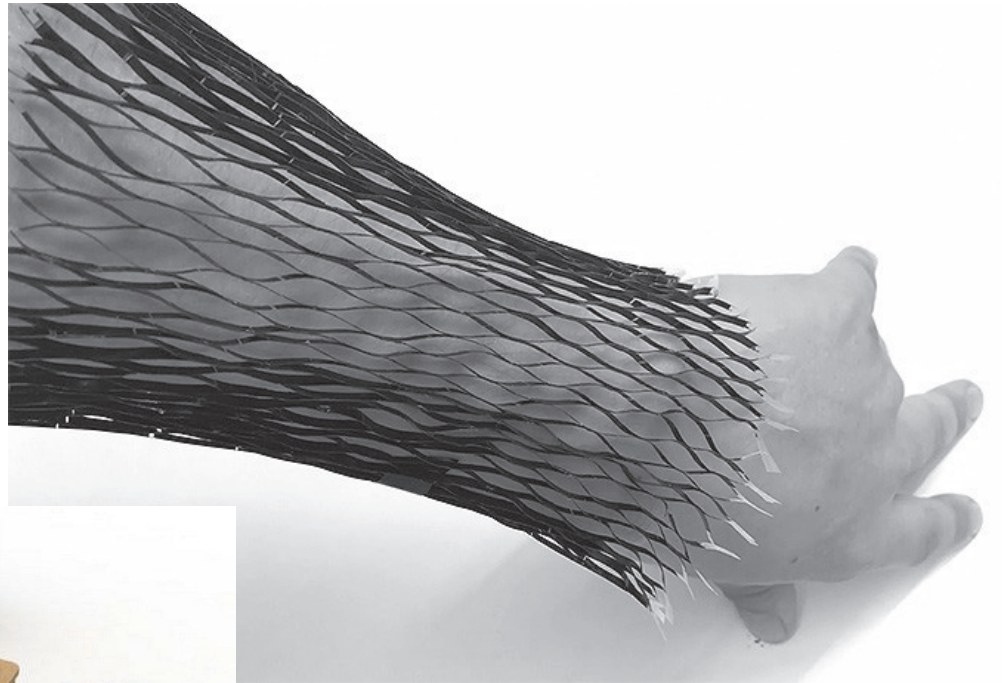
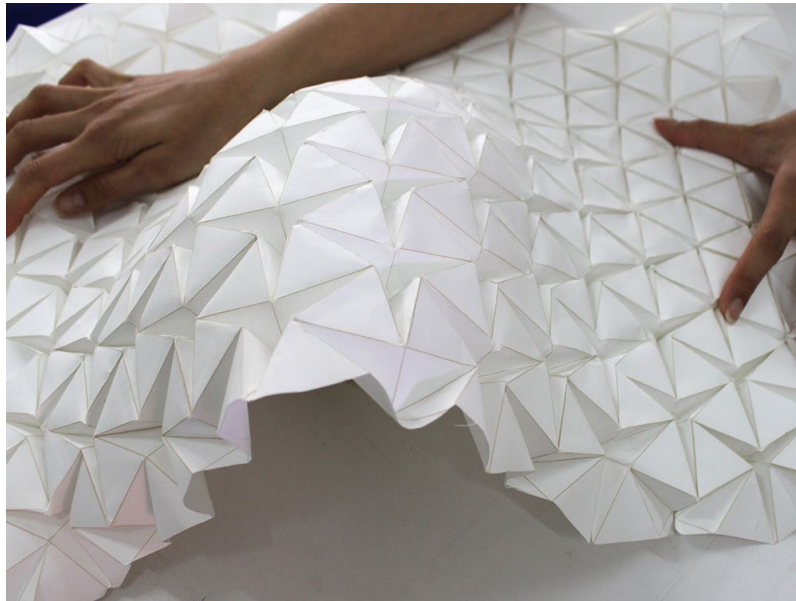
Focused Sound System

Avoids Isolation from Surrounding

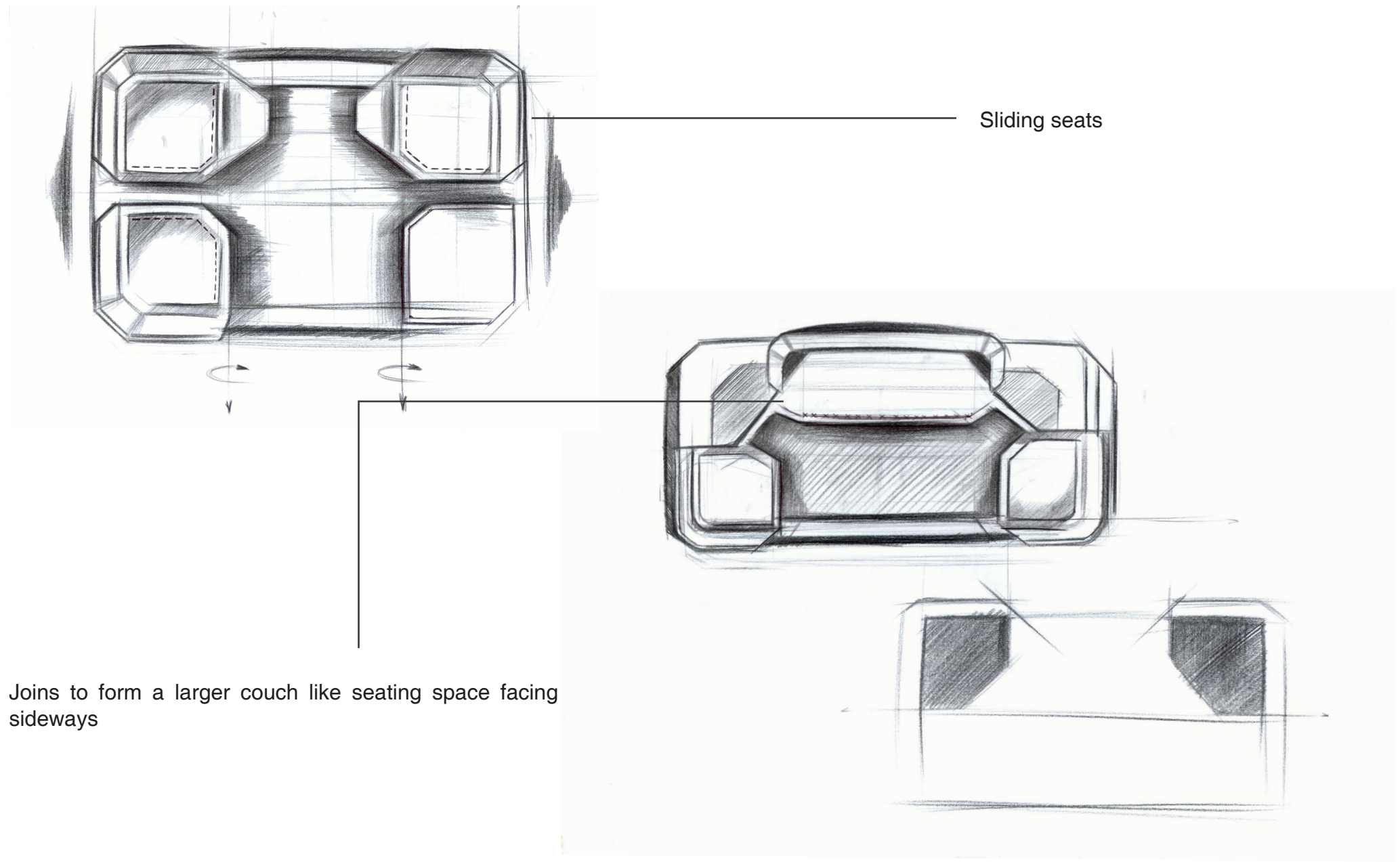
You could still hear surrounding sound and engage in conversations

