Research on consumer demand and trend of automobile HMI function

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Abstract. Consumers pay more and more attention to automobile intelligence. Under the trend of "new four modernizations", it is inevitable for automobiles to move towards intelligent terminals, and automobile HMI is an important carrier of automobile intelligence. At present, the design of automobile HMI is still not accurate enough to grasp the needs of consumers, which leads to poor consumer experience. In this paper, from the perspective of consumer demand, consumers are classified according to the difference of automobile HMI demand, and the experience evaluation and demand difference of different types of consumers on automobile HMI are analyzed to explore the demand trend of consumers on automobile HMI function.

Keywords: Automobile HMI, Man-machine interaction, Consumer demand, Experience evaluation; future trend.

1. Necessity of research on automobile HMI consumers

1.1. Definition of automobile HMI concept
At present, there is no unified concept definition of automobile HMI, but it can be basically divided into two categories, one is Human Machine interface, which focuses on interface display, that is, man-machine interface of control system, focusing on interactive control between display screen area and drivers and passengers; The other is Human Machine Interaction, which focuses on the interaction mode, that is, the interaction between people and cars, including the interaction of sight, hearing, touch and smell.

In this paper, "automobile HMI" has a wide meaning, which refers to the media and behaviors of interaction between people and automobile systems, including both interactive interfaces (such as central control panel, instrument panel, HUD, etc.) and interactive modes (such as touch screen control, voice control, gesture control, face recognition, etc.), focusing on the consumer functional requirements of human-computer interaction.

1.2. Research necessity and research method
The usage habits of intelligent products have changed the way people think, and the intelligent interactive lifestyle has become a trend. Consumers' attention to car purchase has gradually changed, and their emphasis on intelligence has been continuously improved. Under the trend of "new four modernizations", it is inevitable for automobiles to move towards intelligent terminals, and automobile
HMI is an important carrier reflecting automobile intelligence and networking. However, the development of automobile human-computer interaction generally takes technology as the starting point, ignoring consumer demand, or even paying attention to it, it also has inaccurate grasp of consumer demand and insufficient grasp of hidden demand, which leads to the stacking and homogenization of function development and poor consumer experience. Therefore, for the development and design of automobile HMI, it is particularly important to understand and accurately grasp the needs of consumers.

In this paper, from the perspective of consumer demand, consumers are classified according to the difference of demand for automobile HMI. Based on the combed automobile HMI function classification and the self-built human-computer interaction evaluation system, combined with quantitative questionnaire survey, scene-based in-depth visit, workshop and other research methods, consumers' experience and expectation of using existing automobile HMI are analyzed, and the demand trend of consumers for automobile HMI function is grasped.

2. Automobile HMI consumer demand type

The investigated vehicles cover different price bands and different HMI system types. Ten vehicle owners including Weilai ES8, Model3, BMW 3 Series, Roewe Marvel X, Song Pro, Hongqi HS5 and Fengxing T5 are selected, with a quantitative sample of 300, and representative vehicle owners are selected to participate in scene-based in-depth visits and workshop.

According to the cognition and demand differences of automobile HMI, the overall consumers are divided into three categories: high demand, medium demand and low demand, as shown in Figure 1. From the perspective of social characteristics, from low demand to high demand consumers, the annual income of families is on the rise, and the consumption concept is also from conservative to advanced; From the perspective of car purchase, the proportion of consumers with low demand to high demand to purchase and exchange cars is on the rise, and the model level is rising from entry-level to luxury level; From the perspective of automobile HMI function demand, consumers from low demand to high demand have gradually increased their understanding of HMI, their trust in new technologies and their demand for new functions.

![Figure 1. Types of consumer demand](image)

As shown in Figure 2, an example is given to illustrate the differences between the three types of consumers in HMI function requirements. In terms of attitude towards HMI media entertainment function, low-demand consumers think that too much entertainment will affect driving safety, and
existing music, video playback and other functions are sufficient; Consumers in demand think that they can have more entertainment functions when parking and others or when there are other passengers in the car. Now many cars have co-driver entertainment screens and rear entertainment screens, and they also want to have them; However, consumers with high demand think that HMI should play the latest technology, try everything, and have more and newer media entertainment functions, such as car games, car cinemas, car KTV, etc.

