

Design of Health Monitoring for Elderly Wearable Smart Bracelets Based on Humanized Concept

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Abstract: Currently, the number of elderly people worldwide is constantly increasing, and traditional elderly care methods mainly based on medical care and nursing can no longer meet the needs of the elderly. Therefore, intelligence and technology have become the development direction of the elderly care industry. The article started from the concept of humanized design, focused on user experience as the research focus, and analyzed it based on the physiological characteristics and psychological needs of the elderly. Through analysis, it was concluded that wearable smart bracelets required the following three design elements: design process, product functionality, and user experience. By conducting design research on these three aspects, optimization of product functionality, appearance, and operation can be achieved. The experimental results showed that the bracelet designed in the article had higher monitoring accuracy and efficiency, while ensuring functional integrity. At the same time, the bracelet has achieved good results in actual operation.

1. Introduction

With the increasing trend of global population aging, the health management of the elderly population has become a focus of social attention. The health status of elderly people is influenced by various factors, including chronic diseases, lifestyle, and environment. In order to better focus on and manage the health of the elderly, wearable smart devices have emerged as an emerging health monitoring tool. However, currently most wearable devices on the market are mainly designed for young people, and the special needs and usage habits of the elderly have not been fully considered.

The article aimed to design and research a wearable smart bracelet specifically designed for the elderly based on the concept of humanization, aiming to achieve real-time monitoring, data analysis, and personalized health advice for the elderly. By combining advanced sensing technology, intelligent algorithms, and user-friendly design, it is hoped to provide more convenient, accurate, and caring health monitoring solutions for the elderly, thereby improving their quality of life and health level.

2. Related Work

In recent years, many scholars and experts have conducted relevant research on smart bracelets for the elderly. Zhao Xin proposed a design for an elderly health monitoring bracelet system. After actual testing, the accuracy rates of fall monitoring and exercise step monitoring were over 90% and 95%, respectively [1]. Liu Xiaohua explored the willingness and expected functions of elderly people in a certain community to use smart bracelets, providing a basis for carrying out health education and intelligent elderly care services for elderly people in the community [2]. Sun Juying explored the application and effectiveness of wireless smart bracelets in intestinal preparation for colonoscopy in the elderly. The results indicated that wireless smart bracelets can quantify activity in the preparation for colonoscopy in elderly patients, improve patient compliance with medication during activity, and contribute to improving the quality of intestinal cleaning [3]. The above research has played a certain role in the design of smart bracelets for the elderly, but there is little discussion on humanized design.

3. Intelligent bracelet Health Monitoring Design

3.1 Humanized Design Concept

Humanized design is a design approach that takes human needs as the starting point and centers on user experience. Humanized design requires a combination of product functionality and user experience to achieve the best product. This not only improves product quality, but also provides users with a better user experience.

The concept of humanized design is to meet the basic needs of users and enable them to obtain more value from the product. The concept of humanized design is to design with people at the center, rather than technology at the center, mainly manifested in the following aspects: first, it is necessary to fully understand the user's habits of using the product; secondly, it is necessary to meet the needs of users at different age groups; thirdly, it is necessary to combine functionality, appearance, and usage methods; fourthly, it is necessary to continuously optimize the product to meet the needs of different groups of people in terms of product functionality, appearance, and usage [4].

In the product design process, it is important to have a thorough understanding of user usage habits in order to configure the product's functions reasonably and improve the user experience. The elderly are the main users of smart bracelets, and as a medical device that can achieve continuous monitoring, smart bracelets need to fully understand the usage habits of the elderly, and the design process needs to consider their usage habits. At the same time, elderly people have very high requirements for products, not only to ensure that the products have a high appearance, but also to have a good wearing experience. For example, in the design process, in order to ensure a wearing experience, it is necessary to use soft, comfortable, lightweight and convenient materials for the design; in the design process, it is also necessary to consider the physical characteristics of the elderly. For example, when designing a bracelet, in order to ensure a wearing experience and effectiveness, detachable components can be installed on the bracelet to enhance the user's wearing experience [5].

