A Study for the Elderly Assistive Device Design and Learning Assessment

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Abstract
In recent years, along with the process of economic growth and political democratiz ation, concerns and needs of the rapid increase in social welfare. With the national fertility rate is declining, the average life expectancy increased year by year, the age structure of the population pyramid shape quickly tend to bowling pins. The transformation of society and the aging population will undoubtedly bring a considerable impact, associated research indicates that 17% of people already born with disabilities, and another 30 percent were caused by acquired, the older When the probability of resulting higher.

Through the power of technology assistive device can help elderly people lacking the ability to part, so that the elderly because of age are not physiological or psychology cal degradation of the problems brought to bring, young people living a normal life, reduce the formation of subjective incomplete physiological degradation caused by obstacles, but assistive device the design method for the assessment of not much, especially for the elderly person is part.

After finishing methods and research related to the design and use of assistive device to assess the present study, and then through the literature of consolidation after induction,, proposed addition to the most commonly used way assistive device the design and assessment of learning, with its elderly health, psychological and other characteristics, helping to meet the elderly when the user uses the product design and learning assistive device planning.

Keywords: elderly, assistive device design, evaluation

Introduction

1. Research background and Motivation

The purpose of this research is to organize assistive devices the design and evaluation of the review of the literature and then through the rear, after collate, and then focus on the way it presented its related accessories with the design and assessment, of the elderly person can live more ancillary product design able to meet its users to use and meet their real needs, so the more of the motivation based on the following purposes;

(1) To investigate the physiological characteristics of the elderly because of age and the changes arising from the psychological and social.

(2) Discussion of different methods existing product design assessment of assistive devices.

2. Discussion of relevant literature

2.1 assistive devic

In short, assistive device that is to help people living in a variety of activities to complete tools to comply with a disability or impaired functionusing individual needs. In general, the auxiliary equipment has two characteristics: the user can be compensated defects or loss of function; furthermore its use is life long. With these aids to help them play their biggest independent function at home, school, work or in society, and to play an appropriate role. Therefore, the use of assistive devices can help patients learn not only independent, on the other hand, may be appropriate to reduce the burden on caregivers. (Lu Yucheng, 2002)

2.1.1 Design Trends

In recent years, increasing emphasis on domestic elderly person with a disability and assistive devic to raise R & D, but still close to the main design (Accessible Design), and be adaptable design (Adaptable Design) address barriers to the handicapped and elderly person physically, the attention to social well-being of many advanced countries, assistive devic R & D needs to pay attention to universal design universal Design concept.

Aassistive devic product has a small variety of properties, profit considerations for manufacturers, the market is not easy to achieve economies of scale in product development, and if the appropriate application of Universal Design concept, the product will meet the needs of more than 80% of adults (Guo Lian, 1992)

2. 3. Related physiological and psychological characteristics of the elderly

2. 3.1. Age influence on physiology of the elderly

With age, will have on the degradation function, and this study will be divided into three characteristic physiological and psychological and physical in and so do the explanation and discussion; as shown in Figure 2-1.

