Review of human-computer interaction in mechanical engineering

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Abstract. Under the rapid development of human-computer interaction technology, the human-computer interaction of mechanical engineering will develop more rapidly. This paper first clarifies the development history of human-computer interaction in mechanical engineering; This paper analyzes the research hotspot of human-computer interaction in mechanical field and the existing problems of human-computer interaction in mechanical engineering in China. Finally, some ideas for human-computer interaction design of mechanical engineering are provided by sorting out and summarizing relevant research literature. This paper aims to bring new thinking and reference for the development of mechanical engineering technology and equipment by analyzing the research on human-machine interaction in mechanical engineering.

Keywords: Mechanical engineering; Human-computer interaction; Intelligent; Design

1 Introduction

In recent years, artificial interaction technology has been rapidly developed, it has been applied to our daily life, such as machinery industry, manufacturing industry, transportation industry, medical treatment, government office and many other aspects, whether people can form a good interaction and cooperation relationship with intelligent system will directly affect the user experience, but also affect whether the ability of intelligent system can be greatly exerted. The human-computer interaction system we have now has the capabilities and characteristics of autonomous learning, autonomous decision making, active interaction, situational awareness, etc[1]. When the system develops to autonomous action, the former man-machine relationship mode of "stimulus-response" will change, so the man-machine behavior mode must be considered as a whole[2].

Machinery manufacturing industry is one of the main industries in China, and its development level is an important symbol of modernization. The rapid development of mechanical engineering requires advanced technology and equipment. The new demand for mechanical engineering technology and equipment continues to increase, to ensure the quality, safety and efficiency of products, and to adapt to the trend of

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world development, to meet the market demand for expanded production, and to increase the competitiveness of products in the market. To sum up, the analysis of human-machine interaction in mechanical engineering will bring new thinking and challenges to the development of mechanical engineering technology and equipment.

2 The development of human-machine interaction in mechanical engineering

Human-computer interaction is a multidisciplinary field of computer, ergonomics, engineering psychology, cognitive science, etc., which was formally proposed in a professional form in 1980[3]. Since the end of the last century, this concept has been rapidly popularized in many fields. However, there is no consensus definition, which can be divided into the following two categories: (1) Human-computer interaction is a discipline that studies the design, evaluation and implementation of interactive computing systems for human use; (2) Human-computer interaction refers to the design, implementation and evaluation of interactive systems under the user's work tasks and environment. The man-machine interaction of mechanical engineering mainly goes through the following stages: early manual operation stage, operation control language and command interaction language stage, graphical user interface stage, network user interface stage[4]. With the development of science and technology, we are now entering the era of the Internet of Things, which needs to meet the diverse and complex needs of customers, especially those with less user experience. The natural user interface is designed according to the user's psychological model. People with less experience in the use of equipment interact with the computer just like interacting with people and the real environment. There is no need to deliberately memorize related program functions, which can greatly reduce the memory burden and use cost of users. In the past, many machines were very complex and had interface functions that were difficult to understand or required knowledge to use. At present, human-computer interaction is developing in the direction of anthropomorphism, intelligence, naturalization and materialization, which will greatly facilitate users to quickly understand the operation method of machinery[5].

3 Research hotspots of human-computer interaction in mechanical engineering

3.1 Adaptive user interface

The user interface ADAPTS to the needs of the operator according to its own performance during mechanical use. The adaptive domain of human-machine interaction in mechanical engineering has two forms, namely adaptive system and adaptive system. The former can adapt to different needs of users by increasing operation options or allowing users to customize the operation interface, but it will increase the difficulty of software design and require more memory; The latter can change the presentation of

the system interface to meet the needs of users through the operation characteristics of users. At present, there are two kinds of theoretical model research on adaptive user interface[6]. One is based on user characteristics and user model construction; One is based on operational task modeling to assist users in completing tasks. The two models have their own advantages and disadvantages. The former model based on the characteristics of all users has not reached a unified result so far. Because the latter model is only aimed at a certain task, it has great limitations and is very difficult to popularize[7].

3.2 User interface of multi-channel multimedia

Multichannel user interface refers to the user interface that people can interact with computers through different senses, such as vision, hearing, touch, kinesthetic, expression, eyes, and even neural input. Multimedia user interface enriches information through different forms of presentation to improve the efficiency of user perception of information. At present, the human-computer interaction in the mechanical field is mostly through the hand. With the continuous development of technology, interactions such as eye tracking, gesture recognition and natural language understanding have become more and more research hotspots in related fields. Especially in speech synthesis and handwriting recognition, practical goals have been achieved. For example, according to the report of Tesla, the company will pay more attention to the interaction between people and cars in the future research and development of electric vehicles. In terms of user interface, it is not only the way to operate the central control screen by hand, but also the goal of future research and development is to realize the purpose of operating the car by means of eyes, language and even nerves[8]. What should be noted here is that the multi-channel user interface uses a variety of sensory channels and action channels to interact with the computer system in a parallel and imprecise way, which can give play to the unique advantages of each channel. This is an efficient and low-load interaction mode, which is as simple as people's communication with each other. However, in the field of mechanical engineering, there is little research on how to integrate information from different channels into a consistent semantic information.

