Research on Automatic Ticketing Interface Design of Tianjin South Station under the Background of Aging

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Abstract. Based on the context of increasingly serious aging problem in China, the psychological characteristics of elders in using public self-service facilities and the development status and the future trend of public self-service ticketing service. The approach is analysing physiological and psychological characteristics, education level of the elderly and studying its characteristics of consumer psychology and regional cultural characteristics profoundly before conducting comprehensive analysis and research in combination with the interface features of public self-service ticketing machine. The interface design will be more personalized, intelligent, regional and international. Strategies of caring for the elderly in the regional public self-service facility interface design innovation develops the concept of taking care of the elderly in the entire region as an indispensable people-benefiting optimization system in the modern social services.

1. Introduction
The continuous use of digital interfaces in public self-service devices is facilitating our daily life constantly with great adaptability to the fast-paced social life, while some social problems have also arisen subsequently, namely, problems caused by the friction between the increasingly serious ageing and constantly developing digitalization. In recent years, how to coordinate the relationship between public self-service facility interface and aging has become a hot issue in the society as a whole. Based on the research on the Automatic Ticketing Interface of Tianjin South Station, this paper carries out in-depth research and innovative design in combination with the physiological, psychological and lifestyle habits of elders in the vicinity of the South Railway Station.

2. Research background

2.1. Background of Aging Society
The increasing population of elderly people in China with the increasing social aging problem will occupy a higher proportion of population, as how to take the aging problem into account on public self-service facilities in the society and how to enable elders at all levels of society to use public self-service facilities conveniently has become a prominent issue for development of public self-service nowadays. TVM at railway stations is a typical case, as multiple physiological and psychological states reflected in the elder’s use process can reveal problems of enjoying the convenience brought by TVM better. The most representative problems of interface design are identified via investigation and analysis, and comprehensive design research based on the living habits of elderly at Tianjin South Station is conducted to get access to better innovative design methods [1].
2.2. Status Quo of Elderly in Using TVM
First of all, it is undeniable that TVM renders the daily life of the elderly with further convenience, but a series of problems of TVM for the elderly are also identified via field investigation and research on the use of TVM operation interface:

2.2.1. The problem of colour matching of TVM interface. Many elderly people may suffer from failure of eyesight and even a series of eye diseases over time, such as cataracts and glaucoma. However, colour in design of TVM at the South Railway Station is rather gorgeous and bold in obvious contrast for consideration of young people with fast-paced life, as the elderly people will suffer from visual fatigue in the ticket purchase process, and even feel discomfort.

2.2.2. Fear of science and technology. With the rapid development of science and technology, new high-tech things are emerging constantly, as young people enjoy them a lot for the great curiosity. However, not all the new things are acceptable for elders, as many of them have more or less a sense of fear of newlywed high-tech products, including distrust of their own abilities.

2.2.3. Aging of sensation and perception. It is also caused by physiological problems of aging people, as all the functions of the body are constantly aging over time, so they have to face various problems in operation.

3. Development at home and abroad

3.1 Research status at abroad
Foreign self-service interface is rather mature with particularly high requirement on the user interface, as change of people’s usage, especially rendering the elderly with a convenient form of use has become a new trend of future interface design. (Figure 1) Cartoon elements are integrated into the interface design of subway TVM of Seoul, South Korea, with an intensive affinity; the form of TVM interface design in Japan is not only rather vivid and lively, but also easier for users to identify. (Figure 2)

Figure 1. The subway self-service ticket machine interface in Seoul, South Korea
There has been a dramatic shift in technology from its early days to today, such as Heliodisplay technology introduced by the latest technology development company (Figure 3). As an airborne projection imaging and interactive technology, it utilizes electronics and thermodynamics, as the features of air will be changed after entering the machine. In this way, image will be projected from the bottom to the top after re-projection and suspended in the air, so that people can not only see the image in different angles, but also achieve interaction with users’ finger movements tracked by laser. This design can provide the elderly with a vivid reminder to facilitate their next operation, with a lot of time spared. Meanwhile, it can also encourage them to use TVM actively from the side.

