The In-Vehicle Information Interface Design Based on Internet of Vehicle Context

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***Abstract*—The relevant concepts and contents of Internet of vehicle, as well as the changes and trends of In-Vehicle information interface and the man-machine interaction mode, have been introduced in this paper. Under Internet of vehicle context, the new design requirements of interface information organization and vision design, as well as chances and challenges faced by designers in this revolution have been discussed, in consideration of the changes of vehicle interface design requirements, contents and methods.**

Keywords—internet of vehicle; interface; interactive; user-experience

I. INTRODUCTION

Mobile Internet is increasingly becoming one of the most basic elements in our life. The revolution of information technology（IT） is driving the design of automobile to reach a new stage. Based on deep integration of automobile and IT, especially mobile Internet, the Internet of vehicle is an important branch of Internet of things, and an important development direction of intelligent transportation in future, has the essence of interaction between people and car, car and car, car and road to solve the problems caused by traffic and society environment and make user become the center and provide safe, convenient and efficient service.

Under the Internet of vehicle, the interaction system in vehicle is a three-dimensional system, can meet the needs of users in different stages and dimension by using different products, such as BMW iDrive, OnStar, Gbook, sync, which include navigation, vehicle real-time dynamic information, risk alarm and other services. After leaving the factory, you can install portable products in the vehicle or make use of non-installed portable products.

AS predicted by AT&T Glen.Lille that the car will eventually become a smart phone with wheels. The Internet of vehicle revolution will begin in 2014. The future-oriented interaction system in vehicle based on Internet of vehicle environment should be provided with more options and well experience, of which the UI should be designed with more changes in aspects of design requirements, design content, and design method, which makes more opportunities and challenges for UI designers and more efforts to explore perfect connection of driving experience and digital life.

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II. CHANGES OF UI CARRIER AND FORMATS

From the point of view of vehicle history, in early vehicle information mainly was displayed by mechanical instrument and hardware interface, after vacuum fluorescent display was applied to vehicle interface, mainly by hardware interface and character UI. The two stages both have common characteristics that are simple function, low accuracy, a small amount of information. With liquid crystal display applied in vehicle, the non-physical digital graphical UI has gradually replaced the mechanical instrument and hardware interface, and became the mainstream of modern vehicle. At present, the visual design of digital interface is mainly concentrated in liquid crystal display screen of instrumentation and control. The latest vehicle interactive interface is said as head up display (HUD) that can display graphics and text information of vehicle on windshield glass in form of a head-on perspective, which makes driver access to relevant information without transferring vision and improve driving safety. The existing technology of HUD is projection imaging, such as Peugeot has integrated HUD display system in production vehicles, of which a transparent polycarbonate plate in windshield can receive projection image. Similarly, at present most HUD systems transfer road information of vehicle from instrument panel and center control to a character UI with transparent material at eye level. In next step, the information and live-action will be highly integrated to enhance interaction interface, which relies on Internet of vehicle and big data, the transparent display will also replace projection. In summary, the history of vehicle interactive interfaces successively include mechanical instrument and hardware interface, digital interface of touch liquid crystal display screen, transparent screen of enhancing live-action. Now these interactive interfaces are complementary and coexist, in future will develop to multimodal interfaces, such as voice interaction instead of manual operation which supports gesture and body sense control, even eye tracking interface similar to iron man.

III. UI FUNCTION DIVISION AND EXTENSION

The vehicle information interaction interface developed to the complex information system from a single model, which is driven by computer hardware and software and Internet technology development, and from experience and need of occupants. Vehicle information interactive interface can be divided into auxiliary driving (functional type) interface, entertainment (experience type) interface, vehicle internal and

external information interaction (functional and experiential) interface.

