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The Application of VR Technology in Life Space Assessment of Elderly People

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***Abstract*—With the coming of aging, the elderly become the focus of people's attention. The study of life space assessment for elderly people is originated from the West and is relatively mature in the western country. However, the lack of local tools in the practice of life space assessment leads to some deficiencies in China. This paper discusses the defects of life space assessment in China's practice. Based on the analysis of the adaptability of virtual reality technology in life space assessment of the elderly, this paper puts forward the application of virtual reality technology to evaluate the life space of the elderly, so as to make a beneficial supplement for the practice of life space assessment in China.**

Keywords—VR technology; life space; application; elderly people

I. INTRODUCTION

With the advent of an aging society, the assessment of life space for the elderly has received increasing attention. Life space is a multi-dimensional structure composed of physical space and social space, which affects all aspects of people's lives. The quality of life of the elderly is influenced by life space [1]. In addition, life space is closely related to the physical and mental health of the elderly [2]. Therefore, it is of great significance to evaluate life space among the elderly. As is known to all, China is the most populous country in the world, with an aging population. The problem of aging has become a sore spot for the whole society. Evaluating the life space of the elderly and proposing optimization suggestions will help to meet the "good life needs" of the elderly and promote positive aging.

The study of life space assessment originates in the West and the assessment tools are relatively mature. However, the assessment of the life space for the elderly is not supplemented by localization tools, which makes life space assessment face defects in China's practice. With the advent of the 5G era and the rapid development of technology, virtual reality (VR) technology has become a relatively innovative and mature technology. Therefore, the use of VR technology will be a beneficial complement to the assessment of life space for the elderly in China.

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II. THE DEFECTS OF LIFE SPACE ASSESSMENT IN CHINA'S PRACTICE

Based on the literature research, we find that the Western research on life space assessment is relatively mature, but its research can't fully meet the localization needs of the life space assessment of the elderly in China. At present, life space assessment faces the following defects in China's practice: "emphasis on evaluating mobile space while ignoring fixed space; emphasis on assessing objective status and ignoring subjective expectations; emphasis on evaluating large space while neglecting small space."

A. Emphasis on evaluating mobile space while ignoring fixed space

On the basis of literature research, we find that in the assessment of life space, the western country pays attention to the discussion of the overall life space, that is, the broad discussion of people's mobility in various life spaces, and rarely studies fixed space. The reason is that the West pays attention to defining the concept of life space from the overall view of nature. We know that theory guides practice, and concept is the basis of theory. Therefore, the definition of the concept will directly affect the practice. As early as 1985, May divided the life space into five concentric areas: bedroom; the rest of the room; gardens and courtyards surrounding the house; other blocks in the house; crossing a load-bearing traffic Area of the line [3]. For a long time, life space is considered a series of concentric circles. Webber has adjusted the definition of life space. He believes that life space is composed of five types of vertically arranged spaces–room, home, outdoor, neighborhood, service community, surrounding area, and the world. These spaces are influenced by economic, social psychology, Environmental, physiological, and cognitive [4].

A good life is closely related to a fixed space. The assessment of the fixed space can reflect the real situation of the elderly in many aspects, such as the degree of satisfaction for space convenience, the degree of preference for space and so on, which can reflect the expectations of the elderly for a good life. It is difficult to achieve by evaluating mobile space.

B. Emphasis on assessing the objective status and ignoring subjective expectations

The subjective expectation is a distinctive feature of the needs of the elderly for a good life, which can reflect the requirements of the elderly for a good life. It is a remarkable characteristic of western research to attach importance to evaluating the objective status quo while ignoring the subjective expectation. In 1985, May proposed using the Life Space Diary (LSD) to assess the life space of the elderly, which requires the elderly to record their daily activity area for 31 consecutive days [3].In 1999, Stalvey proposed the Life Space Questionnaire (LSQ) to measure the life space of the elderly, which asked the elderly to report their first three days of activity [5].In 2003, Baker proposed a new life space assessment tool, LSA, which not only included an assessment of the scope of life space, but also added an assessment of frequency and independence, which allowed it to reflect the real situation of the elderly[6].In 2013,Wettstein identified the type of movement of cognitively heterogeneous elderly people through GPS technology [7].

