Study on the Aging interactive System of Harbin Subway under the background of COVID-19

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Abstract: Three years into the global COVID-19 outbreak, mental and spiritual challenges to the older population. The design of road facilities and guidance system related to the daily life of the elderly is not perfect, and it is urgent to solve the aging related design problems, so that the elderly feel more care from the society in the old life. Harbin is the first city in China with an alpine subway system, and the subway is the main place where the flow of people is concentrated and the necessary facilities of the city. Through the questionnaire survey of the elderly passengers, the field survey of the subway and the data analysis, the aging characteristics of the elderly, which are caused by the constant change of age, are analyzed. This paper analyzes the problems and deficiencies of the existing aging design of Harbin subway station and the regional cultural characteristics of Harbin subway, and matches the environmental design and visual design to meet the home consciousness and psychological needs of the elderly in Harbin. The interaction design principles of Harbin subway guidance system under the epidemic condition are summarized and summarized. This is the necessity of designing meaning for the older age group. From the visual guide information design and guide information icon symbol of Harbin subway guide system design, the design of guide system logo usability, the application of emergency special guide system, barrier-free guide application status and the aging design analysis of subway station during the epidemic period are carried out.
Key words: Interactive system; Harbin Metro; Aging design;COVID-19

With the development of the country, the scale of the urbanized population is accelerating, which is not only the economic development, but also accompanied by most urbanization problems, among which the traffic problem is the biggest problem. With the improvement of urban development level, urban rail transit has stepped into the process of modernization. Urban rail transit not only provides convenience for people's travel, but also reflects the level of urban infrastructure construction. Through the scientific management of urban rail operation, the ground traffic congestion is alleviated, and it is widely used in urban traffic because of its fast, convenient, environmentally friendly and efficient characteristics [1]. The birth of underground rail transit has solved the traffic problem of modern cities. The subway is playing an increasingly important role in the urban public transportation system and has gradually become the symbol of the urban context. The rapid construction and development of metro rail transit has brought great convenience to people's travel, but there are still many problems in the operation and management of urban rail transit, which need to be paid more attention to. At present, the extra needs of the elderly are still not well taken care of. Especially in these three years of COVID-19.For example, the improper arrangement of subway guidance system has caused trouble and wasted time for elderly passengers. At present, the steps of the subway system, such as guiding, buying tickets and scanning the code to enter the station, are increasingly modernized and technological. Due to the deterioration of the elderly's vision, cognitive ability, slow reaction and weak acceptance of new things, the elderly feel unfamiliar with the use of intelligent products, which further increases the difficulty of travel for the elderly [2]. People are constantly stressed the importance of interaction design at present, and how the interaction design combined with metro advertising system optimization is an important content of we build the subway advertising system, for interaction design and the subway advertising system optimum design of ageing, is how to make through the role of interaction design subway advertising system to better service for the elderly passengers, the main direction of This paper studies and analyzes the existing subway guide system in Harbin, summarizes and analyzes the existing problems that the elderly passengers have not solved, and puts forward the design of a new guide system suitable for aging.

I.   OVERVIEW OF INTERACTION DESIGN AND GUIDE SYSTEM

1.1 Overview of interaction design

Interaction design is the field of design that defines and designs the behavior of artificial systems. It defines the content and structure of communication between two or more interacting individuals so that they

cooperate with each other to achieve certain goals. Interaction design takes "embedding information technology into the material world full of social complexity" as its core, and strives to create and establish meaningful relationships between people and products and services. The objective of interactive system design can be analyzed from the two aspects of "usability" and "user experience", focusing on the people-oriented user needs.

Interaction may exist between people or between people and objects. Interaction design is a design method that sets user behavior and guides users to use it by planning information content, structure and presentation. Behavior, content and form are the three elements of interaction. Behavior is the framework of interaction process, determines the way of interaction, and is the core of interaction design. Content is the function provided in the process of interaction. It contains specific information and the organizational structure of information, which is the basis of interaction design. Form is the concrete basis of interaction realization, including visual, auditory, tactile and other procedural forms, is the specific content of interaction design.

With the development of computer technology, more and more operation instructions, more and more powerful functions. With the development of pattern-recognition input devices, such as speech recognition and Chinese character recognition, operators and computers can interact at a natural language-like or restricted natural language level. In addition, human-computer interaction through graphics also attracts people to study. These human-computer interactions can be called intelligent human-computer interactions.