As the physical condition of elderly people declines, the demand for healthcare is also gradually increasing. In daily life, elderly people need to constantly pay attention to their physical health status. Wearable smart bracelets can help elderly people monitor their physical health in real-time, thus effectively preventing the occurrence of diseases. Wearable smart bracelets can also help elderly people understand their location in a timely manner through GPS positioning function, and let them know their safety status through remote monitoring function, thereby improving their sense

of security. However, for some older adults with memory decline, it is difficult to remember their position, which requires wearable smart bracelets with voice broadcasting function. In this way, even if problems are encountered during use, they can be resolved in a timely manner, thereby increasing the trust and dependence of the elderly on the product. Therefore, wearable smart bracelets can be designed according to the needs of different age groups.

Due to their older age, elderly people begin to decline in various aspects of their physical functions, resulting in many inconvenient situations in daily life, such as limited mobility and decreased memory. Traditional products can only monitor the health status of users, but for the elderly, their physical condition can no longer meet the monitoring requirements of the product. Therefore, it is necessary to comprehensively monitor the physical condition of the elderly during product design. At the same time, due to the unique physiological characteristics of the elderly, it is necessary to pay attention to the problems that elderly people encounter when using products, and consider these issues in the design process to ensure that the products can meet user needs after being designed. In addition, it is necessary to consider the elderly's requirements for the appearance of the product in the appearance design, and design the product in combination with its usage. Finally, it is necessary to combine product features, appearance, and usage methods to provide users with the best user experience [6].

3.2 Physiological Characteristics and Psychological Needs of the Elderly

The physiological characteristics and psychological needs of the elderly are mainly reflected in aspects such as difficulty in movement, hearing loss, decreased vision, memory decline, and poor sleep quality. (1) With the increase of age, the functions of the body organs of the elderly gradually deteriorate, making it difficult for the elderly to move, especially those suffering from cardiovascular diseases, diabetes and lung diseases. (2) The degree of hearing loss in elderly people is related to their age. As they age, their hearing gradually decreases, especially in noisy environments where they may not be able to hear others speaking. (3) Due to the degradation of physical functions, elderly people may experience blurred vision when looking at things. (4) Memory may decline as people age. Research has found that memory begins to decline after the age of 60. (5) The poor sleep quality of elderly people is mainly manifested in poor sleep quality, insomnia, early awakening, and other conditions. From the above analysis, it can be concluded that the physiological characteristics and psychological needs of the elderly have a significant impact on the design of smart bracelets. Therefore, based on the concept of humanization, the article proposes the design principles and methods of wearable smart bracelets for the elderly [7].

Simple operation is the first principle of wearable smart bracelets for the elderly. At the beginning of design, it is necessary to consider the physiological and psychological characteristics of the elderly and meet their needs for simple operation and convenient use. The design of wearable smart bracelets for the elderly follows the principle of simplicity and generosity, avoiding psychological burden on the elderly due to overly complex appearance design. The wearable smart bracelet for the elderly should be based on their usage habits and be innovatively designed in terms of function and appearance according to their usage habits.

The function of a smart bracelet should be simple, easy to operate, and most convenient for the elderly to use. When designing, the following aspects can be considered. (1) The number of buttons are simplified to reduce the memory burden on the elderly. (2) For the convenience of the elderly, the appearance of smart bracelets should be kept simple and beautiful. (3) Due to the poor physical condition of the elderly, they often cannot wear smart bracelets for a long time. Therefore, a detachable design is adopted, which makes it convenient for the elderly to remove them for testing at any time. (4) At present, smart bracelets are mainly interacted with through mobile applications.

However, elderly people are older and have decreased vision and hearing, which leads to poor mastery of the operation of smart bracelets. To address these issues, the article proposes an interactive method for wearable smart bracelets, which mainly includes three methods: voice interaction, touch interaction, and button interaction [8].

