



#635



In-car HMI UX Evaluations

In-Car HMI UX Evaluation & Benchmarking

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Avatr 12

In this edition, our experts test the Avatr 12 – the latest EV from Avatr Technology, a joint venture between Changan, CATL, and Huawei. While our experts enjoyed the entertainment capabilities and IoT integrations offered by the automotive variant of Huawei's HarmonyOS, they felt that its lack of third-party support could limit its usability for some users. Beyond infotainment, the EV offers a impressive set of features that individually enable unique and seamless user experiences.

COVERAGE



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PUBLICATION FORMAT



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Scoring

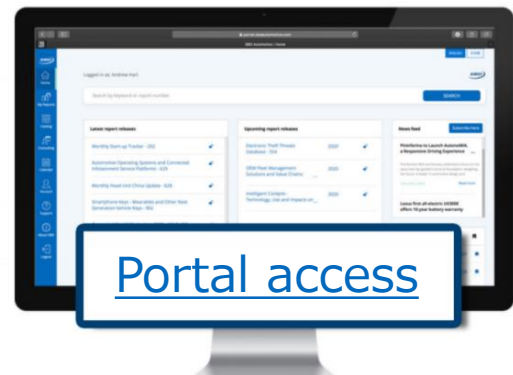
- > **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).
- > **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.
- > **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features.
- > **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience.

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In-Car HMI UX Evaluation & Benchmarking AVATR 12

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Introduction



Report Introduction

Welcome to the 2024 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the US, European, and Chinese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as the Connected Car and ADAS & autonomy domains.

SBD supports clients throughout the development of new HMI and products from a relatively simple companion app to a more complex multi-domain infotainment solution. The methodologies used in these reports take into account many years of experience with consumer testing and custom client projects to provide a fair and, as much as possible, objective methodology.

All viewpoints and analysis within the report are aimed defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.

Please note that due to the ever-evolving automotive technology market, SBD updates it's methodology each year, but does not update scores from the previous years. Therefore, please assume a slight drop in scores for both user experience (UX) and functionality from the previous year.