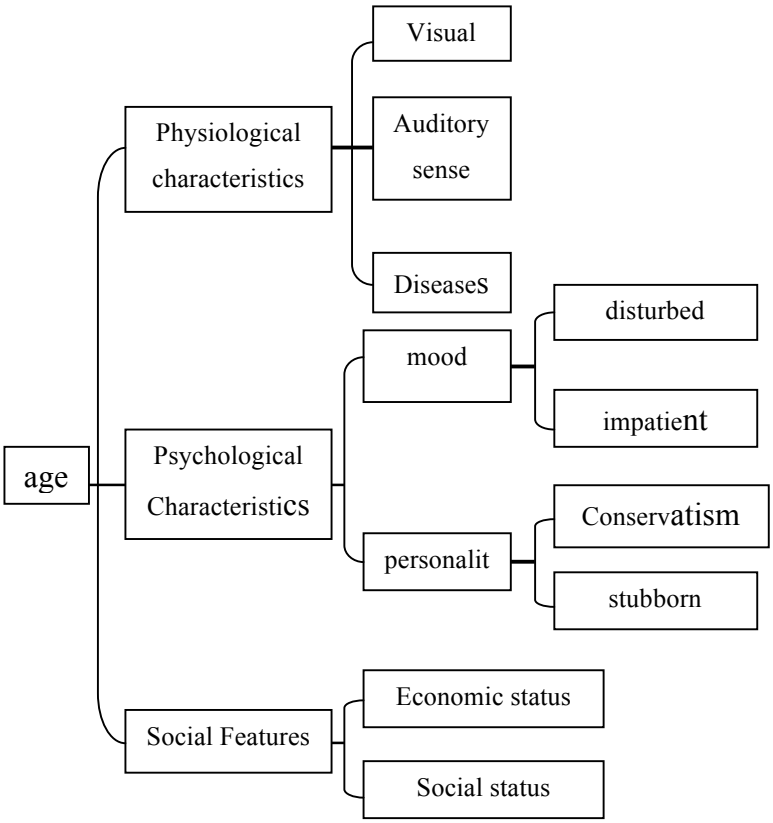

Figure 2-1 elderly person related to physical and psychological characteristics of the body diagram

（1） Visual

Pyykko (1990) found that visual information input elderly, providing 50 percent of posture stability. The elderly on the accuracy of visual contrast sensitivity, spatial sensitivity and resilience of darkness, obviously lower than the young (Pitts,1982; Carter,1982;Duncan,1993;Lord,1994)

Decline in visual function, ability to identify and detect older environments and visual positioning of obstacles will be reduced. For visual impact of the balance in advance to detect obstacles, which led to a series of subsequent reaction constitutes a significant role, and therefore in many sensory systems, the elderly are less dependent on the visual system (Winter, 1991)

（2） Proprioception

Proprioception is conscious and non-conscious awareness of body posture, position and movement direction. He feels the need to integrate peripheral receptacle of information, Skinner (1984) found that elderly knee and plantar knuckles reset Accuracy, namely the ability to detect motion significantly less than young people. Michael (1998) also pointed out that the test reset the elderly knee joint position sense (Joint position sense) was significantly worse than young people. Lord (1994) test vibration sense ankle and knee touch older than the young poor.

（3）Vestibular

Vestibule and three semicircular canals of the inner ear can detect the position of the head relative to the body, to play an important role in stabilizing the head. (Skinner 1984).

Studies have shown that patients with unilateral vestibular damage 18-85 years old, it is difficult to maintain a balance in the visual frame and load plate shaking tests. (Pozzo, 1990). Another study also found that vertical write vestibular tests, its decline will affect the elderly gait. (Black, 1989).

（4）Musculoskeletal System

Muscle function not only generate power and move, also received one of the sense organs proprioceptive messages. Muscle mass and strength from start to slowly decline after the age of 25, to 50 years of age about 10% reduction in muscle strength, to 80 years of age on the left half of the muscle. (Lexell 1988)

(5）Central Nervous System

The peripheral nervous system plays a high-level integration of information coming from the feeling and action commands issued. If this system is damaged, cognitive, behavioral and reaction both bedamaged.

Studies have shown that the elderly receiving stimulation to muscle action in the middle of the reaction time increased the phenomenon (Duncam, 1993; Lord, 1994). Patla (1993) and Chen (1996), who studied the elderly face obstacles when walking reactions and regulatory mechanisms, found that there is different from the young people, it is generally required longer reaction times.

Seen from the above literature, balance and posture control response mechanisms different from the elderly generally young and feeling - motor function is also worse than the young, but the effect of age on the balance control has many levels.

"Elderly person" because many physiological functions of attenuation, it is also gradually appeared on the body of many diseases, such as heart disease, hypertension, Alzheimer's disease, Basson Kim, depression and so on.

a. resulting in restrictions on physical

As the level of the ladder, is set escalators or elevators, pedestrian semaphore whether longer effective green time. Such as hypertension and heart disease and diabetes.

b. bone disease

Such patients because of bone lesions, and makes elderly people in the use of transportation facilities will be limited. Such as arthritis and gout and osteoporosis.
c, out of control: including elderly dementia and Parkinson's disease.

2.3.2 Psychological characteristics of elderly person

Personality of elderly person, usually widely quoted Cavan (1949) data, the following points; (1) Health and economic unrest; (2) a life not fully meet the anxiety caused; (3) In the spirit of loneliness caused due to a reduction of Interest; and (4) increasing physical comfort of interest; (5) decreased activity; (6) decreased sex drive; (7) to learn and adapt to new situations have difficulties; (8) a person feel lonely alone; (9) Heart suspicion, jealousy increased; (10) becomes a conservative; (11) chatter, whiny; (12) Total good recollection of events; (13) stubborn temperament ; (14) does not trimming rich, sloppy; (15) likes to collect junk.

