Design and Application of Automobile Intelligent Instrument Panel Interface

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Abstract. This article first investigates the functions and styles of automotive dashboards on the market, and summarizes some of the existing problems and user pain points. Combining emerging technologies and user needs, analyze the functions and technologies that are helpful to the driver, thereby improving the safety of the driver's operation. This research uses the user-centered design concept and explores the intelligent and humanized dashboard design to replace the display of the car's central control screen. The dashboard adopts an innovative form that combines a steering wheel and a game handle, which gives it a sense of technology and speed, and improves the safety and cognition of users.

1 Introduction

The car dashboard is composed of various normal data display and warning information etc., which provides the driver with the required car operation data [1]. According to the development history and working principle of automobile dashboard, it can be divided into three generations. The first generation is a mechanical instrument panel [2] (as shown in Figure 1); the second generation is called an electrical instrument panel [3] (as shown in Figure 2); the third generation is a fully digital automobile instrument panel [4] (as shown in Figure 3).

Figure 1. Mechanical instrument panel
Due to technical limitations, previous car dashboards have very obvious defects, such as limited display data, poor interaction experience, and inability to interact well with the driver [5]. The current car dashboard is undergoing the fourth revolution, namely the virtual smart dashboard [6] (as shown in Figure 4). The new generation of virtual smart dashboard displays richer and more user-friendly information than the original dashboard.

This research combines the future development trend of automobile dashboards, through integration and innovation, designed a virtual smart dashboard with good user experience.
2 The Development Status of Automobile Instrument Panel

2.1 Market status analysis
At present, the development of automobile dashboards has lagged far behind the advancement of science and technology. The styling design of the car is getting more and more beautiful, the performance of the car is gradually improving, and the intelligence of the car is also in full swing, but the design of the instrument panel has not changed much [7].

With the development of Internet technology, automobile dashboards are becoming more and more intelligent, high-end, and systematic, so that they can better meet the needs of the market. Through the fusion of Internet technology and advanced sensor technology, the perception accuracy of the car's surrounding environment is constantly improving, making the display content of the dashboard more digitized and accurate. By continuously improving the intelligence of the instrument panel, we can better serve the driver.

The proposal and implementation of the concept of "Internet of Vehicles" [8] has led to the rapid development of information technology in the automotive field. The combination of Internet technology and car functions greatly simplifies the display and operation of the dashboard, making the car's information processing more concise and more accurate.

However, in countries or regions where Internet penetration is not high, this emerging technology still has its limitations, resulting in insufficient competitiveness of informatized automobiles and low market share.

The informatization of automobiles has led to a sharp increase in the demand for electronic chips in the automobile industry, but most of the related electronic chip manufacturers are in their infancy. The general shortage of production capacity and lack of talents have caused a shortage of normalized chips in the entire automobile industry. This has become automobile intelligence. The constraints of transformation.

2.2 Survey summary
The instrument panel displays various parameter information when the car is running, and the driver can understand the working status of each part of the car through it. Despite the rapid development of modern technology, the car dashboard still runs counter to the "user-centered" design principle, causing most drivers to pay little attention to the information displayed on the dashboard. At the same time, it is also very unsafe for the driver to watch the dashboard while the vehicle is driving. The consequences may be even more serious if the car is driving at a high speed. But the driver has to pay attention to the dashboard, such as worrying about whether the driving speed is overspeed, the remaining amount of fuel and other information.

Through research, it is found that the current technology used in automobile dashboards has fallen far behind the development of contemporary information technology. Consumers need personalized dashboards, hoping to understand car driving data more accurately and quickly, so as to better assist driving.

This research takes this as an entry point and uses the "user-centered" [9] concept to design a dashboard that conforms to the trend of science and technology and the characteristics of the times.

3 Principles of Smart Dashboard Design

3.1 Design analysis
This design refines the most valuable functions and information for the driver and displays them in the dashboard, such as music, navigation, telephone, mode switching, voice recognition, and general information display (as shown in Table 1).
Table 1. Smart dashboard function.

| Form            | Features | Content                                      |
|-----------------|----------|----------------------------------------------|
| Dash Board       | Music    | Pause, Play, Radio, Volume increase and decrease |
|                 | Navigation | Speed limit reminder, Arrival time budget, Navigation route switch |
|                 | Telephone | Answer, Hang up, Contact person              |
|                 | Mode Switch | Sport mode, ECO mode, Normal mode            |
|                 | Frequently Used Display | Speed, Energy consumption, Normal display such as door switch reminder |
| Control Unit    | Steering Wheel | Up Down Left Right, OK, Return, Navigation, Voice input, Function custom area |
| Interactive Technology |                | Intelligbat wireless transmission technology, Light-sensitive, Voice input, etc. |

3.2 Design concept
Drivers observe the instrument panel more frequently than the central control screen, but the auxiliary functions of most models on the market are displayed on the central control screen, which affects the safety of the driver [10]. Some models even place the instrument panel above the central control screen. This design method requires an adaptation period for the driver, which increases the driver’s learning cost.