Aided-driving interface is mainly concentrated in dashboard region and HUD display area, which is also the most accessible and coverage area of sight (the vision scope under normal activities of eyes and head in normal driving position), of which information displayed plays a extremely important role in driving. At present, the interface of this area popularly is mechanical instrument plus digital display modules (driving computer) which is used to display various parameters and feedback vehicle condition to driver, comprises a driving information display including rotate speed, speed, water temperature, fuel consumption, and so on, and status information including lights, wipers, doors and windows, time, air temperature, safety belt, engine etc.. At the same time, whole digital instrument interface also is used in many vehicles, which can have more space to display more driving state and environmental information in intuitive graphical image, by means of Internet of vehicle, can become an information system interface integrated with environment perception, planning and decision-making, multi-class aided-driving etc..

In-car entertainment interface is a touchable LCD screen in center control area, typically 6 to 10 inches, mostly has physical keys for controlling. Therefore there are many physical buttons surrounding the screen, especially below the screen. While Tesla directly has 17 Inch touch screen with digital graphics interface completely replaces the physical buttons. In March 2014, Apple officially launched Carplay IOS system, without interference and cooperated with Siri, which can be used by the driver for navigation, playing music, sending and receiving information, calling and so on. Volvo has already equipped with the system which will change driving experience from now on.

The information interaction interface is in the sub-level display interface of instruments, HUD area and center control area, timely and automatically displays the vehicle state according to the user. Instruments and HUD area can display road navigation, tire pressure and temperature, the position of vehicle on road (level, slope, etc.), temperature area control, parking assist or automatic parking and other image information. Internet of vehicle can provide active safety early warning, such as alarm vehicle speed, vehicle distance information feedback, road traffic signal lamp information feedback, and real-time information of the front road and vehicle to make safety warning. The central control area can display and control equipments inside and outside of vehicle, such as Tesla's control interface which can control roof, lights, air conditioning, seats, chassis model, etc.. The interaction interface of this area likely includes four function modules: Travelling Service (positioning, map, navigation, search around, intelligent real-time traffic planning, etc.), security services (online condition detection, feedback condition, periodic or fixed mileage, remote fault diagnosis, road rescue, anti-theft alarm and tracking, etc.), life service (illegal information feedback, booking service, maintenance reminders, on behalf of the drive, gas station location and queuing time information, parking information, Social Networking Services), intelligent office (voice or video conferencing, document processing, mail, etc.).

Furthermore, based on Internet, the vehicle interaction system can be correlated with mobile handheld devices. Therefore you can have vehicle information timely sent to mobile phones, such as parking position display, remote emergency opening and control and so on.

IV. Information Organization and Vision Design of Interface

A. *Interface of Aided-Driving*

Driving a car is a complex task which demands synchronously deal with a large number of information related to driving, and includes three levels of plans, strategies and the manipulation and more than a thousand independent tasks. So the aided-driving interface of instruments and HUD area is particularly important. Digital graphics interface greatly increases information displays in this area, therefore, on the one hand, the driver can obtain relevant data and traffic information to improve safety according to need; on the other hand, a large amount of information pouring into driving space will also increase cognitive load of drivers and make interference to bring security risks. Because the interface of this area is facing to complex human-computer interaction situation, it should be mainly display driving information closely related to driving process, to information directly and accurately, the level of clarity, with objects of aided-driving, driving safety and facilitating driving.

Aided-driving interface information should be organized according to importance of information, in order to strengthen the main information and reduce cognitive load. Some interface space can set display content and method by users based on using frequency and attention. For example, it is concerned about the instantaneous fuel consumption by some people, while some people pay more attention to mileage; the data is displayed in a graphical way or in digital characters with different preferences for different users. In the main interface, the final display amount of information should be controlled; while the adjacent information in display interface should be grouped according to types and also be emphasized and weakened according to vision design. Generally in order to distinguish primary and secondary in a same level, color, brightness, and distance from visual focus are used.