Uneasy on health and the economy, as well as not fully adapted to life caused by anxiety, loneliness due to reduced interest in the spirit of the scope and cause of increased interest for physical comfort, mobility impairment, to new situations have difficulty learning and adaptation, became a conservative and stubborn temperament, etc., but the phenomenon which caused psychological factors as described as follows: (1) on anxiety (2) on the impatience (3) become a conservative personality (4) becomes stubborn personality.

2.3.2.1 Quality of life assessment of the way the elderly

In terms of psychological perspective (psychological perspective) cut, objective indicators of a healthy ESR situation, living conditions and other factors; subjective experience, there are indicators of self-concept (self concept), self-esteem (self-esteem), life satisfaction (life satisfaction), the control sense (sense of control), psychological well-satisfaction (psychological well-being), morale (morale) and the like. (Baltes & Baltes, 1990; Coleman, 1999; Ryff, 1989a; 1989b).

Many studies explore the lives of older persons based on adaptation, and Rudinger and Thomae of longitudinal research results: the satisfaction of psychological well-being, life satisfaction and other subjective perception the elderly evaluation, compared to health status, socio-economic status and other survey data and more help us to effectively explain and predict the behavior of the elderly and emotions. This index shows that subjective experience more predictable than the objective indicators of quality of life of the elderly.

2.3.3 Relations with the elderly person's physical activity

Exercise on physical and mental health of the elderly Pynn, in psychological terms, King, Taylor, and Haskell(1993) research suggests that the experimental group consciously low from stress and anxiety than the control group sports training.

American College of Sports Medicine (1998) report notes that regular exercise can prevent and reduce injury; has been confirmed in epidemiological studies, engage in physical activity can reduce cardiovascular disease (Wilmore & Cositll, 1999; Paffenbarger et al, 1986. ; Pate et al, 1995;. Berlin & Colditz, 1990). Chia instrument (2002) study found that the elderly physical activity and perceived health status was positively correlated negatively correlated with age, namely the elderly physical

activity level and perceived health is closely related to the quality, age and physical activity are closely related. Fuli Lan (2001) survey found that physical activity score and the elderly suffering from several diseases negatively correlated.

2.3.4 Elderly Social Characteristics

The aging is a biological process of the objective laws of life, biological whole body morphology, structure and function of the decline is a gradual, relatively slow process, for a man, this feeling is not self-evident. But in the off (back) Hugh, their respective environment, conditions have played a full range of change in the social status of the first performance of a downward trend.

A. Economic Status
(1) reduction in income (2) an increase in expenditure

B. Social status
Because older people facing physical or economic recession, not like the relatively young with others close to "fair" type of interaction, it will get less support. Both of them are likely to reduce the phenomenon of social support the elderly (Ren Xiao Zhao, Lin Yaosheng, Zheng Yi, such as translation, Min 86). Social support is particularly important for the elderly.

2.4 Universal Design

Universal Design concept put forward, can be traced back to the latter half of the period in 1970, Ron Mace, director of North Carolina State University Accessible Housing Center presented "Universal Design" term, 1998 The Center for Universal Design further amended to "in within the maximum extent possible, regardless of gender, age and ability, and easy to use for everyone's environment or product design.

The seven principles of universal design is currently the most commonly used definitions have been proposed and, by ten advocates edited to December 7, 1995 announcement of version 1.1, within as described below:

(1) .Equitable Use: do not use a particular ethnic group and distinguish objects, to provide a consistent and equal significance.(2).Flexibility in Use:with accommodation of use, such as providing a variety of use, consider the right hand of the user, depending on the person using the speed adjustment and other operations. (3) Simple and Intuitive Use: straightforward design, regardless of the user's experience, knowledge, etc., can easily get started operation. (4) Perceptible Information: provide a visible or can feel the message, giving the user the appropriate response. (5) Tolerance for Error: allowable error design considerations, in order to reduce the risk of errors caused by the use. (6) Low Physical Error: allow users to easily operate and use, do not spend too much effort or skill. (7) Size and Space for Approach Use: planning appropriate scale and space, so that different user activity in space.

2.4.1 Universal design assessment model

Try universal design concept will have the ability to defect to be integrated with the normal users of various properties both sides to find a mutually acceptable to the intersection, and then design the two sides of the product or device is suitable for. In general, the assessment of the concept of universal design is to have the ability to investigate defects and general users who demand both sides of the original product. (Li Cong, 2001)

2.5 Comfort Discussion

On the "comfort level" to make a basic induction Description:

1. Comfort is a subjective feeling, which may be due to the different length of time, the object or action and have a different feeling reaction.