User experience and human-centered design are the core of interaction design. Interaction design connects people and products, behaviors and actions. The starting point of interaction design is the user's needs. Through user research, user needs and pain points are analyzed, and practical and targeted functions are proposed. Interaction design is to guide the process of functional design and reasonable design behavior, so that users can operate more naturally and smoothly, and the interaction between users and products is closer to the sense of freedom between people, rather than the interaction between people and cold machines or products. At the same time, interaction design is also about action feedback. When the user issues a series of actions, we need to receive action feedback so that we can better tell us what to do next. Good interaction design can guide the user in a very natural state, allowing the user to receive feedback on the actions. However, whether interaction design is designing behavior or designing feedback, it is user-based. It follows the user's habit, according to the user's goal and scene, designs the operation behavior which conforms to the mental model and logic, designs the function which is easy to use and easy to learn. Interaction design is always designed around users, and its foothold is also user experience. Therefore, at its core, it is about users and human-centered design.

Alan Cooper, an American interaction design expert, defined interaction design as the behavior of artifacts, environments and systems, as well as the design and definition of appearance elements that convey such behavior. The concept of interaction design not only pays attention to the design of the product itself, but also pays more attention to the user behavior in the environment and system. Taking the actual needs of users as the fundamental starting point and foothold, it is a reorientation of the relationship between product design and users. Especially in the modern society with increasingly developed Internet information technology, the system can provide people with more abundant information, and even provide users with scientific, reasonable and tailored suggestions with the help of artificial intelligence technology, so that users can feel better service experience and meet or even exceed users' expectations for products [3].

1.2 Overview of subway guide system

The guide system is an information interface system which integrates the relationship between environment and people. In a specific environment, through the signage, text or symbol with clear meaning, in a certain color, constitute a complete system, for the user to determine the direction and path selection to provide reference and guidance. In many cases, it embodied in the individual modelling of identity, is now advertising system has been widely used, in modern business, public facilities, urban transportation, community public space, such as advertising is no longer a single isolated design or simple sign, but the integration of brand image, landscape architecture, system design of the traffic node, information function and even the media interface.

In the subway system, the guidance system usually includes the positioning system (such as various station entry and exit signs), guidance system (such as subway line map), advisory system (such as station perimeter map) and safety warning system (such as platform fall warning) [4].

Subway interaction is the relationship between passenger and advertising system, based on the user as the center, design the passengers and the interaction between the advertising system, using the human-computer interaction technology, from visual and auditory strengthen advertising system functionality, integration, interaction and advertising system guide is to help passengers through advertising system depending on the target.

II.   DESIGN AND ANALYSIS OF HARBIN ALPINE SUBWAY

Harbin Metro vehicles adopt modular design, more reasonable structure, more convenient operation, is conducive to the daily repair and maintenance of vehicles. Secondly, higher requirements are put forward for

each system of the vehicle. It is the first real cold-resistant subway car in China, and it is also the first vehicle to realize the equidistant arrangement between the doors of a single train in China. At the same time, the vehicle adopts the international mature traction drive system, which has been widely used and has high reliability. In addition, the subway trains use the world's advanced network control system, which integrates train monitoring, diagnosis and control functions, and the products meet international standards. The brake control system adopts distributed brake control mode, the basic brake device adopts tread brake, and the design mode of centralized interface with bogie is adopted for the first time. For the first time, the braking system adopts the internal network structure of 6 vehicles as a unit, which makes the braking control speed faster and is not constrained by the vehicle network system. The advanced passenger information system is adopted to realize the flexible station reporting function and provide a good alarm call function between passengers and drivers. The following is the picture of the current situation of Harbin subway and the actual use of subway interactive system equipment (Figure 1, 2, 3, 4, 5). The font size of the line diagram and the display screen in Figure 1 and 2 is too small for the elderly to see clearly; the color of the guide board in Figure 3 is not easy for the elderly to identify; the font size of the self-service ticket machine in Figure 5 is too small for the elderly to operate and it will be difficult for the elderly to operate. It can be seen that the current Harbin subway interactive system equipment is not designed to take care of the elderly population.

| Figure 1 | Figure 2 | Figure 3 | Figure 4 | Figure 5 |

III. ANALYSIS OF POPULATION AGING

3.1 China's aging population analysis

Since entering the new period, China's urbanization rate has been steadily rising at an average annual rate of about one percentage point. According to the Seventh National Population Census Bulletin published by the National Bureau of Statistics, China's urbanization rate has reached 63.89%, which has reached a high level. However, at the same time, the population aged 60 and above accounts for 18.70%[5]. The aging of the population has deepened.