In short, studying the elderly from the perspective of objective status quo is the consistent model of Western life space assessment. Studying the life space from the perspective of the elderly and proposing some beneficial suggestions for the elderly are lacking in Western research, which is also a practical defect they face in China.

C. Emphasis on evaluating large space while neglecting small space

Life space defines a movement that extends from one's home to a town or geographic area [4].In previous studies, scholars chose elderly people who embrace a healthy physical to study their mobility from small life space to large life space, such as from home to town, which leads to the neglect of small fixed space assessments. However, for the elderly with mobility impairments, small space such as bedroom is common life space that can be achieved by their mobility. Therefore, attaching importance to the evaluation of large space and neglecting small space is a defect in the practice of life space assessment.

III. The Application of VR Technology in Life Space Assessment of Elderly People

Virtual reality technology, abbreviated as VR technology, is a technology that creates a virtual reality environment through a computer, allowing participants to experience the simulated environment from a variety of sensory channels such as sight, hearing, and touch. By setting up multiple virtualized life scenes which are closely related to the daily life of the elderly, VR technology can timely measure and evaluate the attitude, experience and behavioral performance of the elderly. The use of VR technology can avoid the defects of Western life space assessment in China’s practice, and is a beneficial supplement to the assessment of the life space of Chinese elderly people.

A. Characteristics of VR technology

VR technology has three characteristics: immersion, interactivity and conception.

The sense of immersion, also known as the sense of presence, refers to the authenticity of the virtual environment felt by the participants. The ideal virtual environment should reach the level that makes it difficult for users to distinguish between true and false, thus attracting users to fully devote themselves to the three-dimensional virtual environment created by the computer [8].

Interactivity refers to the user's degree of operability for objects within the virtual environment and the natural degree of feedback from the environment [8].For example, an elderly person can experience the process of opening a window in a fictitious life space, and feel the different physical and mental feelings brought by different switching methods.

Conceiving refers to the user's understanding of sensibility and rationality from the virtual reality scene simulated by computer, so as to further exert initiative and form a new understanding of related things, that is, the formation of new concepts.

B. Adaptability analysis of VR technology applied to the evaluation of life space of the elderly

VR technology can overcome the defect of life space assessment in Chinese practice. VR technology is a mature technology with three characteristics of immersion, interaction and conception. It can design different virtual scenes to meet the different researches of researchers on life space.

A specific scoring system can be set in the virtual scene to meet the needs of scholars to explore the subjective expectations of the elderly in the life space. For example, in a virtual room, a floor with different smoothness is set, and the elderly rate the room according to the change of the smoothness of the floor, which can reveal the psychological changes of the elderly with spatial changes, that is, the elderly have different preferences for different factors in space. The expectation of the elderly is an important factor in studying the needs of the elderly for a good life, and VR technology is a good way to study the expectations of the elderly.

Compared with previous life space assessment studies, VR assessment is done in a fixed space. It does not require the elderly to assess the life space through the display of mobility capabilities, which allows older participants with mobility impairments to participate in the assessment.

In addition, VR technology has other advantages. Compared with the questionnaire research, VR technology can directly display virtual scenes similar to real-life scenes, which can more realistically reflect the attitude of the elderly to a certain life space. Secondly, the life space constructed by VR technology can be adjusted according to the requirements of the research, so it has the incomparable flexibility of other research methods and can satisfy the needs of researchers to the greatest extent.

From the above perspective, VR technology is a beneficial complement to life space assessment.

C. Development of VR-based life space assessment tool for the elderly

The VR experiment program for the assessment of life space for the elderly consists of two main spaces: the bedroom and the bathroom. The independent variables in the bedroom space include: space size, lighting level, floor smoothness, wall color, furniture corner sharpness, door and window opening mode, furniture placement position, modernization degree of decoration style, etc. The independent variables in the bathroom include: space size, light level, smoothness of the floor, wall color, corner sharpness of the sink, faucet and shower opening method, squatting and toilet, squatting and toilet flushing, modernization degree of decoration style, etc. There are four variations of these independent variables, such as the size of the bedroom space is changed by 8m2, 10m2, 12m2, and 14m2, so as to clarify the sense of the size of the elderly in space. A score of 1-10 points is set in the four variations of each independent variable, that is, the dependent variable, the higher the score, the more satisfied the elderly are with the change.