Intuitive



Supportive



Flexibility



Consistency



Brevity



Depth



Presentation

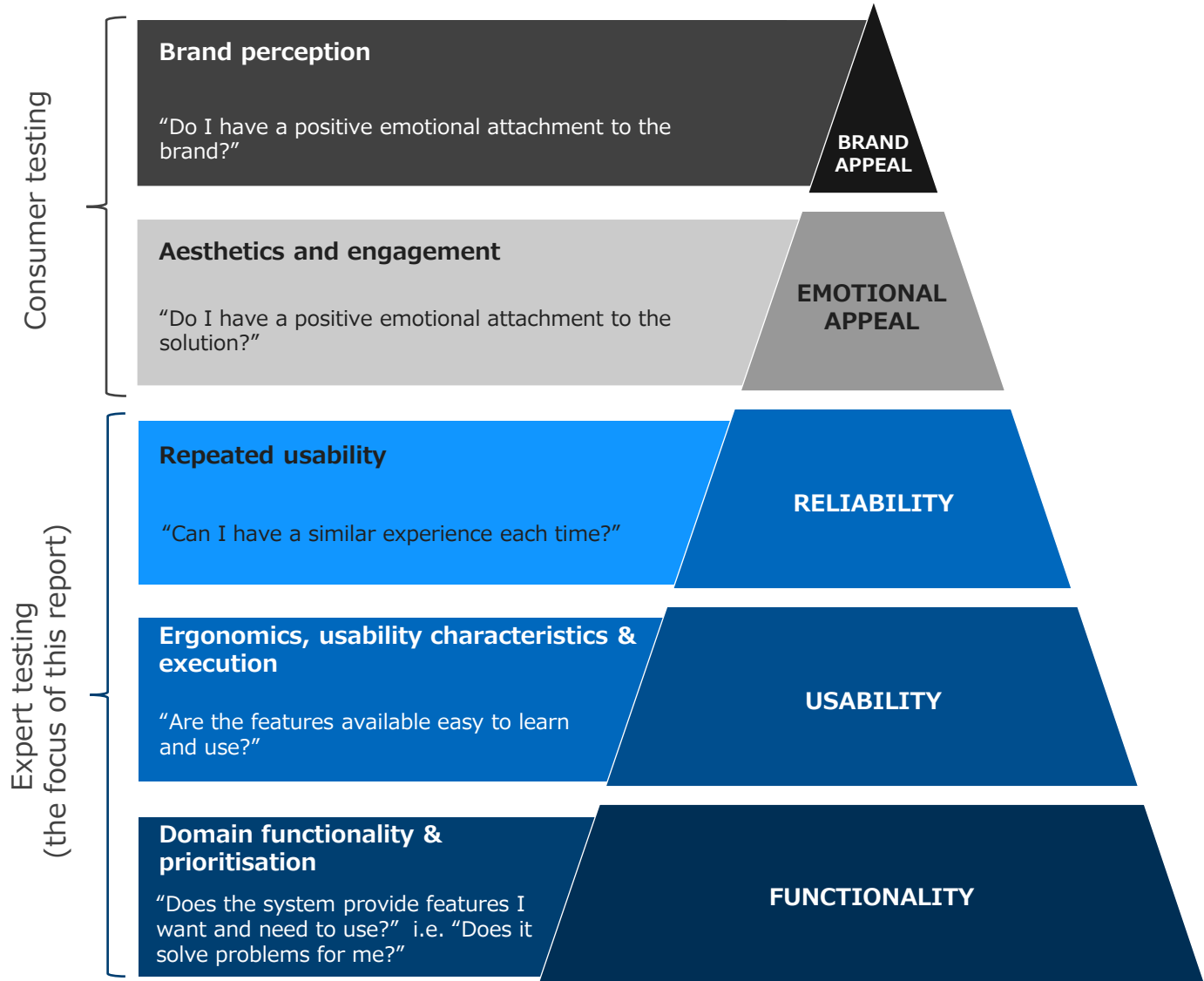
Section	Content
Birds Eye View	An overview of the key findings from SBD's various CX related and adjacent reports.
Executive Summary	Presents key highlights and conclusions from the report.
The Basics	What do you need to know about SBD's CX evaluation methodology?
Analysis	Analysis of report findings by SBD experts.
Features and functionality	Overview of key features and functionality by domain.
Execution	Assess success of implementation and overall execution of various system elements.
Perceived quality	Scoring and analysis of interior perceived quality levels.
ADAS domain	Highlight and analysis of key positive and negative points within the ADAS domain.
Infotainment domain	Highlight and analysis of key positive and negative points within the infotainment domain.
Navigation domain	Highlight and analysis of key positive and negative points within the navigation domain.
Voice recognition domain	Summary and scoring of various aspects of the voice recognition system.
Convenience domain	Summary of various convenience focussed features.
Future Outlook	Seven UX principles are considered against drivers and barriers into the future of this reports test vehicle.
Next Steps	Can SBD help you with any unanswered questions?



Aim of this report

One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **Features and functionality:** evaluating whether the solutions provide features that customers expect & need, and solve problems (or provide a wow factor)
- **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features
- **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time
- **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience



SBD's view on the hierarchy of needs for CX benchmarking



Scope of report: focus on in-car HMI evaluations

The scope of evaluations in this report are constrained to the in-car HMI experience, in both static and dynamic conditions. One notable element is driver distraction which SBD covers at only a high level in this study as carrying out a full driver distraction evaluation requires biometrics test equipment to ensure the collected data is unbiased and objective.



A full evaluation of the end-to-end customer experience is not within scope of this report, but it is something which SBD has many years experience in from both a consumer and expert perspective. Other areas such as the companion app, online portal and in-home smart devices are not in scope as they are defined as “out of car” experiences.

