User Preference of Different Artificial Intelligence Level in Vehicle System

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Abstract. With the development of artificial intelligence technology, the functional requirements of the vehicle central control panel becomes various and abundant. This work studies the preference degree of the user's in different artificial intelligence level, which is of great significance to the application research of artificial intelligence technology in the car interaction design. This paper uses the driving simulation test method to conduct experiments. Through the qualitative research on 20 users, the Chinese users' preference has been studied, which provides a new research content for the application of artificial intelligence technology in the driving process.

1. Introduction
The functions of the in-vehicle system are constantly updated with the development of technology and user needs. At present, the most commonly used functions are audio, telephone, navigation and so on. With the development of technology, face recognition technology, gesture recognition, vein recognition and other technologies create more in-vehicle system functions. Asustosh Padhi of McKinsey pointed out in the Disruptive forces in the industrial sectors -- Global executive survey, Automotive & Assembly, Advanced Electronics and Aerospace & Defense March 2018 -- which the global manufacturing industry is undergoing tremendous changes [1]. The driving force behind it is the five subversive forces, among which Artificial Intelligence (AI) is a subversive force that has a profound impact on the automotive industry, the aviation industry and other industries. Currently, Big Data-based Machine Learning is the main way to achieve AI. The most important contribution of AI to car and mobile travel includes three aspects [2]: (1) Acting according to highly complex situations; (2) Respond to a large number of complex situations that cannot be adequately covered by explicit programming; (3) Improve clear instructions, learn unstructured unknowns from previous data, and continue to improve without clear instructions [3]. With the continuous development of AI technology from Artificial Normal Intelligence to Artificial Generalized Intelligence and Artificial Super Intelligence. In terms of networked vehicle technology, AI will realize real-time communication of automotive V2X, including RSU [4], from on-board computer to cloud computing. Döring et al. compare gestures with different ways of interacting [5]. In fact, the authors compared their interface to two traditional interfaces, a radio with buttons for the central dashboard of music control tasks and a traditional car navigation system for navigation tasks. In terms of interaction time, the user uses the touch interface faster than gestures and buttons [6]. Also in this study, the gesture interface is mainly
superior to the traditional interface. Some studies investigate the implications and risks of using a speech-based interface in a car [7-9]. Maciej and Vollrath compare the touch screen interface and voice-based interface in the dashboard to perform four IVIS tasks (audio, phone number selection, navigation system with address input and point of interest selection) for better driving through a voice-based interface Performance, except for all tasks except point of interest selection, which requires a higher visual effect to pay attention to the side screen [9]. At present, there are relatively few studies on the user-only level of user preference, which has wider and more practical applications in AI and interaction design.

In our study, we compared the gesture interaction modality with two state-of-the-art interaction patterns: voice interaction and touch interaction on a large Android touch screen. The users’ preference has been studied, which provides new contents for the application of AI technology in the driving process.

2. Method

2.1. Experimental design

The overall experimental testing process is shown in Fig. 1. Following is the detailed illustration of interactive process test content, user control mode and test evaluation design.

2.1.1. Interactive process test content. This experiment designed 3 AI scenarios and 5 AI level permissions. The 3 AI level scenarios are Low fuel: Gas station search/Maintenance: Garage search/News suggestion. This experiment mainly focuses on the functions of navigation to the gas station/appointment maintenance/listening to the news of the three car system, respectively. The design of the level of AI level is based on the level of AI in the vehicle system. Different interactions and presentation forms are applied in different levels of AI to highly accurately divide the application level of AI level in the vehicle. All manuscripts must be in English, also the table and figure texts, otherwise we cannot publish your paper. Please keep a second copy of your manuscript in your office. When receiving the paper, we assume that the corresponding authors grant us the copyright to use the paper for the book or journal in question. Should authors use tables or figures from other Publications, they must ask the corresponding publishers to grant them the right to publish this material in their paper.
Table 1 Description of the setting of five AI level function applications

| Task | Interaction | level | Notes with different levels |
|------|-------------|------|-----------------------------|
| 1    | Touch/voice | 0    | System has no AI permission |
| 2    | Touch/voice | 1    | Automatically prompt after automatic detection and GPS |
| 3    | Touch/voice | 2    | After automatic detection and GPS, the function selection list is automatically presented. |
| 4    | Touch/voice | 3    | After automatic detection and GPS, the confirmation interface is automatically presented. |
| 5    | Touch/voice | 4    | After automatic detection and GPS, the task is automatically operated, but you can choose to stop the operation. |

In the test process, driving and experience tests are performed on the rights of different AI levels as shown in Table 1. The questionnaire is completed then the total user experience is investigated and summarized.