The physiological and psychological needs of the elderly both affect the appearance design of smart bracelets. In order to meet the psychological needs and physiological characteristics of the elderly, the article proposes a smart bracelet appearance design with distinct features. (1) It mainly uses dark tones, which can increase color contrast and layering. (2) It is mainly based on straight lines, which can enhance the thickness and texture of the product. (3) It focuses on functionality and integrates various functional modules together.

After analyzing the elderly, the article finds that when designing smart bracelets, the elderly have higher requirements for the operating interface. Through investigation and research, it has been found that elderly people may encounter problems such as "cannot find", "cannot see", and "cannot use" when using smart bracelets, mainly due to the overly complex operating interface. Meanwhile, due to the decline in cognitive abilities of the elderly, they may encounter difficulties in operating the interface. In response to this situation, the article proposes two solutions: simple operation and simplified interface.

For elderly people, they prefer simple operating methods. In order to reduce the impact of complex information on the elderly and facilitate their use of smart bracelets, the article proposes two solutions. The first method is to integrate the touch screen into the bracelet, which can prevent the elderly from giving up using smart bracelets due to operational difficulties. The second approach is to simplify the text and symbols in the interface. The purpose of simplifying the interface is to facilitate the use of elderly people [9]. For example, setting a large icon on the main interface of a bracelet can reduce the difficulties that elderly people may encounter during use.

3.3 Smart Bracelet Design

The article divides smart bracelets into two types through user research: one is a simple health monitoring smart bracelet, and the other is a smart bracelet combined with medical technology. Specifically, the former is mainly used to monitor physiological indicators such as heart rate, blood pressure, and sleep quality in the elderly, and to convert the changes in these indicators into a user-friendly interface that is easy for the elderly to understand and accept through certain algorithms, thus facilitating their monitoring. The latter analyzes and judges the user's physical health status through the data collected by sensors. Therefore, the article designs an intelligent bracelet based on medical technology, which can monitor the physical health status of elderly people in real-time through physiological indicators such as blood pressure and heart rate [10].

According to user research results, the article divides bracelets into two categories: one is application software developed based on smartphone platforms, and the other is application software developed based on smartwatch platforms. Application software developed based on smartphone platforms has high scalability, customizability, and portability; the application software developed based on the smartwatch platform has lower scalability. The smart bracelets developed based on medical technology are more satisfied with medical monitoring functions. This type of smart bracelet can not only achieve the above functions, but also complete other life tasks such as recording steps and measuring heart rate. On the basis of the above two aspects, the article proposes a design scheme, as shown in Figure 1.

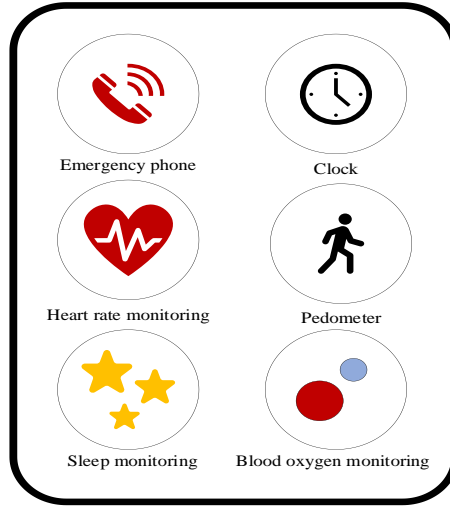


Figure 1: Design scheme

In Figure 1, the functions of the bracelet mainly include emergency phone, clock, heart rate monitoring, pedometer, sleep monitoring, and blood oxygen monitoring. Some calculation formulas involved in these functions are as follows [11].

$$HRV = R - r^2 \quad (1)$$

$$S = \frac{s_i}{s_j} \times 100\% \quad (2)$$

$$P = \frac{Cov(x, y)}{\sigma(x) \times \sigma(y)} \quad (3)$$

In the formulas, HRV represents heart rate variability; R is the standard deviation; S represents sleep efficiency; P is the Pearson correlation coefficient.