Eliminating speakers and headphones

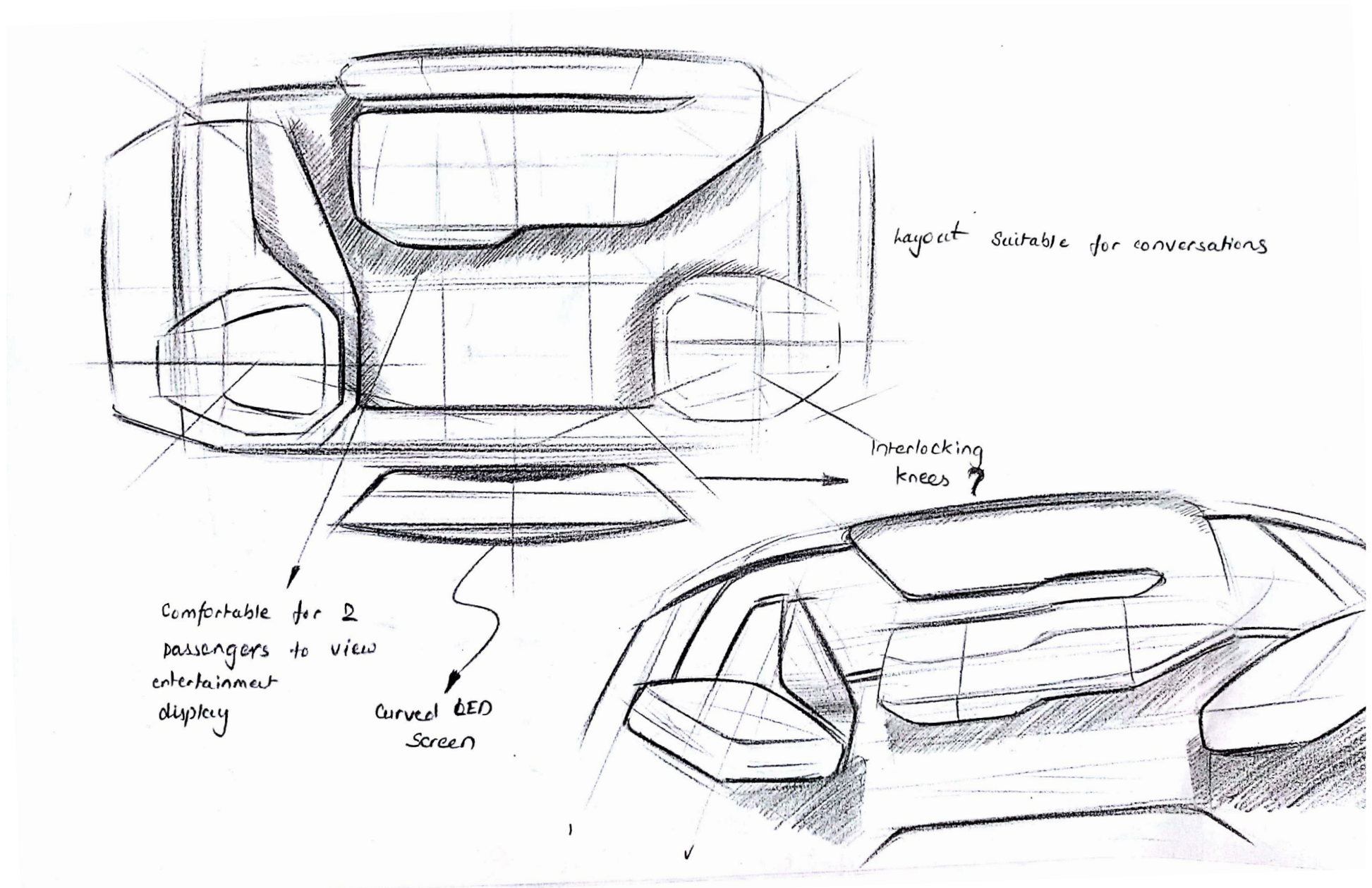
# Image Board



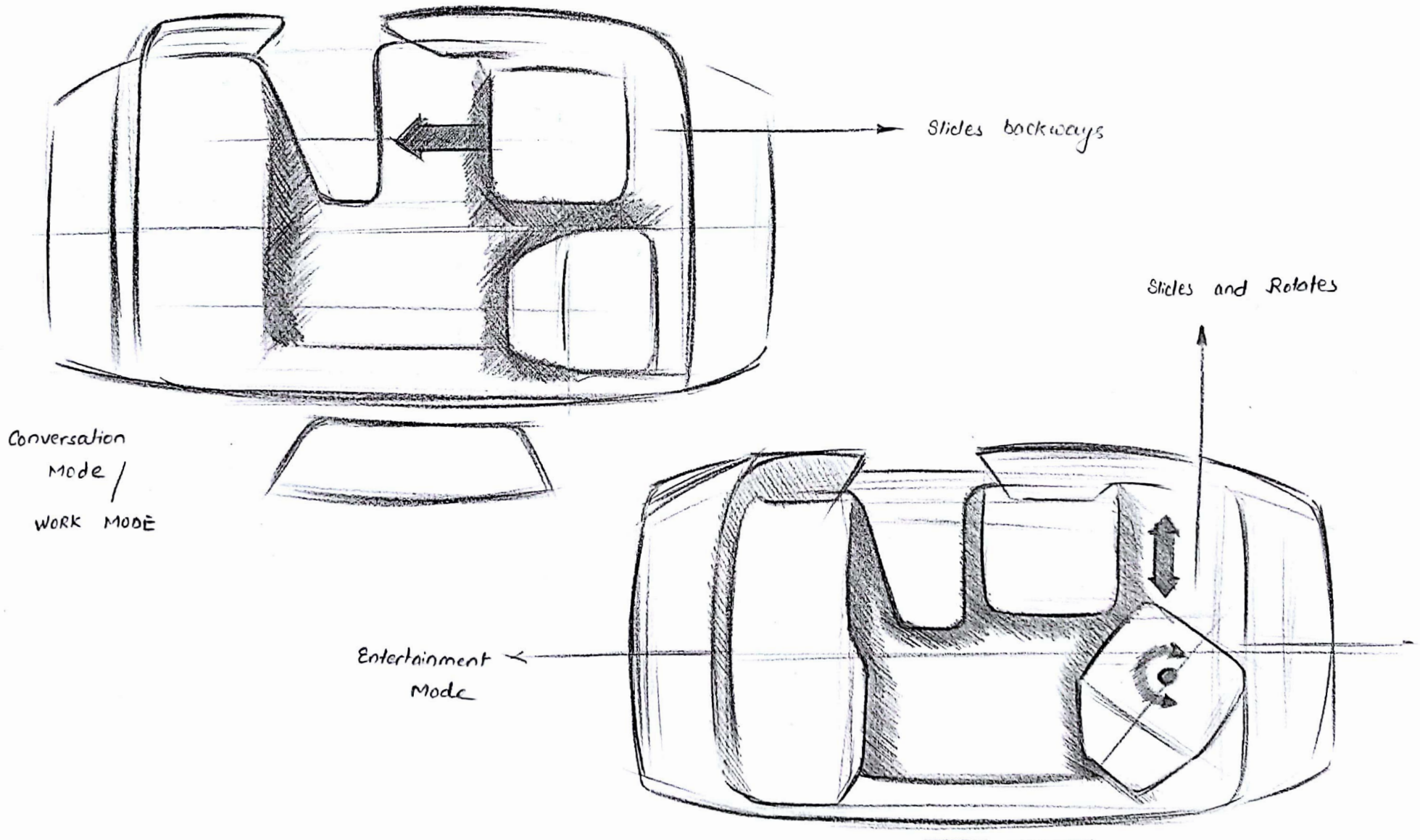
## Design Direction 1