Within the vehicle, any HMI element the user interacts with is evaluated including steering wheel controls, touch screen displays, voice control, HUDs and digital keys. The features and services on offer have been broadly grouped into the following domains (or test areas):

- ADAS domain
- Infotainment domain
- Navigation domain
- Voice recognition domain
- Convenience domain





2024 vehicle list

SBD has chosen ten cars to evaluate in 2024, based on two selection categories. New/interesting UX focuses on systems with to never-seen-before features or functionality, or the implementation of a solution that has previously been a challenge or pain-point for end-users. New mass-market UX includes vehicles in segments that are sold in high numbers and are entering a new generation of UI for that vehicle. While we make best efforts to adhere to the chosen cars and schedule, the last two years have seen release dates slipping significantly, so it may be necessary to make substitutions.

Group A

Cars tested & Report published



BMW X1

- First BMW to be released with iDrive9
- Android based system
- US market test



Mercedes-Benz E-Class

- All-new MBUX Superscreen
- Unique features, apps and games
- German market test



Lincoln Nautilus

- BlueCruise hands free
- Digital Experience
- All-new infotainment system
- US market test



Hyundai KONA Electric

- 12.3-inch cluster and central display
- New Bluelink+ services
- US market test

Priority target vehicles



Polestar 4

- New IVI
- Absence of rear window
- EU market test



ID7

- Updated IVI
- New MIB4
- EU market test

Group B

Cars tested & Report published



Xiaomi SU7

- Xiaomi's first vehicle offering
- New vehicle from CE company
- Xiaomi Pilot MAX
- Chinese market test



Acura ZDX

- Google Built-in
- AcuraWatch 360+ with hands free cruise
- US market test



AVATR 12

- Harmony 4.0 OS
- Huawei ADS 2.0 (ADAS)
- Innovative displays
- Chinese market test

Other vehicles tested



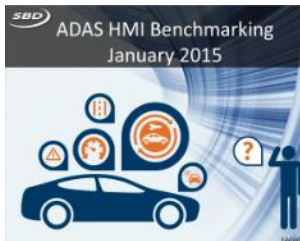
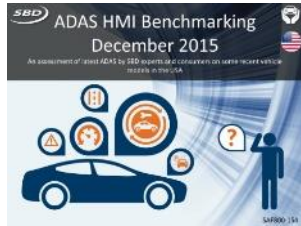
Audi Q6 e-tron

- All-new "Digital Stage" infotainment system
- AR HUD integration
- EU market test



SBD experience through years of testing in-car solutions

Over the last ten years SBD has evaluated over 100 solutions from a Connected Car or ADAS perspective for our public report series (many more for private client evaluations). This current report series is an evolution of both test methodologies to provide a holistic view of in-car HMI. Furthermore, custom evaluations methodologies used across the globe for SBD clients have been included where applicable to enhance to overall approach.





One page methodology overview

One of SBD's core goals of this report is to be as objective, fair and as transparent as possible. To achieve this, various methodologies are used throughout the testing to evaluate different areas of the solution in various conditions.

These methodologies are a mix of different types of tests:

- **Objective tests:** where the value provided is not influenced by a tester's viewpoint e.g. response time
- **Subjective tests:** the test score is based on the expert testers' viewpoints e.g. task ease of use
- **Task-based:** evaluations carried out based on a predefined task list e.g. navigate to a pizza restaurant near location X
- **Freeform:** random free testing by the tester with no clear pre-defined task list. This allows the testers flexibility to dig deeper into various parts of a solution when needed
- **Scoring range:** ranges and definitions of how to score a test element e.g. poor depth and accuracy score = the results provided are not in line with what is reasonably expected by the user
- **Static:** tests are carried out when the vehicle is not moving
- **Dynamic:** tests are carried out when the vehicle is moving in various road conditions and locations e.g. motorways/highways, cities, villages, country roads etc.
- **Misuse/failures:** carried out to evaluate the stability of the solution in unusual conditions e.g. repeatedly pressing the voice command button

This document does not provide a detailed description of the methodology and this page serves to provide an overview of the approach.

