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Research on High Frequency Usage Scenarios of Touch Interactive in Dynamic Scenarios

Shimeng Wang *, Qipeng Zhang, Zhe Tian, Meng Zhao

CATARC Automotive Test Center (Tianjin) Co., Ltd, Tianjin, China

*** Corresponding author:** Shimeng Wang

Abstract: In the era of intelligence, the smart cockpit mainly consists of more abundant large LCD instrument panel, comprehensive touch control screen, advanced in-vehicle infotainment system, etc., to create a new user experience for drivers and passengers in the cockpit. With the development of smart cockpit, touch interaction has become one of the high-frequency ways for users to interact with cars. Performing touch interaction tasks in dynamic scenarios requires distraction that prevents it from keeping its eyes on the road. At present, the scene of touch interaction safety evaluation in the industry is concentrated on air conditioning and radio, but in the dynamic scene, the driver will carry out many other operations, such as making and receiving calls, playing music, navigation Settings, vehicle Settings and other functions, which will bring safety risks such as sight deviation. Therefore, it is very important to study the high-frequency use scenarios of touch interaction in dynamic scenarios, which is helpful for enterprises to develop and design more secure and convenient interaction methods.

Keywords: Dynamic Scenarios; Touch Interaction; High Frequency Usage Scenarios.

1. Introduction

The thriving intelligent automobile industry has not only driven innovations in automotive technology but also significantly transformed users' driving and riding experiences [1]. As a crucial component of intelligent vehicles, the interactive design of smart cockpit has increasingly become key to enhancing user experience [2]. Since the emergence of the smart cockpit concept, the primary interaction points have concentrated on screen media such as central control displays and passenger entertainment screens. These screens not only provide rich information display functionalities but also serve as the main interfaces for users to perform various operations with the vehicle [3].

With the continuous enhancement of automotive intelligence, touch interaction, as an intuitive and convenient operation mode, has rapidly become a frequently used means of interaction between users and vehicles. Screens like central control displays have integrated an increasing number of functions, evolving from initial simple information display to diverse functionalities such as air-conditioning control, music playback, navigation settings, system settings, and phone operations today. This development trend has led to a gradual reduction in physical buttons within smart cockpits [4].

However, while touch interaction brings convenience, it also poses some safety hazards [5]. Especially in dynamic driving scenarios, when drivers need to perform touch interaction tasks, they often divert their gaze from the road to view and operate the screen, resulting in visual distraction [6].

In response to this issue, there is still a certain shortage of evaluation work on the safety of touch interaction in the industry. The existing test scenario library is relatively incomplete, mainly focusing on more basic functions such as air-conditioning and radios, while tests for other high-frequency operations are relatively scarce. For instance, functions like phone operation, music control, navigation settings, and vehicle settings are also highly used in actual driving but are often neglected in touch interaction safety assessments. The uniformity of these test scenarios not only fails to comprehensively reflect the safety issues of touch interaction in real driving environments but may also result in the omission of potential safety hazards.

Therefore, to enhance the safety of touch interaction in smart cockpit, the industry needs to further improve the test scenario library by incorporating more high-frequency operations into the assessment scope. Simultaneously, it is necessary to strengthen research on driver attention allocation during touch interaction tasks and explore safer, more convenient interaction methods.

2. THE Research Status of Domestic and Abroad

The central control screen, serving as the core interactive interface for modern vehicles and many smart devices, underscores the significance of its Human-Machine Interaction (HMI) design. This design is not only crucial to the user experience but also directly impacts the overall performance and user satisfaction of the device. Currently, research on the HMI design of central control screens and its testing evaluation has indeed become a focal point of attention in both industry and academia. For example, Li Jiaxin and Li Jia [7] elaborates on the issue of distracted driving in the context of interactive design for smart vehicles. They analyze the human factors related to distractions in visual, auditory, operational, and cognitive aspects of driving and propose interactive design principles such as simplicity, ease of use, effectiveness of feedback, and prioritizing the reduction of cognitive load. Liu zhuofan et al. [8] propose the influence of visual distraction on the driver's operating behavior is related to the traffic environment and the degree of distraction. Li Qian [9] studied the effects of the layout of the central control screen in different car cab on the driver's visual attention through eye movement experiments. Dukic T et al. [10] shows that visual distraction while driving leads to increased savoir-gazing time and more gaze and gaze time.