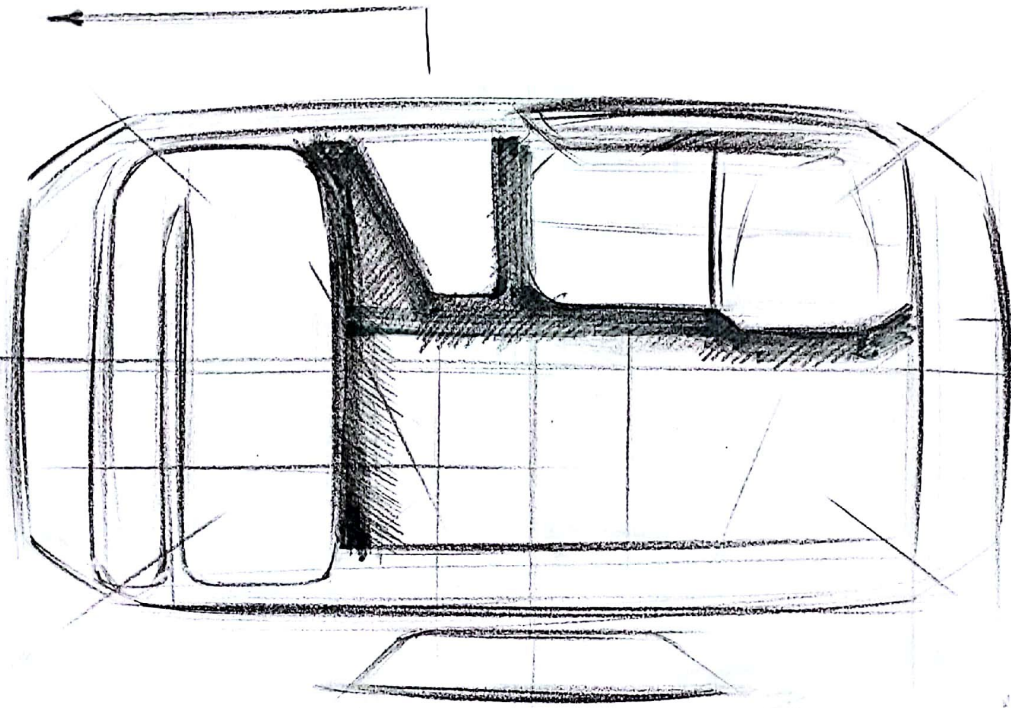
## Design Direction 2



# Design Direction 3



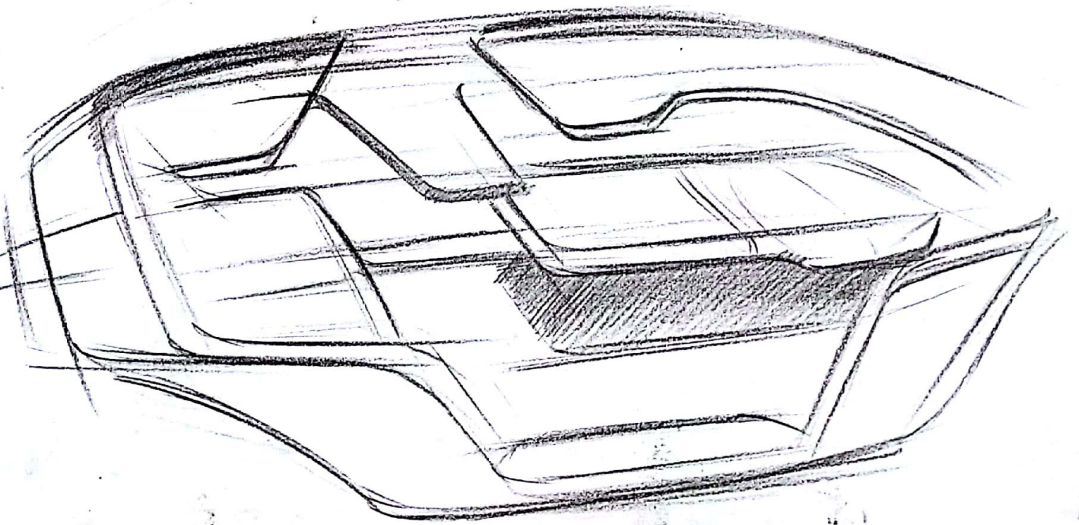
Opacity  
control  
Glass