2. The so-called comfort is the feeling of physical and psychological experience. Review of the amount of comfort, often need to measure the physiological basis to infer subjective experience of.

Basic measuring and evaluation method of comfort (Shackel,1969) sorted out the four basic assessment method to measure the degree of comfort as follows:

(1) anatomy and physiology of the way:

Some are physiological factors on the human body as a comfort index assessment, research methods more commonly used disc containing research, EMG muscle mass measurement, the flow of blood pressure research other methods. This is the comfort of the most important indicators of assessment.

(2) The body posture and movement of the observation:

Mainly record human body movements and observation of posture, to evaluate the relationship between the comfort of the seats gives.

(3) Work performance of the observ -ation:

Observation of users at different work chair, in a period of time, the performance of its work to assess the amount of seat comfort.

(4) Subjective methods:

That method is the use of subjective rating scale to do against the subject's subjective description, and the use of statistical analysis to do finishing evaluated to expect an objective of statistical data.

In many comfort studies, often several cozy metric measuring method to do with the application, the desired physiological response and psychological feeling of doing a

better explanation, such as Buckle P. and Fernandes (1996) is the amount of pressure applied measuring instruments and subjective rating scale 10, the comfort of the mattress material to do the assessment; comfort Chen dao Yuan (1999) Assessment bike is also physiological reaction pressure and vibration of each other and subjective comfort scale applications. Similar with the application of such methods, the reaction may be physiological fatigue and discomfort psychological connection between the do, more in keeping with Lueder (1983) referred to: evaluate the comfort, the need to measure the physiological basis for objective and subjective assessment of inference to the comfort

2.6 Usability and usability engineering assessment

2.6.1 Define the use of:
For a system, if properly and efficiently help users to complete the job they want done, while allowing the user to have a positive and enjoyable user experience and are happy to use the system, which is the use of the definition. Whereby the definition can know, with high use of a user interface must have efficiency, effectiveness. (Andre W. Kushniruk, 1996)

2.6.2 Usability engineering:
That is the way some of the methods used to assess the use of the system, in which the observational assessment method is most common. Implementing this method comprising the steps: First, record a video, or an automated way to capture the user performs "reference job" performance and operating conditions. Next, in order to investigate or interview marking the way to collect comments or data on the user. Finally, so use the data collected from engineering analysis and discussion. Jakob Nielsen's ease of use of the project (discount usability engineering), the main steps of (1) user work observation (2)situation analysis (3) simplified thinking.

2.6.3 Use the engineering steps:
(1) Situational Analysis (2) Typical work and step (3) user and job analysis (4) heuristic evaluation (5) recommendations

Conclusion and Suggestion

In this study, the following is from the "Taiwan Boshuo paper News" to assistive devic, design, evaluation, the elderly (the elderly) and the use and comfort archive search keywords such as finishing their studies in the following table.

Table 3-1 assistive device design and evaluation studies

Researcher	Thesis Title	Abstract	School / Department
TSAI, SHENG-PING	Carbon fiber is added to the biomechanical function of the foot assistive devic assess-ment	In this study, patients with amputation of the foot part, use the shoe pad measuring system and finite element analysis,to explore different assistive devic when changing material combinations and add carbon fiber plate in the sole change to the patient's foot biomechanics.	Jhong Yuan University Institute / Medical Engineering