The visual design of aided-driving interface should be focused on reducing cognitive load and enhancing security. In addition to strengthen important information, it should also pay attention to information interaction efficiency, such as the recognition, accuracy and consistency of graphics and character information transfer. Additionally, visual design also needs to deal with complex interactive situations which are caused by internal and external environment changes, such as light, weather, traffic, environment. Therefore the interface will regulate display color or brightness and other modes according to these changes. In general, the structure and the most vision design of aided-driving interface are suitable to use flat, rational design style. In aided-driving interface, it is important that rotate speed, speed, temperature and the fuel

consumption and other information displayed by instrument panel which are displayed by graphical interface in some vehicles, such as using numbers and lines to indicate speed, however the traditional circular instrument is still the mainstream. As shown in studies, it is more easily to perceive the relationship between data and whole that using circular instrument, and makes driers focus on a small view to obtain efficient information and reduce distractions. From the point of interface design details there are some aspects need pay attention to including location, shape, size, color, space environment, pointer color, shape (depended on indicating accuracy) and layout of instrument panel, improving cognitive efficiency decreasing color stimulation, fatigue, creating high-tech sense through the design of materials, light, color, giving drivers better visual experience.

B. *Entertainment Interface and Internal-External Information Interactive Interface*

There is a large amount of information in entertainment interface and internal-external information interactive interface, which involves many dimensions, most of which are located in central control area. Also there is a small amount of traffic state information located in the sub-level of instrument interface area, such as that display content changes of instrument panel automatically according to road conditions or environmental changes, the display interface of relative relationship between vehicle and road when vehicle body is tilt caused by climbing, or a alarm combination of dynamic graphics flicker and voice when partial failure such as too high tire pressure and temperature. In addition the display dimensions of this interface information should use flattening simple graphic symbols; the text information should use recognition font with concise text to show the core information and reduce information dimension.

The interface of central control area is usually multi-level structure under the main interface, which is complex and full of functions. This interface should be not directly occupation of drivers vision, or display refining information in a large are interface which can be seen by the driver in a quick sight. Of course, it is a good way to exchange information through voice, such as Siri of CarPlay, of which the recognition accuracy is to be improved. Some simple interface interaction can also be made by voice at a traffic jam or low speed, such as a function of interaction with the vehicle body. In Tesla the virtual interface has completely replaced the physical buttons of skylight, lights, air conditioning, seat and the chassis model. The quasi physical interface elements with high-definition images can be used in this area to display three-dimensional virtual state of vehicle, through controlling virtual vehicle body to achieve interaction and control, which is more visual and can improve interaction experience of users. Reversing image and parking assist interface generally are located in the area and should consider the relationship between image, character and real view. Entertainment and Internet of vehicle interface are the interface with a most amount of information in this area, which is can be used generally only when parking, and long traffic jams, or by passengers, has a lot of common points with mobile internet terminal interface, can be designed on the base of mobile internet terminal interface and pay attention to vehicle situational characteristic, and should be consistent with the main interface and in-car style.

C. *Interface Experience*

It is the first object of interactive interface to achieve interface visual experience which needs to pay attention to drivers' affection need and use interface technology, usability and high efficiency to enhance security sense of users. The interface design based on user-friendly can make user feel humanistic care and enhance product quality. The image and style of interface can express brand concept of products and improve brand recognition and acceptance. Furthermore, in order to meet different users, different interface design should be done in different vehicles. Then the characteristics of different groups should be studied to customize the exclusive interfaces. Now Google self-driving car has travelled more than 30 million miles. Perhaps, when Internet of vehicle and intelligent traffic system have developed to a considerable height, automatic driving system will liberate user completely from driving; vehicle interface will more display Internet application related to our life to provide a better experience.

V. CONCLUSION

From the day when car was born more than 100 years ago, it has never stopped to develop intelligent in car of which the interactive interface has been becoming more and more user-friendly from adaption of machine. Now vehicles are gradually becoming an interactive space collected with information acquisition, communication, communication and entertainment from a machine with the single function of vehicle utilizing. The new interactive technology and interactive platform will make the future car into a more secure, convenient and comfortable means of transport. With the advent of the era of big data, more intelligent online vehicle systems, user-friendly digital interface integrated more features will become a new trend in future.

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