![Figure 2. Differences in the demand of three types of consumers for media entertainment functions](image)

**3. Evaluation of automobile HMI consumer experience**

**3.1. Function carding and evaluation system construction**

In this study, the automobile HMI functions are re-classified from the consumer's point of view, including seven first-level functions, such as driving safety, driving habit management, navigation and location service, life service, car service, system basic setting and interactive mode, 29 second-level functions, such as driving assistance, door and window control, navigation, communication and social interaction, remote car control and OTA upgrade, and more than 200 third-level and fourth-level functions.

In order to study the consumer experience in detail, this study constructs a set of consumer evaluation index system of automobile HMI, which comprehensively evaluates each function from different angles such as usability, pleasure and efficiency, and deeply understands consumers' joys and pains through scene-based in-depth visits and workshop, so as to tap consumers' needs.

**3.2. Evaluation and difference of consumer experience**

As shown in figs. 3 and 4, through quantitative data analysis, it can be seen that among the interactive interface functions, consumers have better experience of some basic functions such as door and window/lighting control, vehicle status display, safety alarm, etc., and have poor experience of some extended functions such as information service, network interconnection, communication and socialization, etc., with low equipment rate; As shown in fig. 5, in the interactive mode, the user is satisfied with the basic mechanical control, but has poor experience with the immature interactive modes such as gesture control and biometric identification.

The overall experience evaluation of medium demand consumers is higher than the other two categories. Through scene-based in-depth visits, it is found that the main reason is that the medium demand representative models are high-end models of independent brands, and the HMI functions of independent models in this price segment are relatively perfect, while the functions of joint venture models are relatively poor; The evaluation of voice control among the three types of consumers is quite different, and the high-demand consumers have the lowest evaluation. The high-demand consumers also have lower evaluation in information service, network interconnection, communication and social
functions, mainly because the high-demand consumers have higher expectations and demands for these functions, while the current functional experience and expectations on vehicles are quite different.

**Figure 3. Evaluation of interactive interface function (secondary function TOP5)**

**Figure 4. Evaluation of interactive interface function (secondary function Bottom5)**
Figure 5. Evaluation of interaction mode (secondary function)

4. Consumer demand trend of automobile HMI function

4.1. Entertainment demand
With the continuous upgrading of consumption, consumers' demand for automobiles has risen from the original basic practical demand and safety demand to entertainment demand. Coupled with the maturity of intelligent technologies such as automatic driving, the hands of car owners are liberated, and the demand for HMI entertainment functions will continue to rise. For example, passenger entertainment screen, car games, KTV, car watching and other functions not only meet the entertainment needs of car owners, but also need to meet the entertainment needs of passengers, and there are different requirements for the same entertainment function in different scenes and different occupants. For example, when there are children riding, if voice assistants can chat with children and calm their emotions, they will better help car owners concentrate on driving.

4.2. Active interaction requirement
With the convenience brought by intelligence, consumers increasingly hope that cars can identify the intentions and needs of car owners more actively, and provide help actively instead of passively executing commands. More humanized and intelligent active interaction is a major trend of HMI in the future. For example, HMI can automatically detect the owner's mood, weather, etc., recommend playing appropriate music, adjust fragrance, etc., voice assistant can actively greet and remind schedule, actively prompt whether to start automatic driving when entering congested road section, actively recommend parking lot when approaching destination, or recommend food and entertainment places after identifying the owner's intention, all of which require perfect linkage system and humanized design.

4.3. Emotional interactive demand
With the development of society, people pay more and more attention to emotional demands. People prefer to communicate with people, not with machines. Natural and emotional human-computer interaction can attract consumers to pay the bills. Emotional interaction design is to fully consider and satisfy people's emotional needs in the interaction between products and people, so as to make people happier in the use process, thus realizing the spiritual function of products. The most typical demand of emotionalization is to hope that the intelligent assistant will be more humane. For example, the holographic intelligent assistant with specific image has expressions and movements, can interact with
car owners and passengers in all directions, and adjust the content and way of dialogue according to people's emotions, making people feel comfortable and happy.

5. Summary
The development and design of automobile HMI is no longer technology-oriented, but consumer demand-oriented. Whether it can accurately grasp consumer demand and translate it into HMI development and design is the key to the success or failure of HMI products. But at the same time, it is necessary to identify which type of target consumer groups the vehicle models correspond to, and what their characteristics and needs are, so as to develop and equip corresponding HMI functions according to the needs of target consumers. Consumers with low demand do not need cool and rich HMI functions required by consumers with high demand. In addition, consumers' needs will change with time and their own situation, and low-demand consumers will change to medium and high demand with the improvement of economic ability, so it is also very important to grasp the future trend of target consumer groups.

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