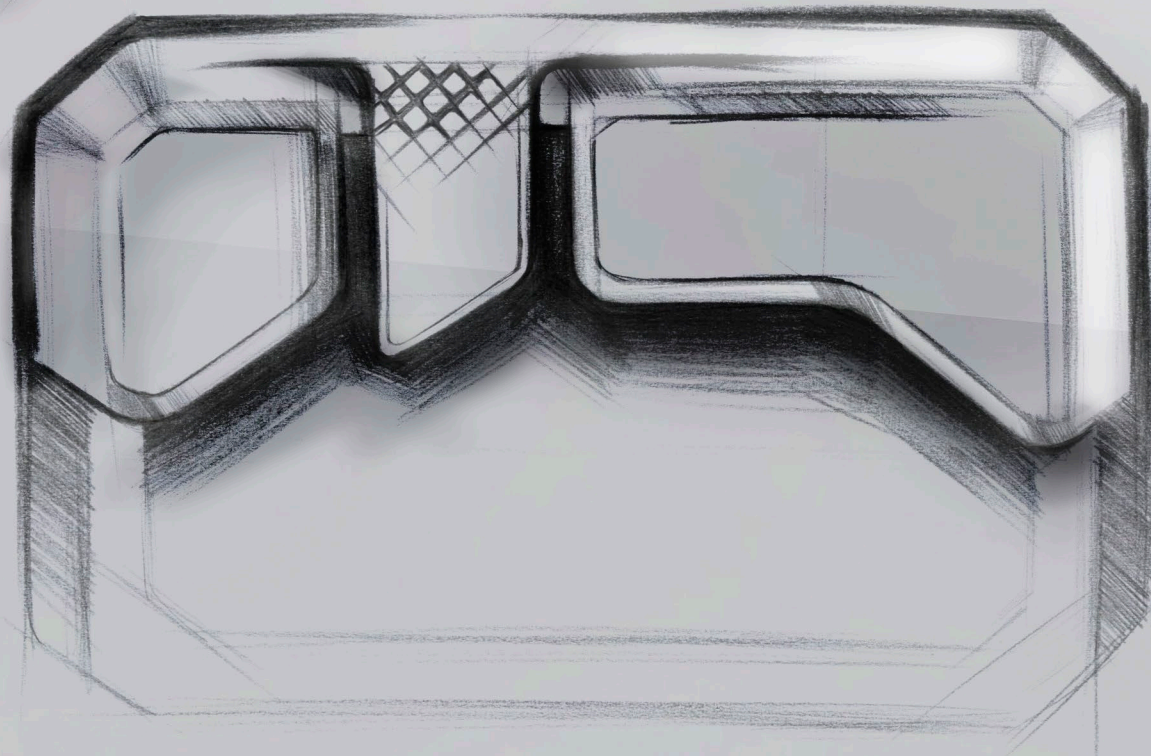
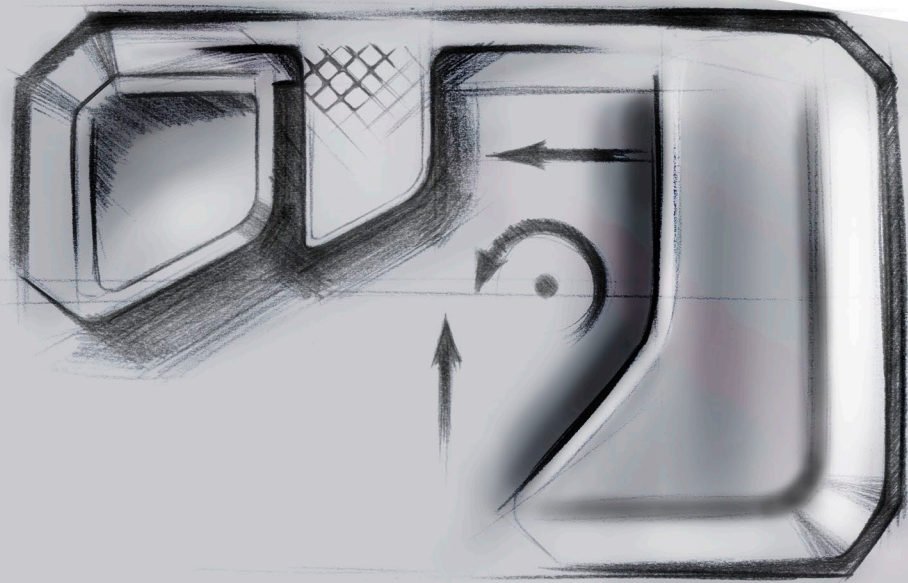


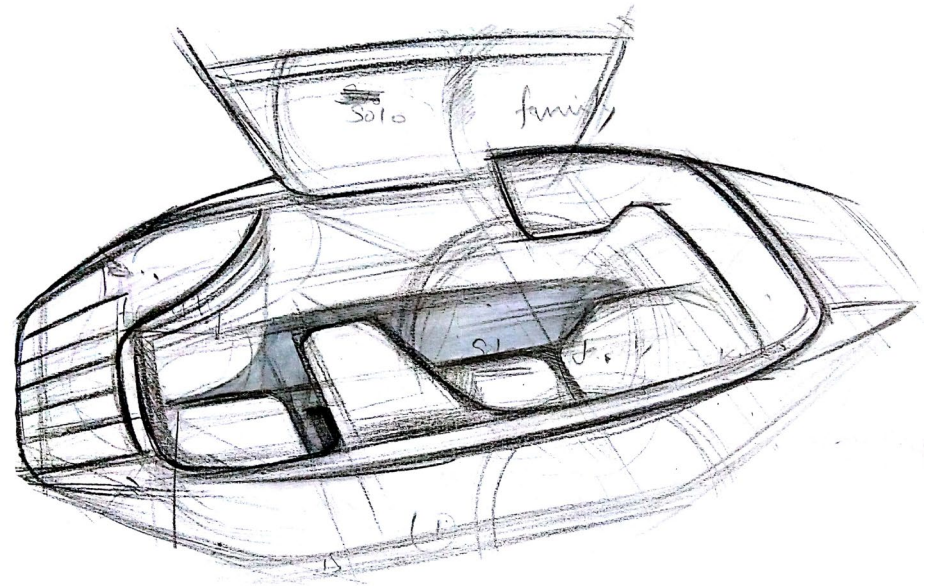
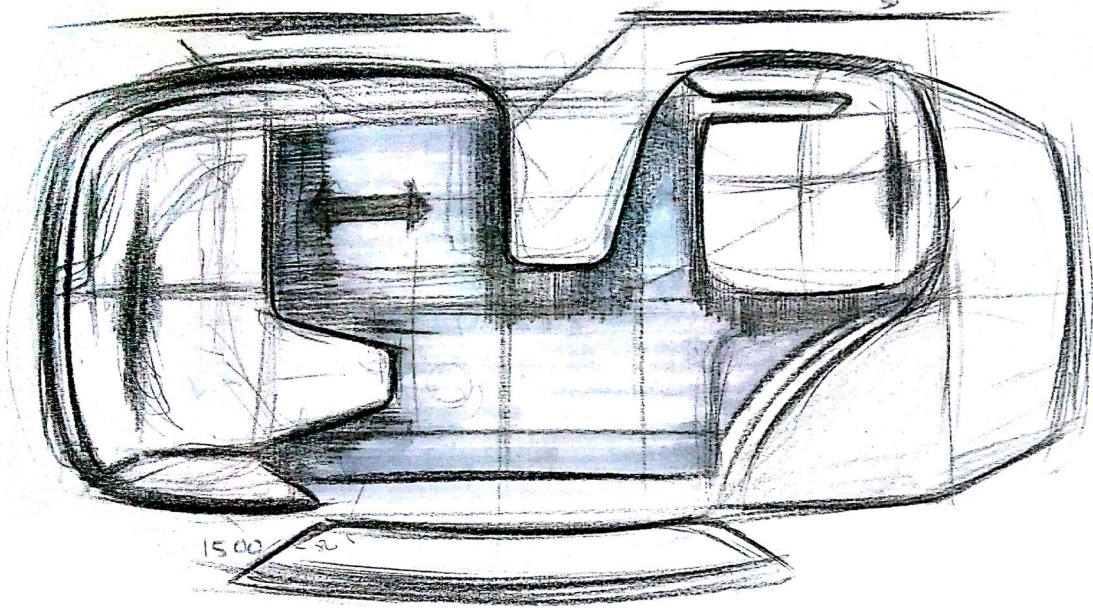
ENTERTAINMENT  
MODE

