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Research Article

Construction and Application of Rehabilitation Training System Based on Intelligent Measurement and Control

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Rehabilitation training plays a very important role in the treatment of movement disorders. In order to meet the needs of modern rehabilitation training, this paper designs a rehabilitation training system based on intelligent measurement and control. The system realizes software and data construction through C/S architecture and B/S architecture. The intelligent measurement and control technology is used to identify and compare the patient's movements, obtain the matching degree of the movements, correct the movements, and evaluate the training results. The rehabilitation system is constructed through the customized subsystem of rehabilitation specialist, patient training subsystem, and background management subsystem. Through experimental tests, the conclusions are drawn: first, the intelligent measurement and control algorithm has good convergence speed and network generalization ability. The average correct rate is 93.9% for the patient group and 94.5% for the healthy people, and the output results obtained are close to the ideal value. Second, the pressure test results show that the system can run stably when the concurrency is 100, 200, 500, and 1000. Third, the software design of the rehabilitation training system can meet the requirements in terms of usability, the accuracy rate is above 80%, and the user satisfaction is high. Fourth, compared with before training, the time for subjects to maintain balance during and after training increased significantly, indicating that the rehabilitation exercise training system has the ability to train standing static balance, and the training effect is significant. The system improves the effect and efficiency of rehabilitation training and has broad application prospects in the field of limb rehabilitation.

1. Introduction

Population aging is a common phenomenon and trend in the world today. With the intensification of population aging, the incidence and disability rate of cerebral thrombosis, stroke, hypertension, Parkinson's, knee arthritis, and other diseases are getting higher and higher, causing motor dysfunction such as standing imbalance and walking instability. This brings inconvenience to the patient's life [1]. China has a huge potential population in need of rehabilitation, with an estimated total population of 170 million, including the elderly, the disabled, and chronic patients. It is estimated that by 2030, the prevalence of chronic diseases in China will be as high as 65.7%, 80% of whom will need rehabilitation training. Studies have shown that 90% of patients can recover their body functions to the maximum extent and improve their work and life self-care ability through a large number of intensive and repetitive rehabilitation training [2]. Therefore, rehabilitation training is a necessary treatment process and plays a very important role in the treatment of movement disorders. The traditional rehabilitation training mode relies on one-on-one training with therapists and has achieved certain results, but there are also many shortcomings and drawbacks: a serious shortage of medical staff, rehabilitation training is monotonous and boring, and data are difficult to record and query. These questions have plagued doctors and patients alike. Therefore, it is an important research topic to provide a rehabilitation training system that can train independently, has high interest, can record and query the training data in detail, and has good effects.

The rapid development of computers and artificial intelligence has injected new impetus into intelligent measurement and control technology. Intelligent measurement and control technology has good convergence speed and network generalization ability. It is widely used in many fields and has achieved good results in the field of rehabilitation training [3]. In view of the needs of rehabilitation training, this paper designs a rehabilitation training system based on intelligent measurement and control. The core technology is to use intelligent measurement and control technology to realize one-to-many remote rehabilitation guidance of rehabilitation teachers, make up for the lack of physical rehabilitation resources, and combine traditional rehabilitation training in the form of games. The method can relieve the boring feeling of traditional rehabilitation training and increase the interest of rehabilitation training. The system combines physical rehabilitation and psychological adjustment while carrying out physical rehabilitation training, taking into account the psychological and emotional adjustment of patients, so as to improve the effect and efficiency of rehabilitation training.

1.1. Related Discussion. Health issues are a concern of people all over the world [4]. With the continuous development of the aging population and the increasing traffic accident rate, the number of injured people around the world are showing a growing trend. These patients have different degrees of incapacity to work, affecting their daily lives. A large number of researchers and medical personnel have found through research that active rehabilitation training causes the pituitary gland to secrete a large number of live brain polypeptides to repair damaged brain cells and replace the dead brain cells with dormant brain cells. An information bridge is built between brain cells and damaged functions, and brain reorganization cells are stimulated through functional training to restore damaged parts and achieve the purpose of rehabilitation [5]. Rehabilitation training refers to the purpose of improving the patient's lower extremity movement ability, selecting appropriate exercise modes according to different rehabilitation stages, and carrying out corresponding rehabilitation exercises. Active rehabilitation training can improve patients' impaired motor function and enhance their ability to live independently [6].

With the development of computer technology, the rehabilitation training of patients is initially assisted by medical personnel and is now completed by the use of professional medical equipment auxiliary systems [7]. The functions of the medical device auxiliary system have also become more intelligent, which can help patients carry out a series of scientific and effective physical exercises and speed up the recovery of patients. For example, developed countries such as Germany, Switzerland, and the United Kingdom have taken the lead in research in this field [8]. The Dutch scholar Peter H. Weldink has made such an exploration. He integrated monitoring equipment, small accelerators, and patient monitoring equipment, so that acceleration information can be obtained, and relevant recovery treatment plans can be formulated for patients based on this information [9]. Hushen Hai of the University of Essex in the United Kingdom conducted research on medical devices used by stroke patients. These medical devices monitor the lives of stroke patients around the clock through cameras, mobile monitoring, and other equipment. Relevant disease data obtained through monitoring can be handed over to the patient's attending doctor, and the doctor can formulate a professional recovery exercise plan for the patient through research and analysis of the data [10]. Scholars such as Valentino J in the United States have developed a system called "exercise talk," which analyzes the data information obtained through the device and then helps patients to carry out disease rehabilitation exercises in their own homes [11]. Scholars such as Pastor in the United States combined the Kinect technology with their own research system to provide recovery assistance for the upper limbs of stroke patients, and the treatment effect was satisfactory [12]. The teachers and students of Yanshan University have conducted research on electrical stimulation technology to study the therapeutic effect of this type of technology in paralyzing diseases. For the common characteristics of paralyzed patients, they have developed a rehabilitation treatment system suitable for paralyzed patients, which has realized the systematic overall design [13]. The teachers and students of Harbin University have carried out relevant professional research on the rehabilitation assistant robot, mainly exploring the control of the strength of the rehabilitation assistant robot and the implementation of the training program [14].