WANG JIANJHANG	Foot section Foot amputees and biome -chanics of assistive devic material evalu -ation	In this study, amputees wearing assistive devic front foot to experiment and finite element analysis, and the existing assistive devic mater -ial analysis processes do establish ◦	Jhong Yuan University Institute / Medical Engineering
HUANG, YUAN-HAN	Computer assistive device to simplify the selection and evalu -ation of the deci -sion tree logic Jhong Yuan	This study will simplify input device sub-tree, and the tree is divided into sub "click input device" and "text, numeric input device" two sub-tree, the three mutually exclusive category-ies for the independent assessment process to improve each other, to comply with a disability of assistive devic needs. Followed by nine disabilities obstacle characteristics of the test tree for the main case to seek appropri -ate assistive devic.	National Taiwan University of Science and Technology / Industrial Management
LI, JIAN-CONG	Universal design eva -luation and applic -ation of assistive de -vic - Take sanitary system of care facilit -ies in Taiwan.	In this study, sanitary system case care facilities of an example, the generic design assessment and evaluation results recommend -ations.	National Yunlin University of Science and Technology / Industrial Design Master Class
JHU, JIA-WEI	Biomechanical assess -ment of func -tional foot assistive devic	In this study, using the finite element method to perform stress analysis between the foot and assistive devic. Research based on the CT image slice foot and with this study, as well as foot ligaments dimensional finite element model of assistive devic with three-dimensio -nal model for analysis of stress neutral plantar pressure distribution.	Department of Chung Yuan Christian University / Medical Engineering
LIOU, CIAN-SIOU	Moderate to severe cerebral palsy put spe -cial sitting position to assess the efficacy of supporting assis – tive devic	In this study, biomechanics, neuromuscular control theory, human factors engineering and rehabilitation engineering among technology in medical rehabilitation assistive technology field, select the six main cerebral palsy patients with a single object the experimental design, with repeat clinical evaluation, muscle Telecommunications No measurement and assessment of upper limb function, discuss with moderate to severe cerebral palsy using a special wheelchair with individualized support positioning assistive devic specific therapeutic effect of the treatment and rehabilitation.	National Cheng Kung University Institute / Medical Engineering

Table 3-2 assistive device design and development

CIOU, CHUN-CIH	Planning and develop -ment of clinical in -dexable assistive de -vices	In this study, through fieldwork observation, to understand the nursing work environment, job characteristics required to use assistive devices; and by interviews and questionnaires distributed to caregivers understand the inconvenience during translocation generated, and understand the use of design missing indexable assistive devic encountered and needs. The demand for the import QFD technology to effectively convert the users' needs in the new product development process, and the conversion results on demand to design demand for new products and explore the elaboration of a strategy to improve the design and lack of recommendations.	Nan Tai University of Science and Technology / Industrial Management Institute
JHANG,	Science and techno -	In this study, observation and interviews to	Nan Tai

JHIH-CHUN	logy of the product planning assistive de -vices - remote tran - sitional wheelchair carrier Case	explore the needs of users in the use, and the use of quality function deployment method to convert user requirements into engineering parameters to determine the quality requirements demand weights, determined to analyze the level of procedural law, and the use of failure mode and effects analysis as QFD reserved bottleneck technology to design and develop a transitional assistive devic comply with physical disabilities who operate it.	University of Science and Technology / Industrial Management Institute
CHEN, JHIH-HAO	Wrist and elbow rehabilitation, assis - tive devices of mech -anism design	The present study is to present the relevant patent wrist and elbow rehabilitation of the exerciser, analyze and compare, understand its design focus, the action principle, advantages and disadvant - ages; at the same time, through the expertise of rehabilitation doctors, as this design agencies required conditions, enabling them ergonomic hand movements.	National Taipei University of Technology / Manufacturing Technology Institute
CHEN, SHIH-JIANG	Application of QFD method in product development and re - search of medical assistive device a manual wheelchair Case	The main purpose of this study is to apply QFD design study investigated the manual wheelchair, get customer needs through surveys, product user's point of view, introducing QFD method, via QFD matrix to analyze, compare, judged after development of new methods to PDPC wheelchair concept design, design development to solve the inconvenience of users of the new wheelchair.	Nan Tai University of Science and Technology / Industrial Management Institute
HUANG, CHAO-CYUN	Development of di - sabilities assistive de -vices	This paper, we propose a new method that combines Kohonen self-organizing feature map network (SOM), and a pattern matching method to be applied to identify the word phonetically.	National Central University / Information Engineering Institute
LI, GUO-RONG	Science and tech - nology assistive de - vice development fall detection and alarm device.	The objective of this study is to test by simulation of experiments to develop a fall detection - alarm; the elderly or persons with disabilities to wear it once fall disaster occurs, can automatically signal the close of the person for the first time take the necessary actions in the hope that the future can be integrated with other biomedical signals to complete the physiological detection of fall prevention - early warning notification system.	Machinery Research Institute of Tsinghua University
HUANG, HAI	Dismemberment by the assistive device developed.	In this paper, especially for hand dysfunction designed an alternative input of the computer system that can be used as a keyboard in addition to the use of outside, and immediately switched to mouse function; In addition, users can also be learned from the LED display device the key to type the information. The experiment proved that this system can really meet the needs of the impaired hand function.	Tamkang University Department of Electrical Engineering
CIOU, YU-SIAN	Bit digital mobile assistive device con - troller design and testing.	The purpose of this research: application of mechanical and electrical integration, digital micro-processing technology and handicapped functional considerations, research and de - velopment of digital electric wheelchair / scooter controllers, in order to improve the traditional analogical low efficiency and functional shortco - mings, enhance compliance with personal disability function rehabilitation needs of science	Institute of Medical Engineering, National Cheng Kung University