On May 11, 2021, the National Bureau of Statistics released key data from the seventh national census at a press conference of The State Council Information Office. Among the national population, 253,383,938 were aged 0-14, accounting for 17.95%; The population aged 15-59 was 894,376,020, accounting for 63.35%; The population aged 60 and above was 26,4018,766, accounting for 18.70%, among which the population aged 65 and above was 19,063,280, accounting for 13.50%(Table 1). Compared with the Sixth National Population Census in 2010, the proportion of population aged 0-14 years increased by 1.35 percentage points, the proportion of population aged 15-59 years decreased by 6.79 percentage points, the proportion of population aged 60 years and above increased by 5.44 percentage points, and the proportion of population aged 65 years and above increased by 4.63 percentage points [5].

Age	Amount to	Percentage(%)
0-14	253383938	17.95
15-59	894376020	63.35
60-	264018766	18.70
65-	190635280	13.5

Table 1 Data of the seventh National Census

3.2 Analysis of population aging in Harbin

The registered elderly population in Harbin has reached 1.972 million, accounting for 20.7% of the total population of the city, which is higher than the aging level of the whole province and the whole country. Harbin has a population of 1,009,854. Among the population of the city, 1,047,204 people were aged 0-14 years,

accounting for 10.46%; The population aged 15-59 was 6,762,590, accounting for 67.56%; The population aged 60 and above was 22,060, accounting for 21.98%, among which 1,466,109, accounting for 14.65%, were aged 65 and above (Table 2). Compared with the sixth National Census in 2010, the proportion of the population aged 0-14 decreased by 0.54 percentage points, the proportion of the population aged 15-59 decreased by 8.66 percentage points, the proportion of the population aged 60 and above increased by 9.21 percentage points, and the proportion of the population aged 65 and above increased by 6.56 percentage points. According to international standards, Harbin has entered an aging society [6].

Age	Amount to	Percentage(%)
0-14	1047204	10.46
15-59	6762590	67.56
60-	2200060	21.98
65-	1466109	14.65

Table 2   Data of the seventh Population Census of Harbin

It can be seen from the above that Harbin has entered an aging society. The eyesight of the elderly has deteriorated, the cognitive ability has declined, the reaction is slow, and the acceptance ability of new things is weak. As a result, the elderly feel unfamiliar with the use of intelligent products, which further aggravates the difficulty of the elderly travel. Subway is an important means of transportation for people to travel, so the aging subway guide system is particularly important.

IV.   AGING FIT DESIGN ANALYSIS OF HARBIN SUBWAY INTERACTIVE SYSTEM
4.1 Aging analysis of guide system

The subway guidance system plays a role in guiding and diverting passengers. In the actual investigation and research, the method of questionnaire survey is adopted, and the elderly passengers are asked to fill in the questionnaire. Among them, the elderly in the survey choose the elderly passengers who often take the subway. The age, gender and experience of the investigators are all in line with the target objects of this study. Through the questionnaire, it was found that with the increase of age, the physical function will generally decline. The weakening of basic metabolism is the aging of physiological structure, and the decline of body function is irreversible, which is referred to as the symptoms of aging (Table 3).

Age	Aging organs
20	Brain, Lung
25	Skin
30	Muscle
35	Skeleton
40	Heart, Eyes
50	Kidney
55	Listening,Intestines
60	Taste，smell
65	Voice
70	Liver