3.3 Virtual Environment

Virtual environment is computer technology as the core and combined with other science and technology, its goal is to achieve a digital environment highly similar to the real environment. Users interact with the virtual environment by using the corresponding equipment, so as to produce the feelings and experiences corresponding to the real environment. This technology has not been widely used in the field of mechanical engineering, but with the continuous development of technology, the trend of widespread application in the future will be more and more obvious. In July 2015, for example, the VR short film Henry added "interactive" scenes with the audience, changing the completely passive experience of the past. As for some medical machinery, the purpose of remote surgery can be realized through virtual environment technology and other related technologies[9]. In addition to the mechanical field, the future virtual environment technology can be widely used in urban planning, interior design, indus-

trial simulation, historic site restoration, bridge and road design, real estate sales, tourism teaching, water conservancy and electricity, geological disasters, education and training and many other fields, truly usher in the era of human-machine natural harmonious interaction of the Internet of Things.

4 Problems in human-computer interaction of mechanical engineering in China

4.1 Low technical level of the equipment

China's mechanical engineering human-computer interaction technology research started slowly, compared with foreign countries and regions, related products and technology generally lag behind about 10 years, most small and medium-sized enterprises backward technology and equipment, but also lack the corresponding talent or the introduction of new technology and equipment ideas. The overall performance is that the diversity of products is low, the processing of products is insufficient, the production efficiency of products is low, the added value is low, and the benefit of the final enterprise is low. At the same time, because the technical level of the equipment is low, it will be limited when doing mechanical human-computer interaction. This greatly restricts the development of human-computer interaction in mechanical engineering in China. Therefore, improving the technical level of equipment in the field of mechanical engineering as soon as possible is a key task in related fields in the future[10].

4.2 Poor set and few types

For example, in our country, the current seed processing machines in the agricultural field are still relatively backward, the operating level is not high, and some products are of poor quality[11]. Compared with the advanced level of foreign countries, there is still a huge gap in the quality, reliability and stability of relevant machinery and equipment. In economically developed countries, the seed industry has become a new industrial sector closely related to agriculture, with relatively good seed cultivation, processing and dissemination systems, and there is a tendency for seed processing to change from a machine to a factory. This involves the interaction between people and seed processing equipment, and the user can achieve extremely high efficiency production by operating the seed processing equipment. In China, similar processing equipment is less and of poor quality. It can be seen from the seed processing machine that the complete set of Chinese machinery and equipment is poor and the types are less. Through the human-computer interaction technology of mechanical engineering, multiple devices can be assembled into an integrated device, thus solving the problem of poor complete sets of mechanical equipment in China.

4.3 Backward mechanical process and manufacturing means

Most foreign machinery manufacturers have adopted computer-aided design and production computer-aided manufacturing, so as to achieve the purpose of human-computer interaction and improve the accuracy of machining[12]. Generally speaking, the average mechanical equipment only needs one or two operators to complete the task, which greatly reduces the labor cost. China is now entering an aging society, the labor force is greatly reduced, and it is one of the future trends to reduce labor costs through the extensive application of human-computer interaction technology. Therefore, it is necessary to complete the upgrading of the mechanical process as soon as possible and optimize the manufacturing method to achieve the good operation of the equipment.

5 Design ideas for human-computer interaction in mechanical engineering

As mentioned above, the interface of a human-machine system refers to the part that the user can see or touch. Examples include radio buttons, information boards on airplanes, or power control rooms. The design of the human-machine interaction interface should fully reflect the user's understanding of the system and ensure that it is easy to use or use. The purpose of improving the degree of artificialization of mechanical equipment is to facilitate the machine to adapt to the needs of users and enable users to better interact with the machine.

5.1 Human-computer interaction in function operation area

Functional operation area is the key area of human interaction, it must have certain flexibility and reaction speed. When designing, we should consider the requirements of human motor organs and visual organs. In the future, according to needs, other sensory organs need to be considered. For example, vr technology should consider people's hearing, touch, and movement characteristics, etc., otherwise it will greatly reduce the user's experience effect. For example, the design of the foot pedal should consider the human body shape, and the height should be 20 cm[13].

5.2 Man-Machine Interface of the operating system

The connection between man and machine is a means of transmitting and exchanging information, and it is also a way of dialogue between users and machines. Human-operated input devices such as handles, switches, commands, etc., and mechanically operated active output signals such as faults, warnings, etc. These "inputs" and "outputs" are carried out between mechanical devices[14]. Therefore, when designing the operation interface of human-computer interaction, it is necessary to consider the user's view of the operating system, so that it conforms to the display of the system obtained after completion, so that the user is satisfied with the system and can effec-

tively use the system. Therefore, only by understanding the user's situation can we analyze and correctly judge the needs of users and carry out design.

5.3 Consider typical problem design in interface design

The following elements must be considered in the design of human-computer interaction: system response time, user support, error message handling, and the manner in which instructions are issued. According to previous experience and related research results, the reaction time of the system is the most complained about by users[15]. Therefore, it is best to use a comprehensive system in the design to improve the efficiency of users. At the same time, to avoid the user need to contact a lot of irrelevant information; Error and warning messages must be clear and accurate.

6 Conclusions

With the rapid development of artificial intelligence technology, human-computer interaction in mechanical engineering will develop more rapidly. However, the intelligent system applied in the mechanical field is far from mature, so how to promote human-machine intelligent collaboration has a broad research space at present. This paper first clarifies the development history and research hotspot of human-computer interaction in mechanical engineering. Then the problems of human-machine interaction in Chinese mechanical engineering are analyzed. Finally, some ideas for human-computer interaction design of mechanical engineering are provided by sorting out and summarizing relevant research literature.

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