Curved LED  
Screen on  
sideways

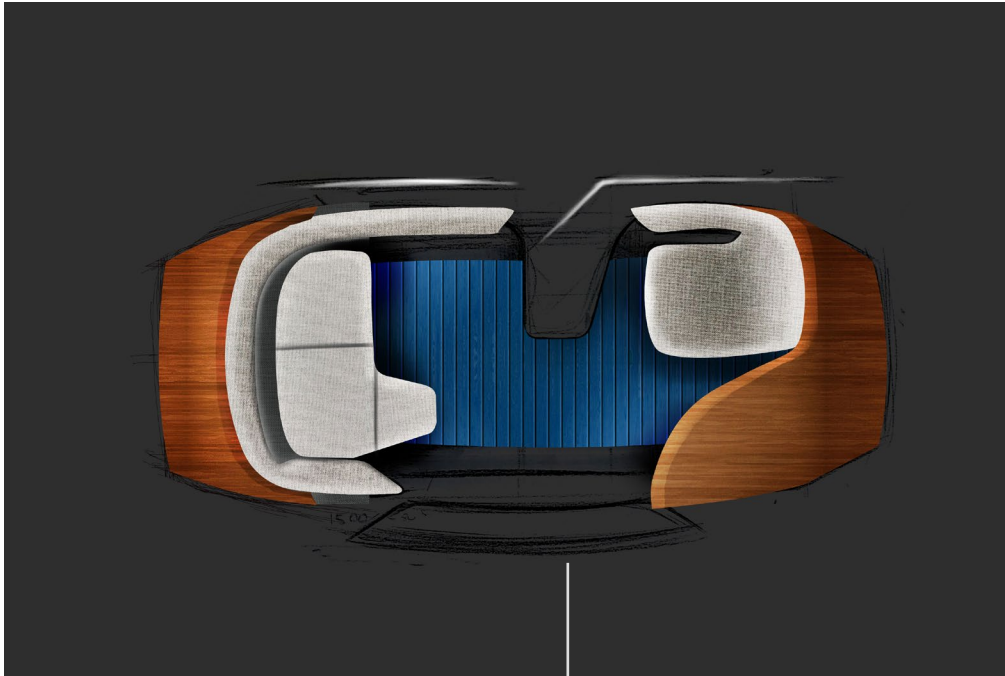
Embedded into  
the windscreen



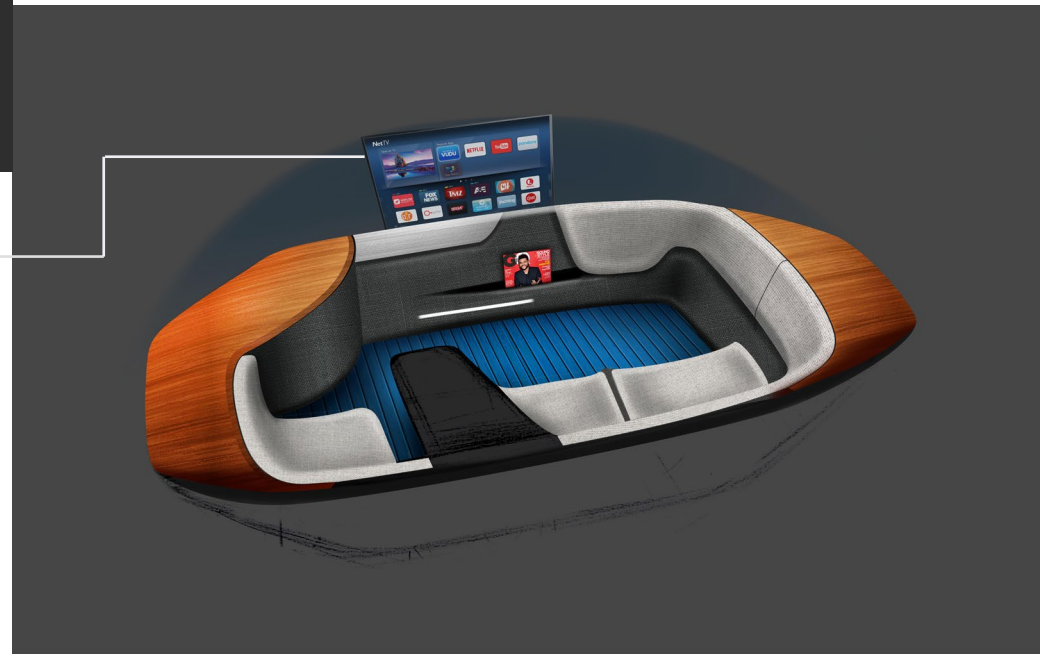