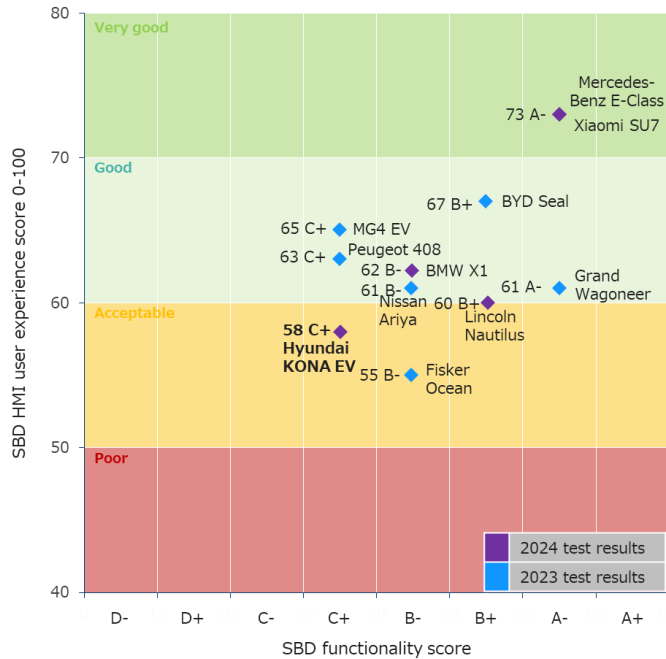
For a detailed discussion and presentation of SBD's methodology please [contact us](#).

Test area	Type of tests							
	Objective	Subjective	Task based	Freeform	Scoring range	Static	Dynamic	Misuse/failures
First impressions		✓		✓		✓	✓	
Static tasks	✓	✓	✓		✓	✓		
Dynamic tasks	✓	✓	✓		✓		✓	
Random free	✓	✓		✓		✓	✓	✓
Navigation specific tests	✓	✓	✓		✓		✓	✓
Voice recognition	✓	✓	✓	✓	✓	✓	✓	✓
Performance & response	✓		✓			✓	✓	✓
System Usability Scale (SUS)		✓			✓			
Final SBD UX score	✓	✓			✓			
ADAS	✓	✓	✓		✓	✓	✓	
UX heuristics	✓		✓			✓	✓	
Execution		✓			✓			
Ergonomics	✓	✓	✓			✓	✓	
Legibility & readability	✓		✓			✓	✓	
Perceived Quality (PQ)	✓	✓	✓	✓	✓	✓	✓	



Report structure and how to interpret certain data sets

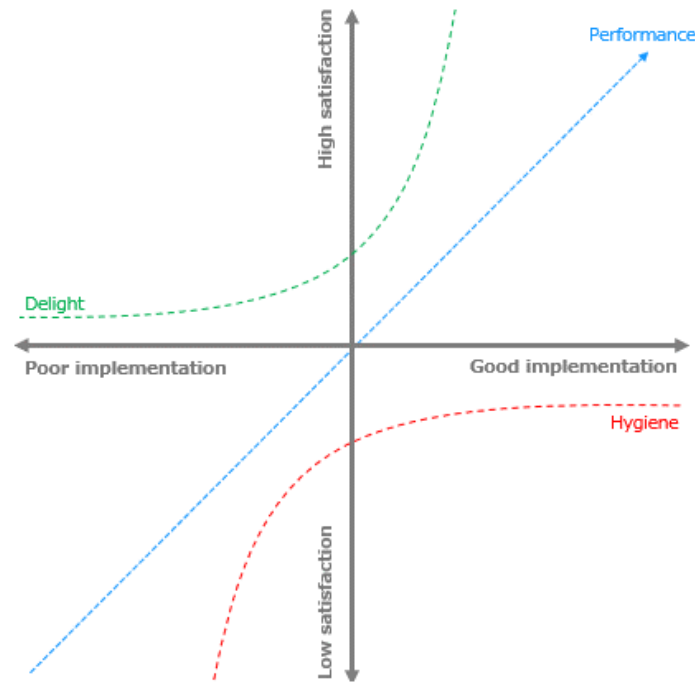
Throughout the testing and evaluation process SBD uses multiple methodologies to align to the situation and test area. Outputs from these evaluations can be broadly grouped into the following three types of report outputs - SBD's goal with these options is to ensure understanding of the results are as clear and fair as possible.