Most scholars at domestic and abroad have focused on the human-machine interaction design and testing evaluation of the central control screen, while there has been almost no research on user high-frequency usage scenario library in dynamic scenario.

Therefore, this paper will screen out and identify high-frequency usage scenarios where users employ touch interaction in dynamic scenario.

3. Research Route

Firstly, we will conduct extensive data collection and organization on user usage scenarios through various means such as research reports and literature reviews. This will help us gain a comprehensive understanding of how users interact with different technologies and devices in various contexts.

Next, we will carry out user research on a sample size of over 100 users through survey questionnaires. This research will include users of different genders, age groups, driving experiences, driving personalities, and occupations to ensure that the research results can truthfully and comprehensively reflect the actual needs and preferences of a broad range of users.

When selecting survey participants, we will consider multiple dimensions to ensure broad coverage of the sample:

(1)Different genders: Men and women often have different driving habits, concerns, and needs. Therefore, we will ensure that both male and female users are adequately represented in the survey.

(2)Different age groups: Age is a significant factor influencing driving behavior and needs. From young novice drivers to experienced senior drivers, each age group has its unique driving characteristics and requirements. We will select users from various age groups to obtain more comprehensive data.

(3)Different driving experiences: The length of driving experience is often closely related to driving skills, experience, and confidence. Therefore, we will include users ranging from those who have just obtained their licenses to seasoned drivers with many years of experience to understand the differences in usage scenarios and needs among users with different driving experiences.

(4)Different driving personalities: Some users are more cautious and steady when driving, while others are more aggressive and adventurous. This difference in driving personality also affects users' usage scenarios and needs. We will identify users' driving personalities through relevant questions in the questionnaire and conduct in-depth analysis based on this information.

(5)Different occupations: Occupational backgrounds often determine users' daily travel needs and driving habits. For example, business professionals may require more navigation and meeting scheduling functions, while freelancers may focus more on entertainment and comfort. Therefore, we will select users from different occupational fields to obtain a more comprehensive user profile.

Finally, we will utilize descriptive statistical methods to organize and analyze the collected data. Through this process, we will screen out and identify high-frequency usage scenarios where users employ touch interaction. Based on these findings, we will develop test cases that accurately reflect the typical usage patterns of users, ensuring that products and services are designed to meet their needs and expectations.

4. Result Analysis

4.1. Research on Relevant Standards and Regulations

Based on the research of standard regulations, such as “E-NCAP 2026 Road map, General Driving Controls Protocol: Safe use of general controls.”, “NHTSA-2010-0053 Guidelines for Reducing Visual-Manual Driver Distraction during Interactions with Integrated, In-Vehicle, Electronic Devices.”, “T/CSAE 334-2023 Safety test and evaluation methods for touch screen interaction in automobile cockpit.”, “China Intelligent-connected Car Assessment Programme (C-ICAP) (Version 2024) - Detailed Rules for Assessment of Smart Cockpit”, “An Evaluation Method for HMl Scenarios in Intelligent Connected Vehicles.” Based on the research of standard regulations, research reports, domestic and foreign evaluation systems, and literature materials, the statistical results are as shown in Table 1. The results show that the high-frequency use scenarios for touch interaction are mainly navigation, air conditioning, music, phone calls, radio, and settings.

Table 1. Research result on relevant stand

Research on Scenario Library	Navigation	Air Conditioning	Music	Phone	Radio	Setting	ADAS
E-NCAP 2026 Road map		√			√		
NHTSA-2010-0053	√	√	√	√	√	√	√
T/CSAE 334-2023	√	√	√	√	√	√	
C-ICAP		√			√		
An Evaluation Method for HMl Scenarios in Intelligent Connected Vehicles	√	√	√	√	√	√	

4.2. User Research

We issued 120 survey questionnaires and received 100 valid responses. The surveyed users covered different genders, age groups, driving experiences, driving personalities, and occupations. The survey results are shown in Fig. 1.

The research results indicate that the high-frequency touch interaction scenarios in dynamic situations mainly include phone control, navigation, air conditioning control, music control, ADAS control, and radio control.