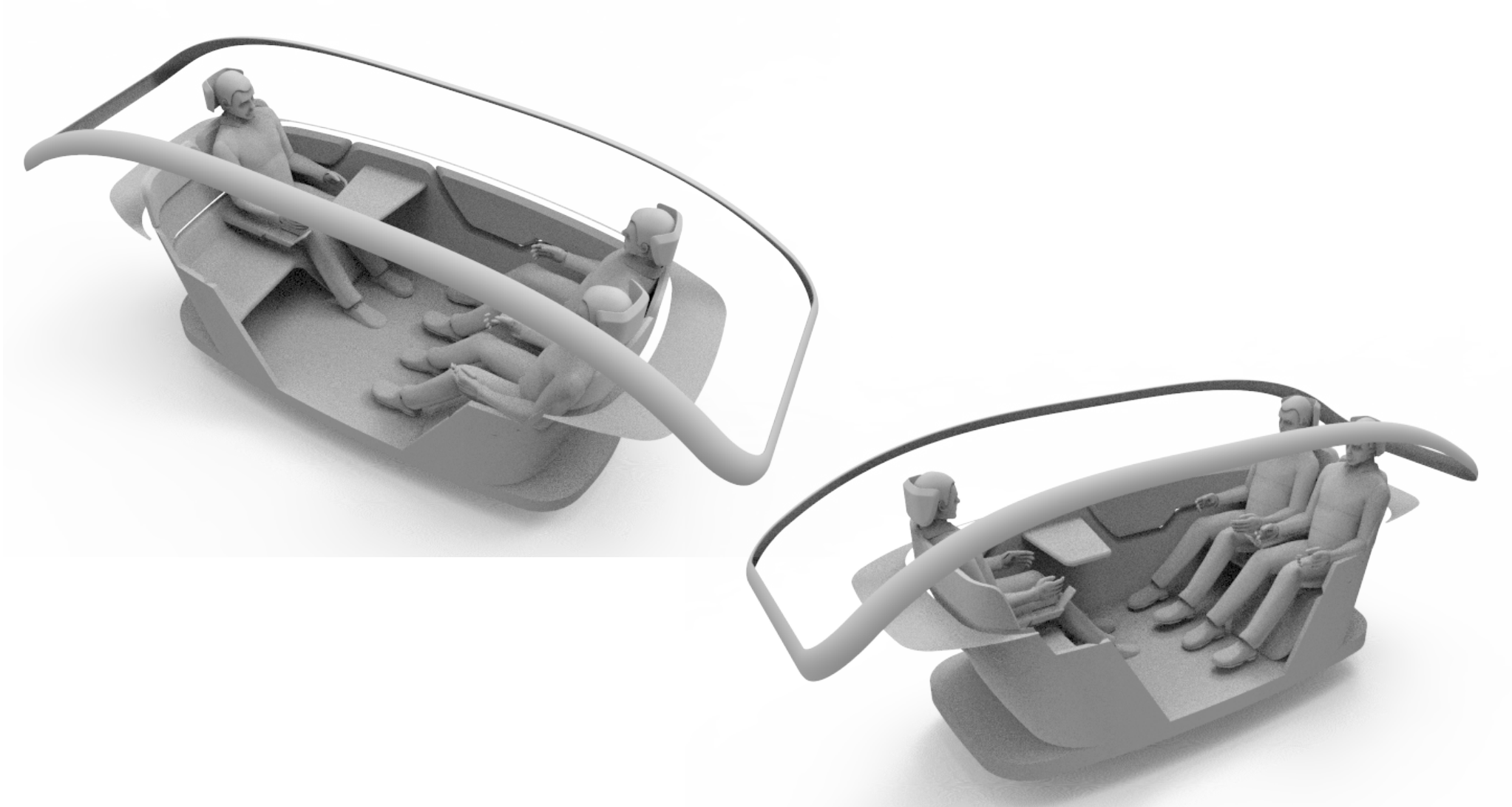
## 6.4 Quick Photoshop Renders

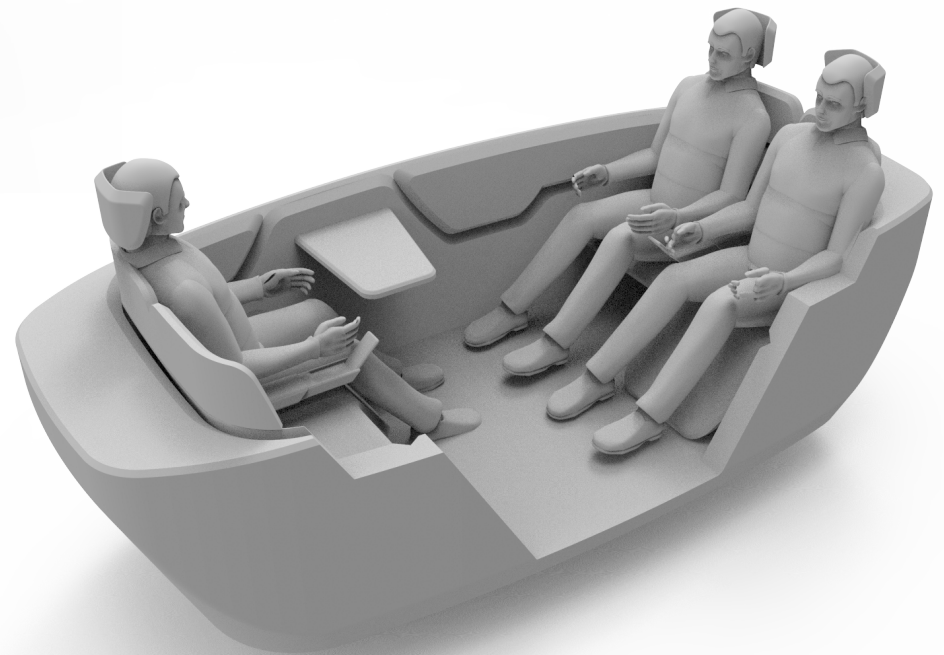
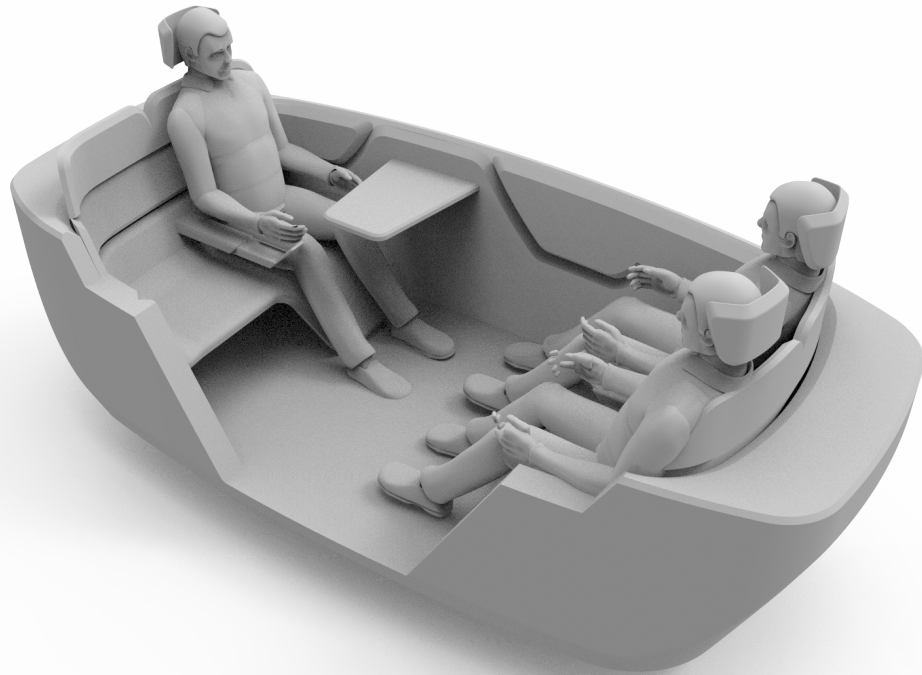