Table 3 Aging schedule of human organs

The common recessionary changes in the elderly are mainly reflected in the visual, auditory and action aspects of the guide system design. With the gradual increase of subway lines and the complexity of subway lines, there will be a variety of problems in guiding passengers in the guidance system, which will affect the travel efficiency of elderly passengers. At present, Harbin subway station guidance system has some details problems, such as: guide signs are unclear, the font or icon is too small. In terms of vision, the elderly with the growth of age, the lens hardening, ciliary muscle function, corneal diameter narrowing and flattening, these physical changes will lead to the elderly in reading near text need to be properly away from the clear, which is commonly known as "presbyopia", Due to the thickening of corneal endothelial cells and the smaller pupil, the sensitivity of the elderly to light decreases [7]. The distance between the signboards is too large, and the transfer station lacks barrier-free signs. The subway line indicator map, especially the comprehensive information indicator map, is very different from the plane design, which increases the reading difficulty of the elderly. The indicator map is not clear. The transfer station is a fast transfer channel from the ground point to ordinary passengers, which makes it difficult for the elderly to find the barrier-free transfer channel. After entering the station, the elderly cannot easily use the self-service ticket-buying machine, which causes the problem of difficult ticket purchasing. Especially for elderly passengers with visual impairments. In terms of hearing, the auditory system of the elderly naturally degrades with age, and the most common phenomenon is inhearing or deafness. The degenerative changes of the inner ear, vascular atrophy and so on, make the elderly to high-frequency sound capture reduced or even lost. The muscles and ligaments of the elderly are atrophy and stiffening, muscle strength is weakened, bone density is decreased, and bone elasticity and toughness are weakened, leading to frequent soreness of limbs, muscle fatigue, poor sense of balance, osteoporosis, and easy fracture. All these reasons will reduce the mobility of the elderly [7]. Harbin is the northern metropolis with the highest latitude and lowest temperature in China. Due to the heavy snowfall in winter in Harbin, the temperature difference between indoor and outdoor subway stations is large. Snow makes the road surface at the entrance of the subway station covered by snow and ice, and the road surface is too slippery, which brings great inconvenience to the elderly in and out of the subway station.

4.2 Analysis of psychological characteristics and design needs of the elderly in Harbin

As older adults age, they lose brain cells, brain volume and weight, cerebral blood flow and oxygen consumption, leading to a decline in the comprehensive analytical ability of the cerebral cortex, leading to a general decline in brain function. Such as memory impairment, especially recent memory loss. And as older people's perception and memory function deteriorate, so do their logical thinking skills. At the same time, cognitive dysfunction such as disorientation, language disorder and visual and spatial ability decline may occur. These reasons will cause the elderly poor sense of direction, can not clearly identify similar visual signs and other problems. Therefore, in the guide design should pay attention to the effective distinction of signs, appropriate increase the direction, location and other guide signs use frequency. In the senile nervous system decline or pathological changes, often accompanied by emotional ups and downs. Physically, it is manifested by different degrees of emotional changes, and the intensity and persistence of emotional experience are high. In addition, due to the decrease of their physiological function and the change of their social role function, the elderly will also show different psychological changes, often accompanied by negative emotions. Therefore, the design of the guide system should pay more attention to improve the density of the guide sign, but also to have simplicity and effectiveness. [7] In addition, the design should try to reflect the humanistic care and emotional temperature (FIG. 6).
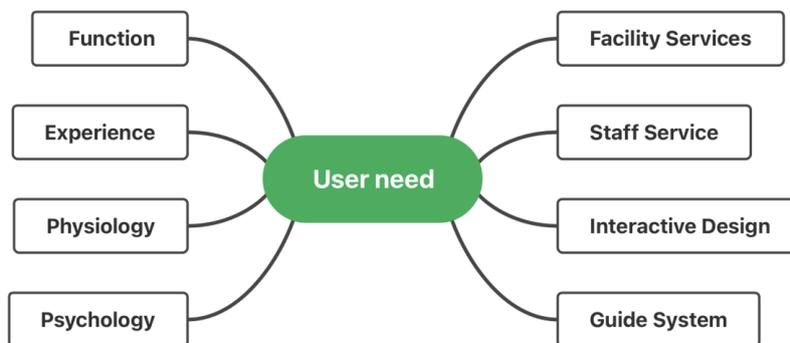

Figure 6 User requirement diagram

4.3 Aging analysis of subway stations during COVID-19

In the past two years, the global epidemic has been severe, but China has implemented strict prevention and control measures in the face of the epidemic. Through the efforts of local governments and medical workers, great results have been achieved, and the spread of the epidemic has been effectively controlled. To epidemic prevention and control, in order to better access to public places need to show your health code and stroke code as well as the body temperature monitoring, as an important transportation, travel and subway station personnel flow is big, clustering risk is big, so the subway station stricter sweep code temperature measurement, and because of that, many old people in the subway travel, because the older, They are not skilled in using smart phones to scan codes, or many elderly people are not equipped with smart phones, so it causes a lot of inconvenience for the elderly to travel by car.Under the epidemic policy, people need to go to the designated place for nucleic acid detection, which is usually set outdoors. Harbin is very cold in winter, so they need to wait in line outdoors for accounting, which is a big challenge for the elderly(figure 7,8,9).