UX & functionality score

Final usability scored based on a 100-point scale with solutions scoring less than 40 defined as "not fit for purpose" with major user complaints expected and score above 80 defined as "exceptional".

Functionality score based on eight core feature set areas: delight features, performance features, hygiene features, navigation feature, ADAS, IoT integration, music, entertainment and info features.

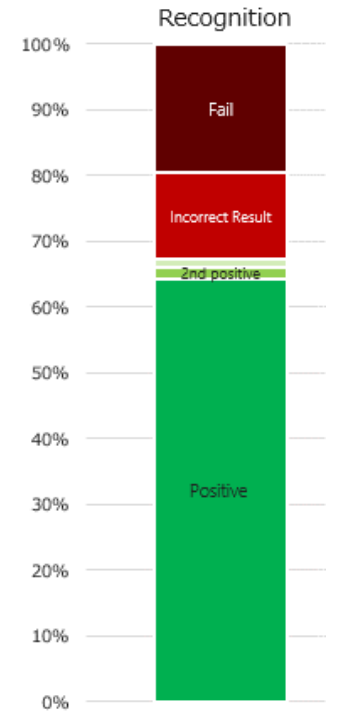


Modified Kano feature analysis

Features plotted against three lines based on their implementation and satisfaction levels:

- **Delight** features: "wow" features likely to provide high satisfaction even with poor implementation
- **Performance** features: as the level of implementation increases so does the customer satisfaction
- **Hygiene** features: poor implementation provides low satisfaction, but good implementation may not provide positive satisfaction as it can be considered as expected functionality

UX heuristic	Score
Cockpit clutter	Good
GUI clutter	OK
Display quality/size	Good
Map aesthetics	Very good
Map layout	OK
Navigation routing	OK
Instrument cluster	Good
General system HMI	OK

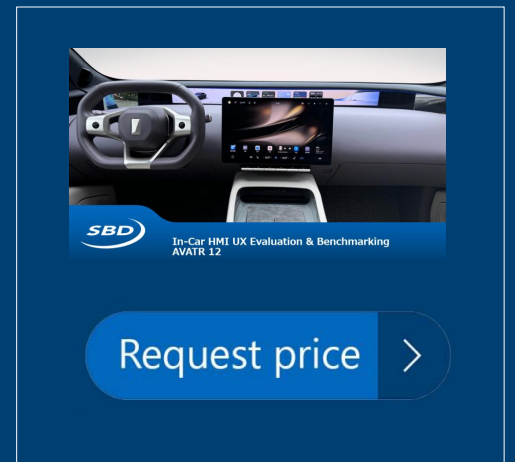


Subjective & objective scores

Scoring across multiple areas through subjective scoring with pre-defined ranges, definitions, and comparison to past results.

Objective scoring generally based on a pass/fail criteria or time-based considerations. SBD attempts to minimize subjectivity as much as possible with results aimed at being fair and reasonable with a minimal level of bias.