Of course, as the research needs change, different virtual life spaces can be set to meet different research needs.

D. Work procedure

The assessment can be divided into three phases. The first stage, the preparation stage. Contact the community to recruit participants. With the help of community organizations, elderly people over the age of 60 are recruited. Inform the participants to participate in the assessment during the recruitment process, and ask if the participants are willing to participate in the assessment and sign the informed consent form. The second phase, the implementation phase, is divided into two small phases: device adjustment and formal evaluation. In the device adjustment phase, the researcher needs to set up the VR base station bracket, and its placement position is diagonally distributed to ensure the smooth transmission of signals. At the same time, run Steam VR on the computer to ensure the smoothness of the virtual scene. In the formal evaluation phase, participants are asked to wear a VR device to observe the virtual life space and score the changing factors in the virtual scene. The final phase, the data collection and organization phase. After the assessment of the elderly is completed, an open-answer method is adopted to allow the elderly to give advice on the setting of the life space. Then, based on the scores of the elderly in the virtual environment and the suggestions of the open answer, try to explore the relationship between good life and life space of the elderly. The specific work procedure chart can be indicated as Fig. 1.

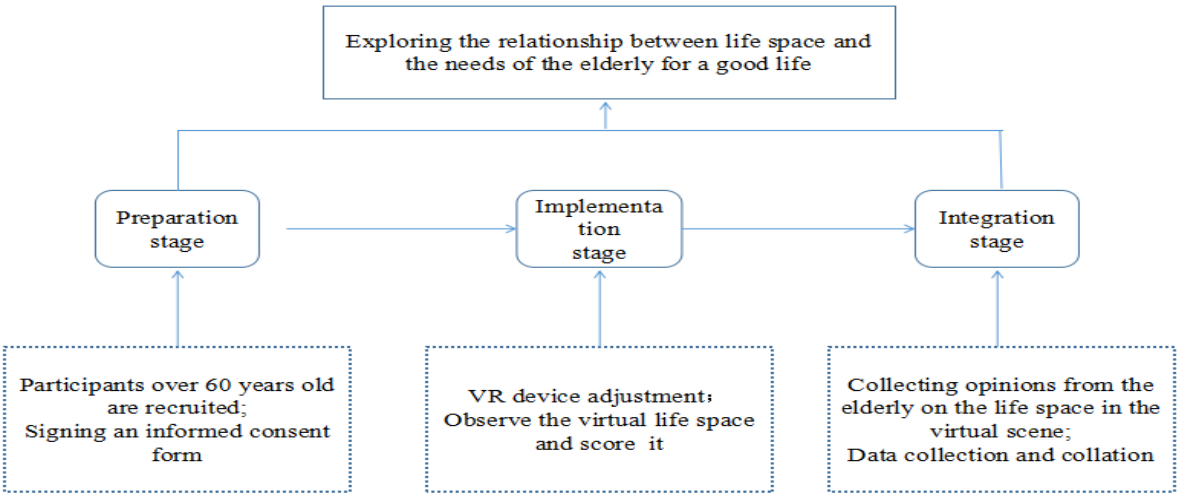

Fig. 1. VR assessment work procedure

IV. Conclusion

Based on the literature research, this paper finds the defects of life space assessment in China's practice, and proposes a method to evaluate life space of the elderly by using VR technology, which makes a beneficial supplement for the life space assessment method.

Of course, based on the current research status, a method that can be operated in the assessment of life space is initially proposed in this paper. Subsequent research can focus on the development of VR technology in life space assessment, and different life spaces can be set to explore the relationship between good life and life space of the elderly. In addition, follow-up researchers can try to generalize the general rules of the elderly's need for a good life, so as to provide some advice for the elderly. It is believed that in the near future, VR technology can be widely extended to the evaluation of life space of the elderly. This is not only beneficial to the elderly, but also to the positive aging of society.

V. Limitation

Although VR technology enriches the way to evaluate life space of the elderly, the method is not mature enough to be widely used. Secondly, the design and development of VR applications require the participation of professional companies, so the cost of research is relatively high.

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