The article divides the elderly into four major groups: those with strong self-care abilities and good living conditions; the elderly population with poor self-care ability and average living conditions; the elderly population with poor self-care ability and poor living conditions; a group of elderly people with poor living conditions and strong self-care abilities. The article analyzes three aspects: appearance design, user interface design, and smart bracelet functionality. Firstly, appearance design: it designs the appearance from the aspects of color, shape, material, etc; secondly, the operation interface: it designs the operation interface from the aspects of user interface design, operation mode, information structure, etc; thirdly, the function of smart bracelets: It designs the functions of smart bracelets from various aspects such as the type, usage, and purpose of use [12].

The article analyzes the physiological, psychological, and behavioral characteristics of the elderly, and designs an intelligent bracelet based on medical technology, and innovates it to a certain extent. Specifically, the article mainly designs a wearable smart bracelet and compares it with ordinary smart bracelets to make it more in line with the physiological and psychological characteristics of the elderly. Ordinary smart bracelets are relatively single in terms of functional design, mainly with step counting function. However, the wearable smart bracelet designed in this article can monitor physiological indicators such as heart rate and blood pressure in real-time, and convert these indicators into a user-friendly interface that is easy for the elderly to understand and accept through algorithms [13].

4. Experimental Results and Discussion on Health Monitoring of Smart Bracelets

The article collected basic information about five elderly people, including their age, gender, height, and weight. This information helps to understand the individual characteristics of the subjects, in order to better analyze their health monitoring data when wearing wearable smart bracelets. The dataset is shown in Table 1.

Table 1: Related datasets

Identifier	Age	Gender	Height (cm)	Weight (kg)
1	73	Female	159	52
2	81	Male	165	63
3	75	Male	167	65
4	69	Female	160	53
5	79	Male	170	70

Among the 5 subjects in Table 1, there were 2 women and 3 men, all in the age range of around 70-80 years old, with the smallest being 69 years old and the largest being 81 years old. The ratio of weight to height was slightly higher. Next, the designed bracelets were worn on the hands of five people, and efficiency and accuracy experiments were conducted for a period of three months. The results are shown in Figure 2 and Figure 3, respectively.