Example slides from the report

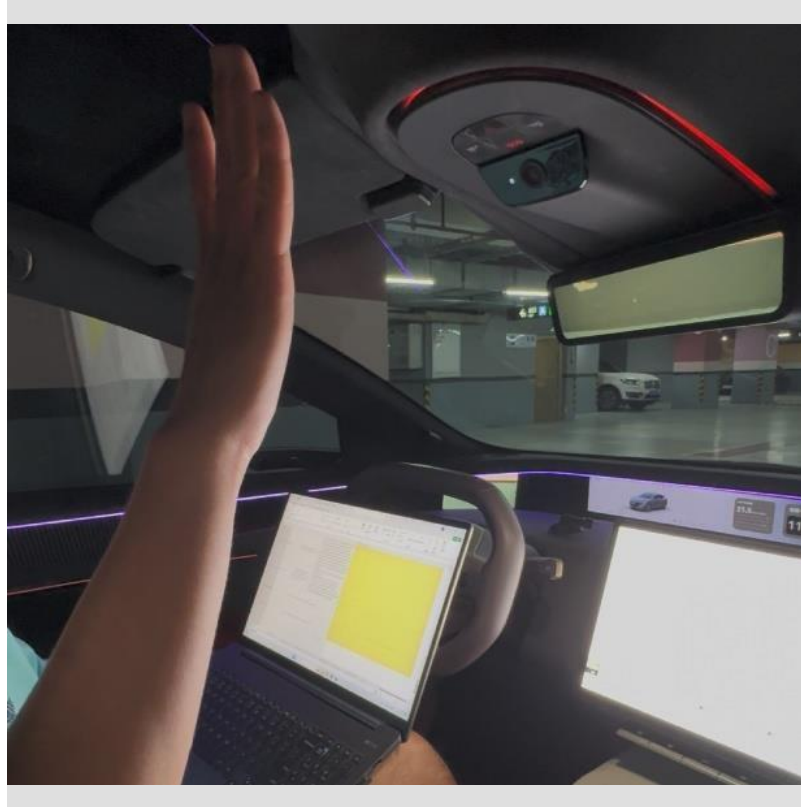
An example slide from the report, enclosed in a white border. The slide features a photograph of a car's interior dashboard and steering wheel. Below the image is a blue banner with the SBD logo on the left and the text 'In-Car HMI UX Evaluation & Benchmarking AVATR 12' on the right. At the bottom of the slide is a blue button with the text 'Request price' and a white right-pointing chevron symbol.

Impressive feature set with cutting-edge functions



Good camera monitoring system

The camera monitoring system replaces the traditional mirror-based rear view with a camera and a screen under the A pillar to display the rear traffic. The system can cope with extreme weather, like heavy rain, better and provides a clear view the whole during testing. The blind spot monitoring is also integrated into the in-cabin screen to display incoming vehicles.



Intuitive gesture control offered

System supports two functions: pick up/hang up phone and music play. User simply puts his/hers hands up for simple gestures then the system can respond. The instructions are intuitive and easy to use. There's minor delay in response but won't affect the overall using experience.



Rich IoT offering with Car-to-home

As part of the IoT integration feature set, many car-to-home interactions are possible. For support for the control of smart home devices is offered including homes camera, air-conditioning, air purifier and lights. Geo fencing scenarios can be created to run certain home routines. This level of connection adds to user convenience levels.



Automatic lane change on solid lane

1. ADAS

When PD is turned on, the vehicle automatically changes lanes to the left. Incredibly, the vehicle ends up changing lanes on the solid line due to a vehicle on the left side of the road obstructing the lane change timing.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical





Half of performances were satisfying, while another half was depressing

The AVATR 12 is positioned within the “Premium high segment” vehicle definition, this means each attribute must score “8, good (+)” to be defined as “acceptable” for this vehicle and segment. Ratings that are colored green are considered as meeting expectation for this vehicle type, ratings that are colored red fall below the expectation. Scores are based on three key considerations: how many times a “normal” user would experience the issue, the severity of the issues and an expectation that the concern would be experienced by 95% of users i.e. the more severe and broad the issue, the lower the score.