At present, most automobile dashboards only play the function of basic information prompts. This research improved the design of the original automobile instrument panel, and redesigned the control components according to the needs of the instrument panel.

3.3 Design goals
The design goals of smart dashboards are divided into three types based on user needs [11]: basic needs (must have functions), expected needs (needs put forward by users), and exciting needs (needs that exceed user expectations).

Basic requirements include speed, vehicle inspection, drive mode, tire pressure, etc. Expected requirements include communication, remote sensing, mode switching, navigation, speeding prompts, music, etc. Exciting needs include wireless sensor road detection, voice control, light perception, etc.

This practical project is designed according to the needs of users, and on the basis of ensuring the safety of drivers, we will try our best to remind users of the comfort experience.

4 Application Design of Smart Dashboard

4.1 Functional analysis
Based on user survey data and from the perspective of the driver, this research has clarified the functions of the smart dashboard (as shown in Figure 5). Through the analysis of the driver’s cognition and behavior, this research conducted a functional analysis of the steering wheel, the control component of the smart instrument panel (as shown in Figure 6).
4.2 Smart dashboard sketch design

The sketch adopts linear drawings. The dashboard interface highlights the ultimate sense of science and technology. The main content shows: the upper layer is the normal display area, the lower is the function switching area, and the left and right sides are water temperature, fuel consumption, speed, and speed (as shown in Figure 7).

| Left control zone | Up, Down, Left, Right |
|-------------------|-----------------------|
| Right control zone| Return, Confirm, Navigation, Voice input |
4.3 Steering wheel design

In order to cooperate with the instrument panel, this practical project designs the car steering wheel. The size of the steering wheel follows the size of the steering wheel of the existing models on the market. The steering wheel is redesigned based on the style of the sports car steering wheel, integrated into the game handle element, and is mainly composed of left and right function buttons (as shown in Figure 8).

![Steering wheel sketch](image)

**Figure 8.** Steering wheel sketch

The shape of the steering wheel is ergonomic, beautiful and easy to control at the same time. The driver does not need to re-adapt and can easily get started. The complicated operation of the traditional steering wheel is abandoned, and driving safety is improved. (As shown in Figure 9)

![Steering wheel control parts](image)

**Figure 9.** Steering wheel control parts

4.4 Smart dashboard interface design

The main interface of the smart dashboard is composed of four modules: mode switching, navigation, music, and communication, and each module contains some sub-functions. This article takes two modules of communication and music as examples.
The communication function is mainly used by the driver to make calls while the car is running. The car machine uses Bluetooth to connect to the mobile phone, and the driver can answer or reject the call through the control part on the steering wheel. The interface of the communication module is shown in Figure 10.

![Figure 10. Smart dashboard communication function interface](image10)

The music function is mainly for the entertainment of the drivers and passengers. Listening to music or radio is the cheapest choice for the driver to pass the boring journey. The control part of the music is also completed on the steering wheel. The interface of the music module is shown in Figure 11.

![Figure 11. Smart dashboard music function interface](image11)

4.5 **Steering wheel control component design**

In order to complete safe, efficient, and convenient operations in a moving car, physical buttons are indispensable. In order to cooperate with the control of the smart instrument panel, the steering wheel has been designed with multiple functions. The left side of the steering wheel is integrated with up, down, left, and right selection buttons, and the right side of the steering wheel mainly has four buttons for voice input, navigation, OK and return. (As shown in Figure 12)

![Figure 12. Multifunctional steering wheel design](image12)
4.6 **Smart dashboard display renderings**
The final display effect of the smart instrument panel is shown in Figure 13, and the effect of the multifunction steering wheel is shown in Figure 14.

![Smart dashboard renderings](image1)

**Figure 13.** Smart dashboard renderings

![Multifunctional steering wheel renderings](image2)

**Figure 14.** Multifunctional steering wheel renderings
5 Conclusion
This practical case is developed around the interactive design of the smart car dashboard. Using the user-centered design concept, the interface design of the automobile instrument panel, and the shape and function design of the multi-function steering wheel are carried out.

With the rapid development of the current automobile industry, with the rise of electric vehicles, automobiles are gradually transitioning to autonomous driving [12]. However, the dashboards and appearances of many traditional car companies still continue the original design, causing the car-machine interaction to lag far behind the development of technology. Looking forward to the future traditional car companies and new car manufacturers can provide consumers with a better user experience.

6 References
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