3.2. Research status at home
Since 1970, the skyrocketing development of metro rail transportation has led to the rapid development of TVM terminal. Especially in the information age, development of computer field and network communication technology have enabled subway TVM, a high-tech product that only existed in imagination of people in early years, to enter the daily life of people at tremendous speed.
Before 1990s, due to the monopoly of key technologies for the production of self-service equipment by some major foreign manufacturers, almost all the self-service devices of China were imported. Up to the late 1990s, all walks of life in China began to recognize the market value and service value of application system of currency smart identification, with imports replaced by domestic products gradually. However, countries with advanced development of science and technology are still at the forefront of the world. (Figure 4) Domestic subway TVM interface.

Figure 4. Beijing Metro TVM Interface

Compared to foreign countries, TVM of China still has a great deal of drawbacks, as it is obvious in the contrast of pictures that iconic marks on domestic TVM interface are not so eye-catching and vivid. It is a major drawback for the elderly of poor eyesight in use. In addition to a series of aging problems such as slow behaviour, the elder people are rather vulnerable for congestion of ticket purchase, as they may have a psychological shadow in the next use of TVM under the hit of this time [2]-[3].

4. Principles of interface design for TVM for the elderly

4.1. The principle of consistency
Consistency of interface operation usually includes the following aspects:

4.1.1 Style: Consistency of colour matching, system terminology, icons and symbols, etc.;

4.1.2 Space: Consistency of classification & combination of space according to the operating habits and interaction requirements;

4.1.3 Operation: For those important or commonly used functions, consistency of operating mode shall be kept with attention paid to conformity with use habits of users.

4.2 The principle of rationality
For the overall layout of interface, the elderly shall be oriented for interface design of elder TVM to provide the elderly with a "simple, quick and easy to operate" man-machine interface. Proper layout of screen can not only relieve the memory burden on elders and improve comfort in operation, but also make it easier for the elderly to control the system. It is mainly reflected in the following aspects:

4.2.1 Whether content on the screen is too much;
4.2.2 Whether significant information is prominent;
4.2.3 Whether different types of information can be distinguished clearly;
4.2.4 Whether regional distribution of the screen and the link structure are reasonable, and so on.

4.3 The principle of coordination

As different colours have different wavelengths, excessive colour may also cause a dazzling feeling, which will affect the user's emotion, mind and psychological activity, so uniform and coordinative colours shall be used. Screen effect can be enriched by adjusting the overall transparency, saturation and using small areas of contrast colour.

5. Research on universal design of TVM interface for the elderly

5.1 Research on universal design of railway TVM

5.1.1 Universal design concept of public facilities and status analysis. The principle of equality, fairness and indifference of human beings is the core idea of universal design. It emphasizes that design should treat everyone equally without discrimination, rather than regard physically weak people or other vulnerable groups as people who need special care to avoid discrimination. A mature universal design system is yet to be formed in China in the face of such a severe trend of aging, so designers shall pay attention to the principle of fairness of "human beings" and carry out design activities from the perspective of humanity on the basis of being "people-oriented".

5.1.2 Universal design of railway TVM facilities. TVM facilities emphasize an undifferentiated design that adopts an undifferentiated approach to satisfy all users and avoids differential treatment to certain groups (such as people with disabilities and the elderly). TVM facilities shall be user-friendly, as embodied as convenience and effort-saving of equipment on the material level. TVM shall have good adaptability in the purpose of meeting requirements of different people; on the spirit level, TVM facilities shall be easy to learn and grasp in line with social and cultural background of users, avoiding increasing learning and memory burden of users; simple and obvious removal of unnecessary complex design is advocated to guide users in operation with simple and clear design semantics.

The consequences of accidents or mistakes that may be caused in the use of TVM should be minimized. Warning design can be applied in the self-service ticketing process to remind users of dangerous operation with timely and effective feedback provided for users to check easily. Recoverable design shall be preferred as users can remedy mistakes or errors. On the one hand, users shall be provided with enough prompts in the operation process, with multiple forms such as voice, image and text adopted to ensure the integrity and effectiveness of information delivery. On the other hand, functions such as returning, cancelling and resetting shall be equipped to reduce the negative consequences of mistakes.