Large Infotainment Display on the windscreen

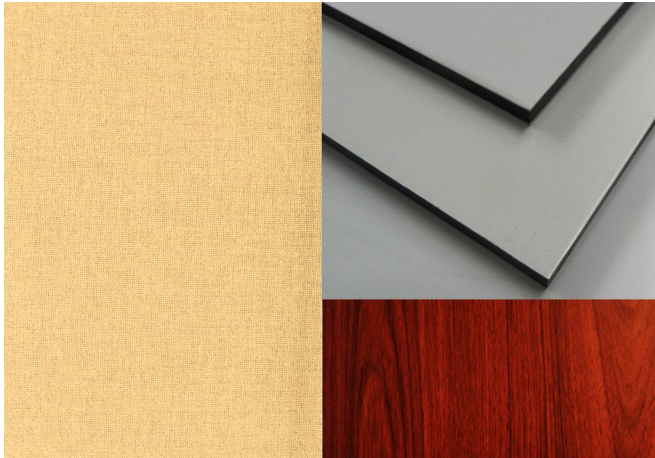


## 6.5 CAD model development

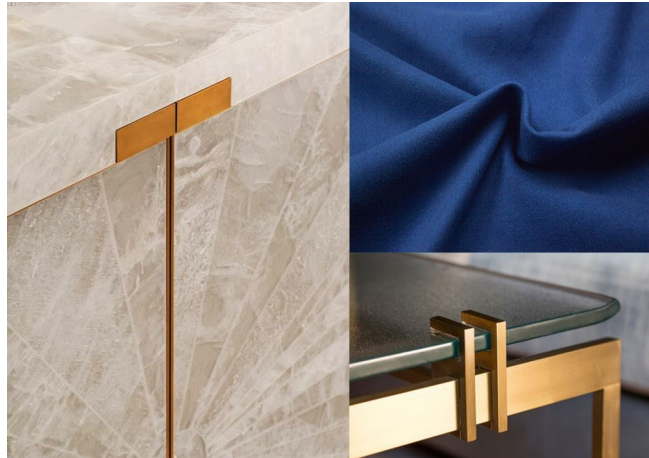




## 6.5 Color, Material and Finish Themes



Material : Cotton, Wood, Brushed Aluminum

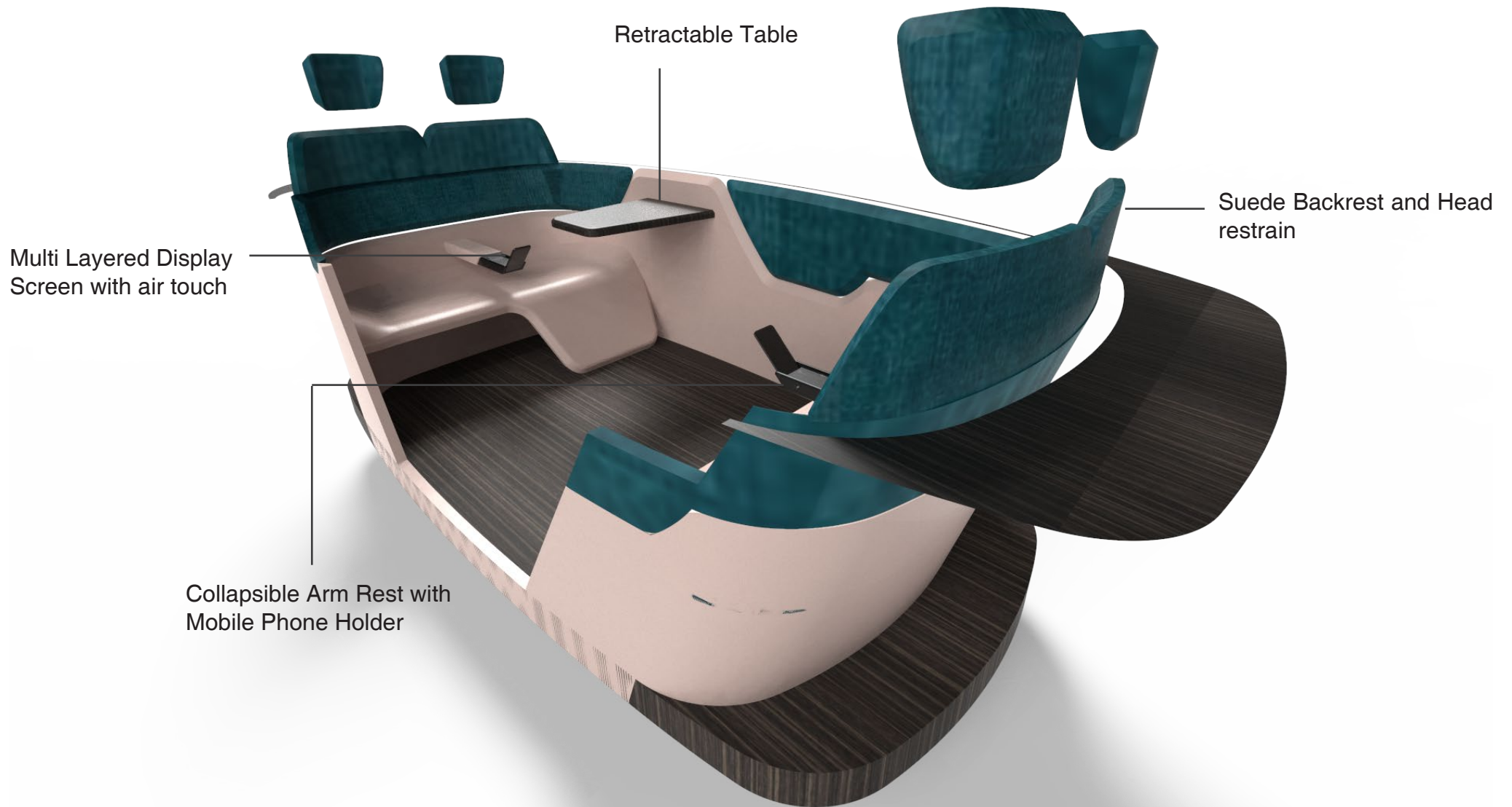


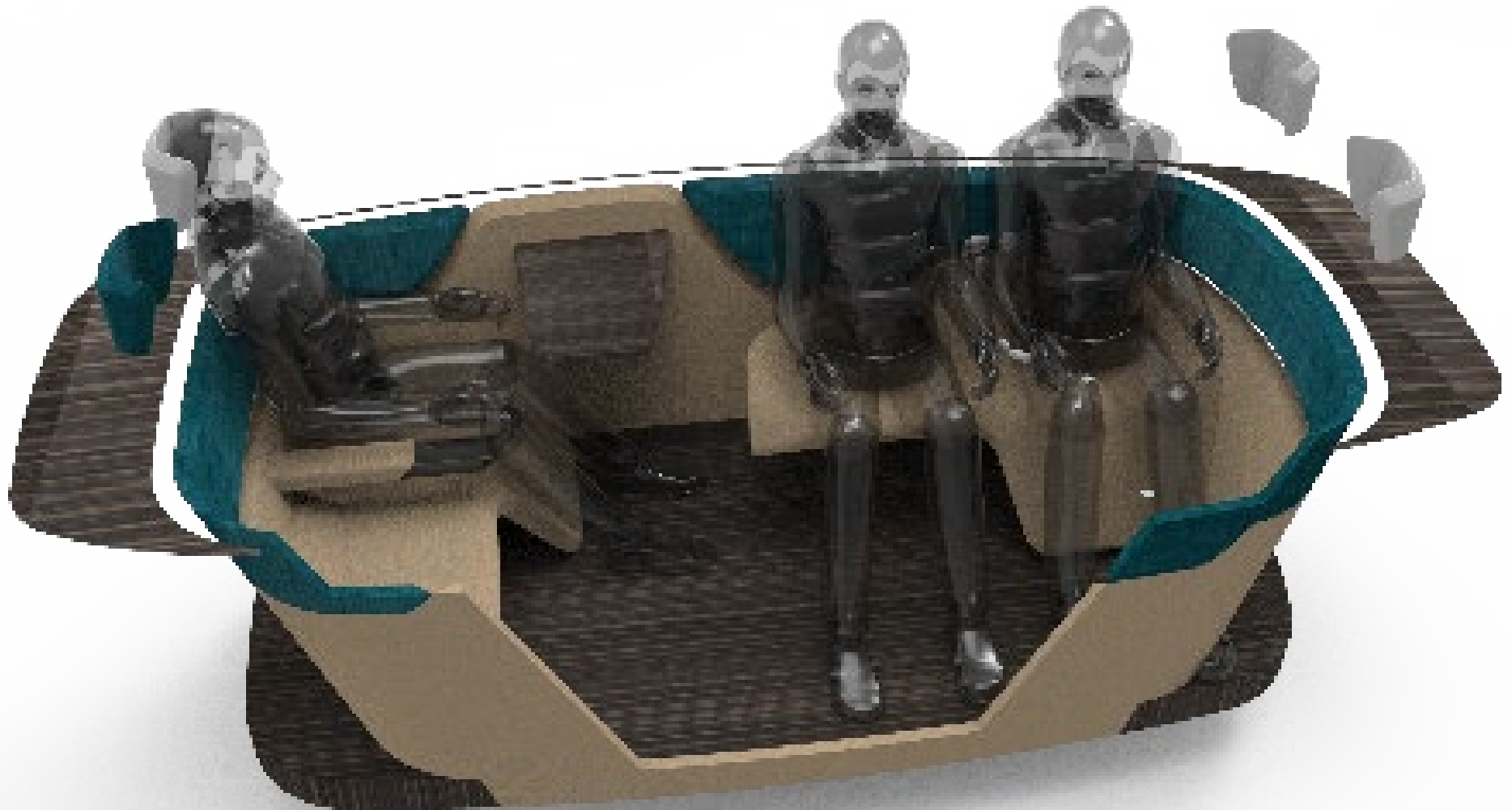
Material : Marble, Suede, Brass



Material : Chrome, Plastic, Leather

## 6.6 Renders





# | Annexure

## Questionnaire

### Part A

Name

Age

Profession

Location

This will help in setting up an initial conversation with users. Also these questions will help to understand the demographic dividend as well.

### Part B

Briefing of the project

Post part A small briefing of the project was given to the users which consisted of where the technology development stands today and by what time can we expect such cars to be rolling on roads. This will create a narrative for the users upon which they will further respond to the questions/tasks. Not too much of technicalities were explained so as to keep them away from any kind of confusion and bias.

### Question 1

With whom do you usually travel (present scenario)

Family, Friends, Colleagues, Solo

### Question 2

What is the purpose of your commute (present scenario)

Daily commute to office

Family Outings

Visiting friends and relatives

Solo Trips

Question 1 and 2 will create a basic setting for the narrative. The user will further develop his story and experience based on this setting.

### Question 3

Users were shown different visual clues and were asked on how would they like to spend their time during journey/commute in an autonomous vehicle if not driving?

(listening music, watching movie, Karaoke, video games, card and board games, working, reading books, eating, relaxing, capturing selfies)

This will create a basic setting for the narrative. The user will further develop his story and experience based on this setting.



*Visuals for different activities*

#### Question 4

What are the common items that you would store in your car? (Excluding boot space)

(cell phone, sunglasses, bottles/cups, wallet, handbag, notebook/laptop, pen and paper, coins, umbrellas, maintenance manual, critical medical information, emergency contact numbers, flashlight, tissue/hand sanitizer, high-energy snacks,toll card)

#### Question 5

Based on the above preferences kindly arrange the space with the given kit based on different usage scenario

The kit consisted of a steering wheel, dashboard, instrument cluster, seats, retractable tables, infotainment screens ,electronic chimney, digital board games.

The aim of the task was to identify some new and interesting layouts that can come from users part and also the kind and extent of trust that users seems to have on the autonomous technology and its potential.



Space arrangement kit (not to scale in image)

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