2.1.2. User control mode. This test is mainly divided into touch interaction and voice interaction in the design of user control interaction mode. In detail, the user performs interactive control through the operation of the touch button and the central control button knob, and the user directly controls by voice control. Through experimental design of different control methods, we look forward to valuable comparison results.

2.1.3. Test evaluation factor design. In the interactive control evaluation factors, the following evaluation factors, including operation time, confidence level, driving influence and step clarity, are mainly selected. In this study, the study focused on the operating time factor. This study sets a score of 1-6 points, that is, 1 point is the worst, and 6 points is the best except confidence level. Detailed evaluation indicators and scoring standards are shown in Table 2.

Table 2 Evaluation indicators and scoring standards

| Time required for operation (1;6) | Confidence level (6;1) | Driving influence (1;6) | Step clarity (1;6) |
|-----------------------------------|------------------------|------------------------|--------------------|
| 1-6                               | 6-1                    | 1-6                    | 1-6                |

2.2. Participants
Twenty participants (10 men, 10 women), aged 20–65 years (20-30:3; 30-40:10; 40-50:2; 50-60:4; 60-70:1) completed the experimental procedure. All the testers are recruited by social workers. Among them, 13 have a bachelor's degree and 3 have a master's degree. One of the test participants is left-handed, and all the testers are engaged in industries that are not advertising, marketing, consulting, automaker, automation, etc.

2.3. Test Condition
The driving environment of this test is a neutral driving condition. The workload during driving is low, there are fewer road vehicles, and no special driving conditions occur. The driving environment is a transaction section and an elevated section.

2.4. Page Numbers
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3. Results and analysis

Fig. 2 Comparison of Length of action touch screen control satisfaction

The user level score for the action length when the function is used during the touch screen interaction is shown in Fig. 2. This data is the average score of the overall evaluation of 20 participants. As can be seen from the chart, for the operation length indicator, the user's overall rating of the "listening to the news" function is higher than "navigation to the gas station and scheduled maintenance." The user has a stronger preference for the overall level of Level 2 and Level 4. In the overall linear trend, the higher the level, the more users like it.

Fig. 3 Comparison of Length of action voice interactive control satisfaction

The user level score for the operation use length when the function is used during the voice interaction process is shown in Fig. 3. This data is the average score of the overall evaluation of 20 participants. As can be seen from the chart, the user has a stronger preference for the overall level of level 2. In the overall linear trend, for the function of “listening to the news”, the higher the level, the more the user likes it. I think the reason why there are two different types of functional trends is that the nature of the functions is different. The function of “listening to the news” is mainly entertainment, and the choice becomes less important. Therefore, in the action length score of the voice control, the higher the user level, the more the users like. Compared with Fig. 2, the user's evaluation of voice control is higher than that of touch screen control, and the user prefers voice control.
This study evaluates the overall preference of the research users for level 0 to 4 by means of two evaluation methods namely the degree of preference and the degree of dislike. The evaluation of factors that do not like the degree is mainly to have more intuitive user data. Secondly, it is also possible to verify the data of the degree of likeness.

At the end of the action length test, the user is given an overall evaluation of the different level settings as shown in Fig. 4. When the interaction mode (voice control or touch screen control) is not considered, the user prefers level 2. The second favorite is level 3 & 4. No users like level 1 & 0. Additionally, the rating is also rated on the user's least favorite level as shown in Fig. 5. The user's least favorite is level 0, regardless of the interaction mode (voice interaction control and touch screen interactive control). The second dislike is level 3. The third dislike is level 4. No user has ranked Level 1 and Level 2 in the last.

In the study, we obtained the most intuitive view on preference of many users through interviews. For example:

L2: “I like the list.” “Feeling respected.” “I feel clearer.”
“A higher level feels less control.”
L3: “If he can recommend me based on AI, I might like it best, so I don’t need to make choice.”
L4: “It’s very smart. It simplifies my operation and is very convenient.”

Similarly, we obtained the most intuitive view on dislike of many users through interviews. For example:

L0: “Not at all intelligent.”
L4: “The higher the level, the more inconvenient it is.”

4. Conclusion

In the research process, the two interaction methods are compared and we found that in the simulated driving environment, the user prefers the voice compared with the touch screen interaction. At present, this study only studies the comparison of action time in the research framework. In the analysis of the action length based on the interaction of the touch screen control the user thinks that the operation of level 2 is the most time-saving. Users can choose the option they like in the shortest time. In listening to news choices, users like level 4 they think 4 is more time-saving, because listening to news is entertainment not necessarily making choices. In the analysis of the operation length based on the interaction of voice control users think that level 2 is the most time-saving, and 20% users think that the more choice of level 3 will make them time-consuming. In the future, our research will be concentrated on other evaluation indicators, including user confidence, driving compatibility, understand ability of required user action and so on based on different artificial file:E:/Dict/7.5.0.0/resultui/dict/?keyword=intelligence levels.
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