5.2 Research on elderly-centred TVM facility interface

5.2.1 Segmentation of elder user groups. It is noteworthy that the criteria for dividing the elderly are not merely linear. In addition to measuring from the age dimension, perspective of demography, such as gender, education level, place of residence and original occupation, shall be taken for detailed comparison. In short, multi-dimensional criteria are determined by the difference inside the elderly group in subdividing elder users(Table 1)[4].

| Table 1. Physiological & psychological characteristics at different stages of the elderly |
|---|---|---|---|
| Stage | Age Range | Physical | Psychological |

5
### Elder-to-be

| Elder-to-be | Conversion period of higher morbidity | Adjustment period, being vulnerable to negative and pessimistic emotion |
|-------------|--------------------------------------|------------------------------------------------------------------------|
| 45-59       | Decline stage, decline slowly and subtly | Dependence, being self-centred                                           |
| Young elder | 60-74                                 | Dependence, with stereotypy increased                                  |
| Old elder   | 75-90                                 |                                                                        |

#### 5.2.2 Design strategies for TVM aiming at features of the elderly

Gradual weakening of visual ability, slowing down process of visual information and reduction of visual attention are inevitable for the elderly over time. For features of visual ability of the elderly, four strategies in interface design are given:

*#### 5.2.2.1 Increasing the size of font and icon*

The basic visual ability of the elderly is lower with blurred vision. Readability shall be taken into account for interface text designed for the elderly, including font size, word-spacing and contrast with the background, where the font on the screen shall be over 24pt and not less than 12pt. What’s more, the size of button and icon shall be enlarged with target content distinguished from the background significantly to enhance efficiency of reading.

*#### 5.2.2.2 Improving colour contrast*

Due to the diminished ability in visualizing colour and recognizing colour, the elderly prefers mid-key colour of apparent contrast. In interface design, colour contrast shall be improved via several approaches such as adjusting saturation, brightness and hue, avoiding the use of colour group of low contrast. Compared with red and yellow, blue and green are even harder for the elderly to recognize. In addition to the impact of psychological factors such as possible sense of loss and loneliness after retirement, the elderly prefers warm tone subconsciously, as red and yellow of mid-key shall be considered in interface design[5].

*#### 5.2.2.3 Providing a clear visual hierarchy*

The elderly is more vulnerable to irrelevant stimuli due to the reduced visual attention ability. The principle of being easy to distinguish shall be adhered to in interface design with the interface being concise and easy to operate; it is particularly significant to provide clear visual hierarchy. A clear visual logic enables elder users to identify the content more relevant to their mission objectives easily when checking information, as both text and graphic symbols shall be used with easy and simple symbols. Graphic symbols should be able to express the functions they present clearly without making users confused.

*#### 5.2.2.4 Making full use of multi-sensory information*

Vision is the major channel for the elderly to receive information, but the efficiency of information reception can be affected by the decline of basic vision, as it can be compensated for by multi-sensory approach such as increasing auditory and touch. For example, shortage of visual ability can be made up by the voice broadcast function: information can be understood and operation can be completed interactively via voice prompt.

#### 5.3 For characteristics of auditory ability of the elderly, the following four strategies are given in interface design:

When using two or more auditory signals, there should be obvious differences between the signals with same information meaning represented all the time for a certain signal to improve the speed of human auditory reaction.

The frequency of sound device can avoid noise masking, so that people can hear the accurate signal despite the noise.

In the case of simultaneous use of several TVMs in the booking hall of railway station, sound signal shall be concise and accurate with intensity controlled within a suitable range to avoid mutual interference. Other transmission devices shall be used in conjunction.
6. Conclusion
This subject mainly studies the design of TVM facilities in the background of aging. On the basis of
theories such as universal design and interaction design, user interface of railway TVM is improved
with innovative design in orientation of users. In this way, frequency efficiency of such products can
be improved with a more pleasant experience provided for users. The memory burden on users is
reduced and the usability of product is improved by simplifying the interface layout. In terms of
software design, function architecture and system operation flow are optimized, with system functions
improved and interactive experience enhanced according to user needs.

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