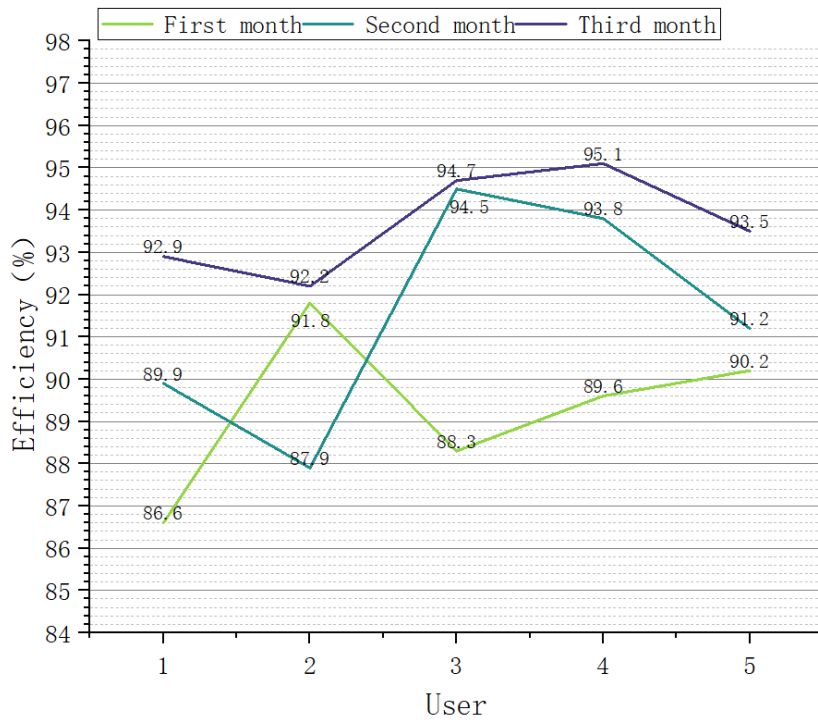


Figure 2: Efficiency

In Figure 2, in the first month, the monitoring efficiency of user 2 was the highest at 91.8%, while user 1 had the lowest at 86.6%. The calculated average efficiency of the five users was 89.3%. In the second month, the monitoring efficiency of user 3 was the highest at 94.5%, while user 2 had the lowest at 87.9%. The calculated average efficiency of the 5 users was 91.46%. In the third month, the monitoring efficiency of user 4 was the highest at 95.1%, while user 2 had the lowest at 92.2%. The calculated average efficiency of the five users was 93.68%. It can be seen that as the experiment continues, the overall monitoring efficiency continues to increase.

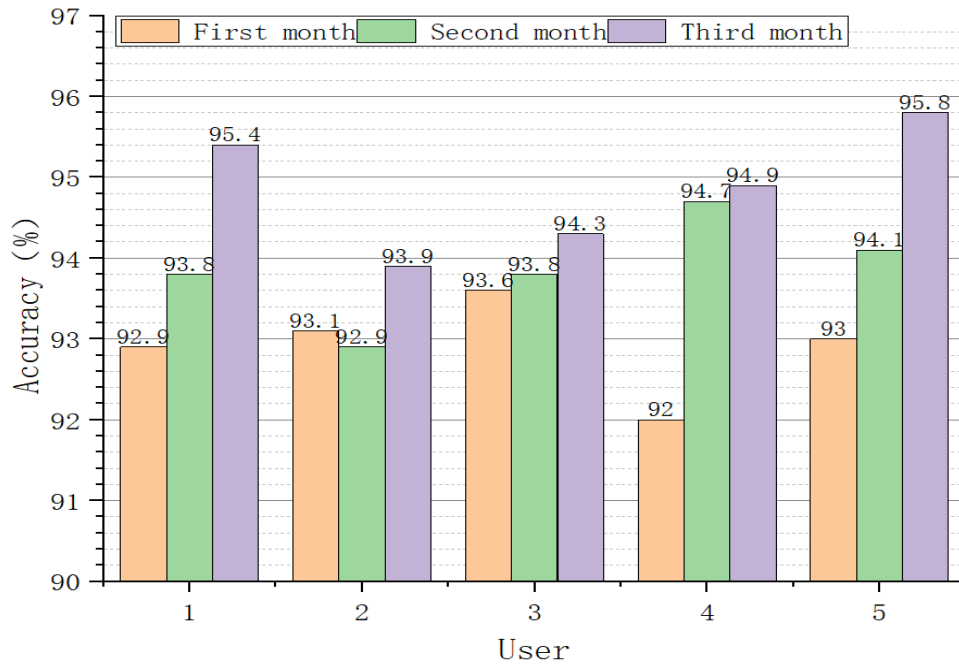


Figure 3: Accuracy

In Figure 3, in the first month, the monitoring accuracy of user 3 was the highest at 93.6%, while user 4 had the lowest at 92%. The calculated average accuracy of the five users was 92.92%. In the second month, the highest monitoring accuracy for user 4 was 94.7%, while the lowest for user 2 was 92.9%. The calculated average accuracy was 93.86%. In the third month, the highest monitoring accuracy for user 5 was 95.8%, while the lowest for user 2 was 93.9%. The calculated average accuracy for user 5 was 94.86%. It can be seen that the monitoring accuracy is gradually improving as the experiment progresses. In addition, the article also compared the functional integrity of the experimental designed bracelet with existing bracelets on the market, as shown in Figure 4.