For the AVATR 12, only 2 examples of perceived quality referred as “Excellent”, and these examples pull up the quality score for the entire cockpit and make a favorable impression. However, as many as 8 examples fall below the expected level of quality, with issues mainly spread across the tactile, auditory and feature set.

Level 1	Level 2	Very poor		Poor		Fair		Good		Excellent	
		-	+	-	+	-	+	-	+	-	+
		1	2	3	4	5	6	7	8	9	10
Visual	Harmony/alignment									✓	
	Geometric								✓		
	Spatial harmony								✓		
	Branding								✓		
	Output HMI							✗			
	Interior lighting							✗			
Tactile	Stiffness & looseness								✓		
	Force feedback							✗			
	Material quality						✗				
	Material harmony						✗				
	Geometric & positioning								✓		
Auditory	Squeak & rattle (passive)									✓	
	Solidity (active after touch)						✗				
	Active sound (from system)								✓		
Feature set (Kano model)	Delight features								✓		
	Performance features						✗				
	Basic/Hygiene features						✗				



Clear HMI with easy entry

Category	System turn ON
System	Remote Parking
<p>SBD viewpoint</p>	<p>There's a clear button dedicated for RP on the FAPA display to inform the user to use the remote parking. After user chooses remote parking, system will prompt two warning information. The first one is to ask user to engage parking gear, which system will carry out automatically. Then there's a clear information on how system may fail and how should user take over during the process. The system will give audio notification to ask the user to leave the car with car key and phone for the RP to start automatically.</p> <p>System also supports remote parking out. When the car is parked, user can enter the "Remote Parking" on the mobile app to initiate the process.</p>
<p>UX impact</p>	<p>Minor Positive</p>



Dedicated RP button



P gear warning



Final warning



No navigation widgets in settings page

SBD viewpoint

The navigation widget will disappear if user opens the setting page during driving.

- If user exits the navigation app, the navigation info will be available on the main page as a widget. However, if user opens the settings page, this widget will disappear, leaving no information for user to refer to on the central display.

Since there's limited information displayed on the pillar-to-pillar display and instrumental cluster, it's important for the system to keep the navigation widget on all the time and need to override other apps to ensure in-time navigation notification.



Setting Bluetooth with navigation



Open setting page during navigation

UX impact

Major negative

Minor negative

Minor positive

Major positive



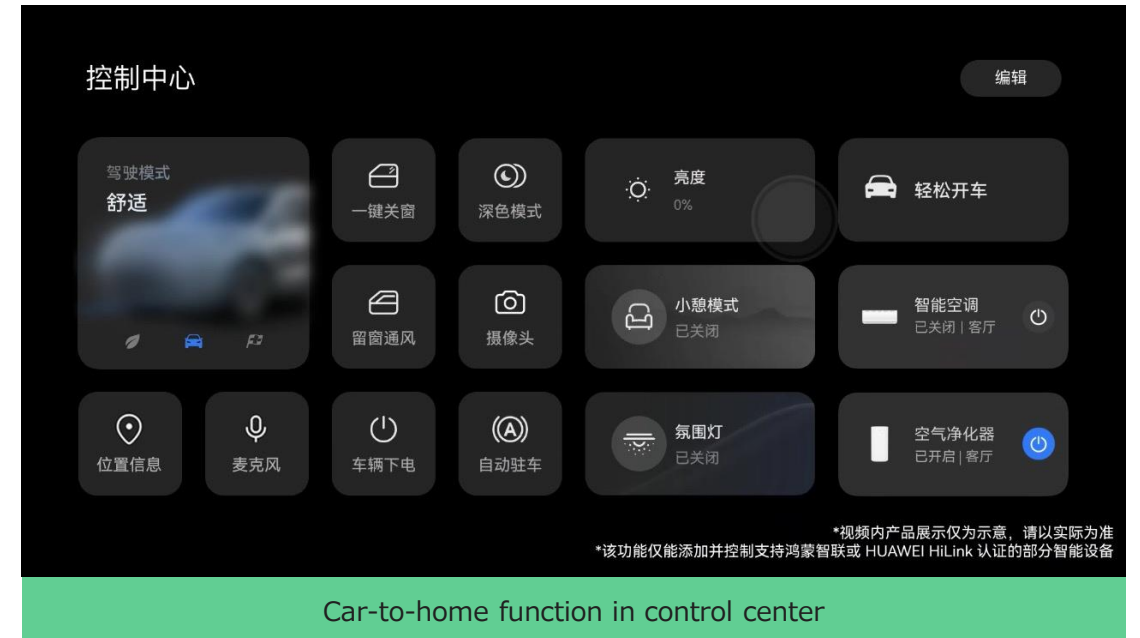
High degree of integration of IoT with smart devices