| Figure 7 | Figure 8 | Figure 9 |

In the process of transfer, the guide system also plays an important role, so that the elderly can more convenient transfer through the guide system. By Harbin metro lines diagram were investigated, the museum station and the central avenue station is the site traffic is larger, and alternates with underground shopping mall, subway station and the fusion of underground shopping mall in and out of the subway line become more and more complex, so the elderly in the process of change will have a lot of problems, such as the traffic was too big can't see advertising CARDS, The direction of line change is not clear, the platform guide is not clear, the transfer station up and down the escalator and other factors, all lead to the inconvenience of the elderly travel.

V.   DESIGN IDEA OF AGING ADAPTABILITY OF HARBIN SUBWAY INTERACTIVE SYSTEM

5.1 Aging design of guide system

The age-appropriate visual guide information must make the elderly passengers first notice the existence of the sign, and then continue to recognize the guidance information of the sign. Therefore, the attraction ability of the sign is the key factor to determine whether the elderly passengers can pay attention to the sign, which is mainly affected by the size and color contrast of the sign. In terms of color perception, with age, the fibers of the elderly lens harden and become darker, yellow or amber. After filtering the blue and green spectrum, the amount transmitted to the retina decreases, leading to a decline in the brain's ability to recognize blue and green. Therefore, the color vision characteristics of the elderly should be analyzed and summarized.

Due to loss of vision in the elderly, so, in the subway advertising system design should be appropriate increase advertising text font size so that the elderly after adjusting the distance reading, advertising system should choose should choose bright color, strong contrast of the text to highlight mark content, through the analysis of figure 3 summarizes we get the conclusion, orange, yellow and white is the visual highlights the elderly, Therefore, orange, yellow and white colors were used in the design of the color selection of the guide logo. Attention should also be paid to appropriately increase the color saturation to avoid excessive use of the elderly eye. In terms of light adaptability, the elderly showed decreased ability to adapt to light and dark, whether from light to dark or vice versa. So, guide to look illume respect should avoid to appear excessive light and shade change. For this kind of physiologic presbyopia, the lighting intensity should be appropriately

increased so that the elderly can read, and the color brightness of the text patterns in the design of the visual guide system should also be improved accordingly to cope with the deterioration of the elderly's visual ability.

In addition, the changes of visual system will cause the decline of contrast sensitivity in the elderly, so that the elderly's morphological discrimination ability is reduced, that is, it is difficult to distinguish similar text forms, small patterns, adjacent colors and so on. As the most important part of contrast sensitivity, color sensitivity can enhance the poor shape by strong contrast and improve the shape perception ability to a certain extent. Therefore, the design of visual guide system needs more reasonable color matching to help the elderly carry out effective recognition and visual protection. It is worth noting that due to the decline in transparency of the cornea and the lens of the elderly, vitreous liquefaction and other reasons, easy to cause retinal imaging changes, resulting in the illusion of light and shadow, that is, too strong side light will make the elderly blind glare and not easy to recover. Therefore, colors with too high brightness should be avoided. In terms of lighting, attention must be paid to avoid weak light and too strong light [7].

The age-appropriate signage of subway station can be in the state of hanging and electronic display screen to better present to the elderly passengers. In this case, attention should be paid to reduce the height of the signage appropriately to adapt to the sight of the elderly, and increase the density of signage appropriately to prevent the elderly from wasting energy due to the difficulty of finding the way. Since the position of the sign will also affect the wayfinding efficiency of the elderly passengers, the position of the sign plays an important role in guiding the entrance, turning point and exit. In terms of the distance between the sign positions, the sign density of about 20 meters is more conducive to the wayfinding efficiency than the density of less than 10 meters and more than 60 meters. Therefore, a reasonable arrangement of the placement of signs can play a better role, the role of the aging guide system can also be played to the maximum.