Among them, the high-frequency functions of phone control include call the specified contact number and answer the phone. The high-frequency functions of navigation include navigate to nearby parking lots, switch navigation announcement mode. The high-frequency functions of air conditioning control include adjust the air blowing mode, turn on the air conditioning, adjust the temperature and adjust the air circulation mode. The high-frequency functions of music control include play specified online music. The high-frequency functions of ADAS is activating the ACC. The high-frequency scenario for radio control is bookmarking radio stations.

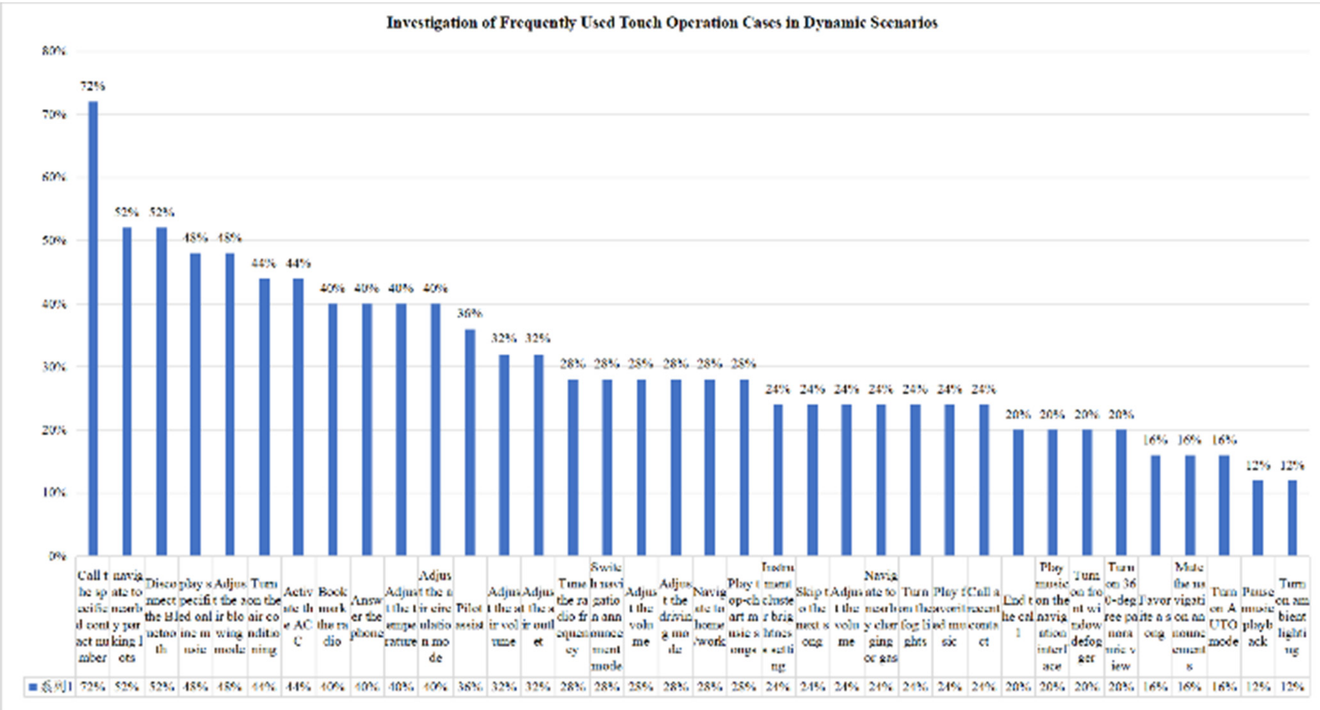

Fig 1. Investigation of frequently used touch operation cases in dynamic scenarios

4.3. Comprehensive Analysis

Through consulting standard regulations, research reports, domestic and international evaluation systems, literature, and other materials, as well as conducting user research, it has been found that the high-frequency scenarios for users' use of touch interaction in dynamic situations mainly include phone control, navigation, air conditioning control, music control, and radio control.

5. Conclusion

Through in-depth research into high-frequency touch interaction scenarios in dynamic environments, combined with touch interaction testing and evaluations within these scenarios, we can conduct a comprehensive assessment of the touch interaction design in vehicle cockpits. This comprehensive evaluation not only helps to uncover potential pain points and safety hazards that users may encounter during actual use, but also provides valuable feedback to enterprises, guiding their development and design processes and enhancing the user experience and market competitiveness of their products.

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