SBD viewpoint

Users can remotely control smart devices and scenes in their homes from their vehicles, which can be quickly accessed from within the control center in minor screen.

- Smart devices that are currently supported to be remotely controlled from the car include: lights, air conditioners, air purifiers, humidifiers, plugs and switches, etc.
- Users need to sign in to the same Huawei account on the central display as the mobile app Huawei Smart Life to synchronize devices and scenes within the app.
- Users can choose to add/remove smart devices and scenarios on the Smart Devices page. Then they can quickly turn on/off devices directly within the control center or execute scene commands on the car before getting home.

These different IoT integrations increase user convenience and enable quick interaction between vehicle and home, allowing users to control them directly in the car rather than relying on their cell phones, providing a more comprehensive solution for car-home connectivity.



UX impact	Major negative	Minor negative	Minor positive	Major positive
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Inaccurate and inconsistent detail information of POI

SBD viewpoint

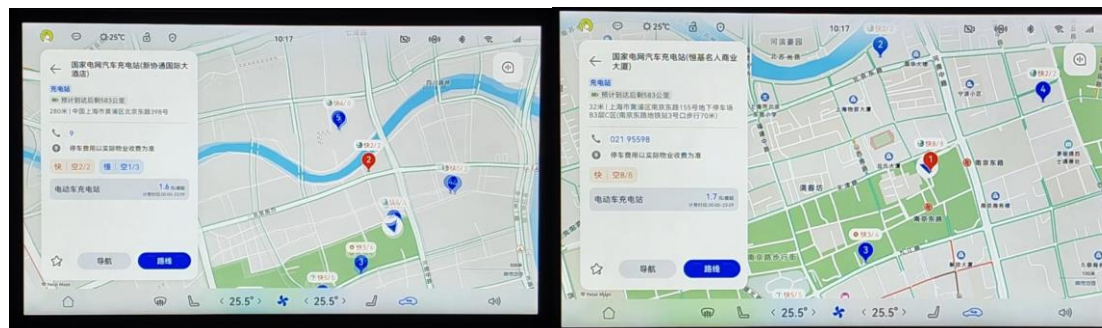
The information provided for POI is inaccurate and insufficient.

- For parking lot, the information provided varies a lot. Ideally, the information provides should include opening time, pricing standard, parking space availability, contact. However, there's no parking space availability for all the parking lot. Some only provides opening time with no pricing standard and contact. Some has opening time and pricing standard but no contact. This level of inconsistency may cause great confusion for the user.
- For charging station, system provides limited and inaccurate information regarding the price and contact. During the test, there's an inaccurate contact number spotted. Regarding the price, it only shows the average price. The actual price varies based on peak and flat hour and it can be split into electricity price and service price. The lack of detailed information will cause severe issue when user want to find a charging station.

The lack of information included in the POI will cause confusion for the user to use and lower the user confidence of the system.



Inconsistent information regarding parking lot



Inaccurate charging station information

UX impact	Major negative	Minor negative	Minor positive	Major positive
-----------	----------------	----------------	----------------	----------------



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