		and technology and assistive devic.	
SU, YU-REN	Stroke patients with lower limb assistive device design.	The main purpose of this study was to develop a suitable stroke patients rehabilitation assistive devic, hoping that stroke patients recover the ability to walk, to make daily life more conven - ient, and by daily walking exercise to maintain good health.	Tamkang University Department of Electrical Engineering
SIE, YUE-YUN	Diabetic patients with foot finite ele - ment contact stress analysis of assistive devic	The purpose of this study is to analyze the finite element method for reducing Keys plantar plates of the required plantar pressure in patients with diabetes, analyzing Keys plantar plate with treatment with plantar pressure distribution junc - tion ask situation.	Chung Yuan Christian University Department of Biomedical Engineering

Cook and Hussey(2002) proposes supporting science and technology evaluation process, from understanding the needs of the case, assessment of the case action, cognition, after feeling, language ability, select assistive devic be trained. Anson (1997) in the flowchart of way to guide the therapist select the appropriate computer assistive devic. Kollodge (1997) proposed to use the principle of a disability assessment of computer assistive devic include consideration of computer keyboard, mouse, screen, control portion (control site), input methods, and provide individual assistive devic description of the nature and possible user. These are different ways to assess assistive devic Design.

From the above study of literature in many assistive devic assessment methods can be found in different assistive devic category has its commonly used assessment methods, each one assistive devic also difficult to simultaneously achieve its assessment of the requirements of each, so working in different When assistive devic must be on the characteristics and needs of their assistive devic needed to finalize its assessment of the way, and this research hopes to sort out especially for elderly people whose elderly person's health, psychological and other relevant characteristics so as to provide the induction of the elderly One of those assistive Resources devic design.

Because elderly person lifting age makes it students, psychological characteristics have changed. However, its physiological characteristics of the visual, auditory, disease (aging) resulted in the ability to pay attention, responsiveness, reduce operational capability; and anxiety on psychological features, irritable and personality conservative, stubborn cause a decline in the ability to adapt and response capacity . However, due to their ability to pay attention, responsiveness, operational capacity, reduced ability to adapt, it is caused by the elderly person shown by the behavior of its unique characteristics, including its non-responders (error) and action can not fit, etc. Also due to changes in the social characteristics of the elderly, making it economic status, social status decline, so elderly person's ability to fall and cause them to choose self-esteem, so the resulting behavioral characteristics of elderly person chosen for psychological and physiological action of thinking are often not very cooperation; and from the demand characteristics of elderly person's life that, assistive devic design characteristics of their elderly person in addition to its own products for the user's convenience and comfort for its use to be outside more psychological satisfaction with the dignity of the individual to do the thinking, its elderly as long as the person is not only convenient to use, the more we have to pay attention to product design in general when less attention to the psychological level, reducing loneliness add a personal ability to control the environment and to improve

the product satisfies the soul, rather than the pursuit of an unobservant its a quantity of comfort and convenience operability.

So far there are many assistive device design and evaluation are based on an objective and quantitative assessment to do as a way of aging product evaluation, but with respect to the relevant information can be seen in this study to assess the needs of the elderly products, but should the assessment is to be subjective or objective indicators indicators to replace more in keeping with evaluators after elderly person really needed to know, and thus further increase the use of a spiritual fulfillment and dignity recognized when ownership and participation, so that the elderly are willing to use assistive devic various activities, thereby improving the quality of life and the body's movement ability, so that it can help elderly people actively participate in social activities with the help of the required personal life, so in order to really assistive devic spirit of play, but alsoIt is the focus of this study.

Therefore, this study was collected by literature investigate the analysis and induction and other elderly person's psychological and physiological characteristics, and explore the related research needed to enable them to provide senior citizens closer to the user of the relevant information needed to learn about the elderly person's , thereby avoiding the pursuit of technology to improve a unobservant but ignored the basic characteristics of the user, so the value and significance of this research, especially inquiry.

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