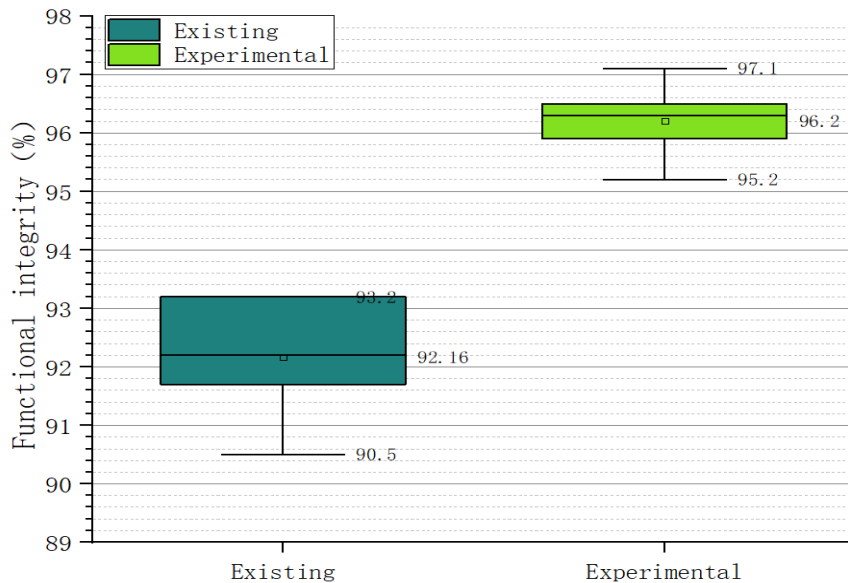


Figure 4: Functional integrity

In Figure 4, the functional integrity of the existing bracelet was highest at 93.2% and lowest at

90.5%, with a calculated average integrity of 92.16%; the functional integrity of the experimental designed bracelet was the highest at 97.1% and the lowest at 95.2%, with a calculated average integrity of 96.2%. Therefore, the experimental design of the bracelet has a relatively complete function. Finally, the designed bracelet was put into practical operation and a satisfaction survey was conducted, as shown in Table 2.

Table 2: Satisfaction survey results

	1-2	3-4	5-6	7-8	9-10
Humanization	1%	8%	28%	38%	25%
Convenience	2%	9%	27%	36%	26%
Comfort	1%	10%	29%	33%	27%
Durability	3%	10%	26%	37%	24%

In Table 2, the humanization score of the bracelet, with a total score of 1-4, accounted for 9%; 5-6 points accounted for 28%; a total score of 7-10 accounted for 63%. In the convenience score, a total score of 1-4 accounted for 11%; scores of 5-6 accounted for 27%; a total score of 7-10 accounted for 62%. The remaining two evaluation indicators also had a score ratio of 7-10 points, which was much higher than 1-4 points. It can be seen that the bracelet designed in the experiment has achieved good results in actual operation.

The article discussed a health monitoring design for wearable smart bracelets for the elderly based on the concept of humanization. Among them, considering the needs and preferences of the elderly, a smart bracelet that meets their needs was designed. The bracelet has a health monitoring function, which can monitor real-time indicators such as heart rate and blood pressure, providing accurate health status information. At the same time, the article also conducted relevant experiments on monitoring efficiency, monitoring accuracy, and functional integrity, and the results showed excellent results. When conducting satisfaction surveys, the results were also quite optimistic.

5. Conclusions

The article analyzed the physiological characteristics and psychological needs of the elderly, and identified three design elements that a humanized design concept for wearable smart bracelets for the elderly requires: design process, product functions, and user experience. On this basis, the article designed an intelligent wearable smart bracelet for the elderly, which has been proven to achieve good monitoring effects through practical applications. Under the joint action of these three aspects, the elderly can effectively achieve real-time monitoring of their health status. In short, wearable smart bracelets for the elderly under the concept of humanization can bring people a better life experience and health services.

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