Ticket aging machine optimum design must first consider to vision and hearing loss in the elderly, the elderly is proficient in the self-service ticketing wit can system can't use, can be set into the old special ticketing system, through the display font size and color contrast to solve, can choose a larger size and bright colors to attract the attention of the elderly. Secondly, the sound visual guide information is also an important part of the design of the visual guide system, which is a supplement to the visual guide. Add the voice system for ticket purchase, so that the elderly can buy tickets without barriers through the voice system. It is necessary to increase the intensity of sound guidance appropriately to obtain sound guidance information accurately while ensuring the reduction of external noise. In the case of deaf patients, a complete visual signal is needed to complement the acoustic signal in the design. In the case of audio-visual obstacles, tactile and olfactory perception and direction guidance are needed to complete the environment perception. While providing tactile components and corresponding guidance systems, potential security threats should be avoided as much as possible, and barrier-free environment and additional directional AIDS should be provided [7]. Some elderly people are still unable to use self-service ticket machines and are used to using paper money. Manual ticket purchasing Windows can be set up to provide more convenient ticket purchasing channels for the elderly.

In the process of transfer, the decline in the function of the elderly motor system and circulatory system due to the aging of the body function, or the lack of mobility function caused by other reasons, common limb disorders, etc., have greatly increased the proportion of the elderly who need to use crutches, wheelchairs and other auxiliary tools. Harbin is located in the cold area of our country, the winter snowfall, when the outdoor temperature is extremely low, winter indoor and outdoor temperature difference is bigger, the pavement snow ice estuary metro subway, we use visual guide system for elderly passengers safe road, barrier-free access the boot process, barrier-free elevator internal should to the old design more easier to find the elevator buttons, increase the channel elderly passengers, It can greatly solve the problem of slow and inconvenient movement of elderly passengers. Seats or rest areas for the elderly can be set up in the underground commercial street with large flow of people, providing a warm and comfortable place for the elderly to rest in the cold weather of snow in winter, which is convenient for the elderly to rest at any time.

5.2Subway stations are designed to age during the COVID-19 pandemic

Affected by the epidemic in the past two years, all provinces, cities and regions in China have cooperated with the implementation of the national epidemic prevention policy and strictly implemented the policy. People must wear masks in public places, take their body temperature, and scan the travel code and health code to enter public places. The subway is more strictly enforced as a public place with a large flow of people. Most elderly passengers are not proficient in using smart phones to scan the code and measure the temperature, which leads to great inconvenience in travel. Therefore, a separate passage for elderly passengers can be planned for this part, and the staff can assist elderly passengers to scan the code and measure the temperature (Figure 10).Outdoor nucleic acid detection points can be set in the subway entrance, so as to avoid the elderly queuing in cold weather.
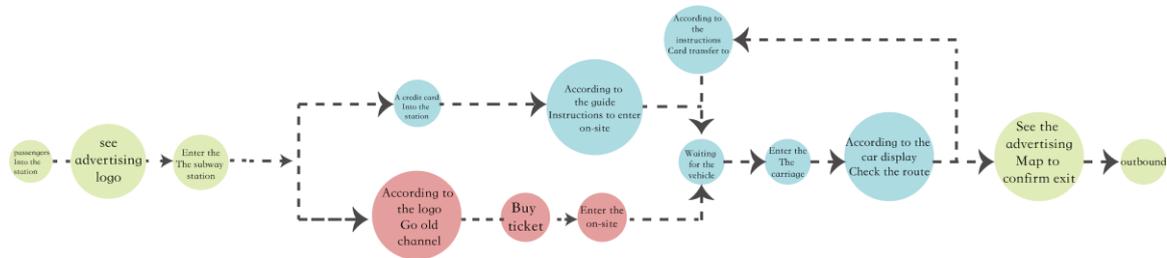
Figure10   Guide road map

In the process of transfer, especially in the stations with large flow of people, the guide board can be made into electronic or suspended above, eye-catching amplification for the elderly to watch, or on the ground for the design of guide signs, so that the elderly passengers more convenient to view, let them through the guidance on the ground for the correct transfer route. Or staff at transfer stations and escalators to help guide elderly passengers.

VI.   CONCLUSION

Under the current COVID-19 epidemic, the existing guidance system in Harbin has a lot of inconvenience for elderly passengers in practical application. Through the investigation and analysis of Harbin subway and elderly passengers, from the perspective of the elderly, the physiological and psychological characteristics of the elderly are analyzed, and combined with the concept of guidance design and interaction design, the research and redesign of the subway guidance system suitable for aging in Harbin subway is carried out. Compared with the traditional guidance system, the design of the age-appropriate guide system pays more attention to the elderly, improves the travel problems of the elderly, increases the frequency of the elderly to use the subway, enhances the comfortable travel experience of the elderly passengers, and enables the subway to better benefit every elderly person.

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