To sum up, Chinese and foreign scholars have carried out a lot of research on rehabilitation training technology and products. However, due to the short research time, there are problems such as low integrity of the rehabilitation training system, low scene richness, rough interface, inability to carry out personalized training, lack of feedback on training, and lack of evaluation of results [15]. Combined with a rehabilitation training system, intelligent measurement and control technology is a kind of new train of thought, the human body movement through gathering the data, the matching of human action, let patients in rehabilitation training and computer interaction, guided by computer in patients with rehabilitation training, not only brought a certain interest but also get rid of the need to be trained and professional restrictions. This topic takes the abovementioned problems as the research point, applies the intelligent measurement and control technology to the rehabilitation training system, uses the intelligent measurement and control technology and algorithm to identify the patient's movements in real time, compares it with the standard movement data to obtain the matching degree of the patient's movements, and gives the movements to the patients. Evaluate, correct, organize, analyze, and visualize the training results. Finally, through analysis, the system can assist in the next recovery training plan, thereby further improving the accuracy and accuracy of the training system test and providing help for the majority of patients to receive rehabilitation treatment more effectively in the community and family.

2. Construction of Rehabilitation Training System

The rehabilitation training system based on intelligent measurement and control completed the construction of the rehabilitation training system from three aspects: system architecture design, system functional structure, and intelligent measurement and control.

2.1. System Architecture Design. The rehabilitation training system mainly includes PC-side software, data management system, and intelligent measurement and control module. The overall architecture includes PC-side rehabilitation software implemented by C/S architecture; data management system website implemented by B/S architecture; and intelligent measurement and control module based on Python application. The PC-side rehabilitation software provides the functions of rehabilitation training and 3D simulation for patients to use. Rehabilitation technicians need PC-side rehabilitation software to perform posture and movement entry and upper limb recording file playback and simulation operations. The web terminal provides the function of data management and provides the operations of adding/deleting/modifying/checking, and the users are mainly rehabilitation practitioners [16]. The intelligent measurement and control module realizes the background start-up response feedback control. The overall architecture of the final designed system is shown in Figure 1.

It can be seen from Figure 1 that the system consists of a system front-end, a system back-end, and an intelligent measurement and control module. The front end of the system includes a PC-side software and a data management system website accessed by a browser. The background of the system includes the management system server, cache, and system database. The server provides the interface for recording data for the PC software and provides the management system website on the web [17]. The intelligent measurement and control module software includes self-starting service, operation response program, data multiprocessing program, data storage, cloud synchronization, algorithm interface, and feedback interface. After the system is powered on, the self-starting service will run automatically. On the one hand, it detects the status of the two operation buttons in the interactive module, and on the other hand, it synchronizes the existing training data to the cloud.

2.2. System Functional Structure. The types of users based on the system are rehabilitation specialists, patients, and background administrators. Therefore, the rehabilitation training system based on intelligent measurement and control is divided into rehabilitation specialist customization subsystem, patient training subsystem, and background management subsystem, as shown in Figure 2.

It can be seen from Figure 2 that the rehabilitation customization subsystem includes a rehabilitation login module, a patient information management module, a training content setting module, a training situation query module, a training content definition module, and a training content editing module. The rehabilitation teacher login module provides basic login information and login system functions. The patient information management module mainly saves the basic information of the patient. The training content setting module is associated with each patient. Once a patient's basic information is entered, the default training content is automatically generated [18]. The training situation query module queries the training situation of a certain time and the training situation within a period of time according to the patient's name and presents it in the form of a list or a line graph. The training content definition module is the color image and human joint data reflecting human posture and action and its confidence. The training content editing module specifies the category, name, and training joint of the input action and displays the color map, joint position, and joint confidence of the corresponding action according to the category.

The patient-side training subsystem is mainly composed of two parts: limb rehabilitation training and psychological adjustment. Limb rehabilitation training includes patient login module, patient preparation module, patient training module, and settlement module. It mainly conducts continuous and stable training according to the customized training plan of the rehabilitation specialist and adds VR scenario simulation to improve the fun of training. Before the system is started, the patient's joints are identified and tracked, and the completion of the patient's movements is uploaded to the rehabilitation specialist's customized subsystem during the training process. The psychological adjustment system includes two modules: the shouting catharsis module and the meditation module. The traditional shouting catharsis therapy and mindfulness therapy are placed in the VR environment, and the effect of the psychological adjustment is achieved by completing the shouting interaction in the VR environment.

The background management subsystem authorizes corresponding functions according to different roles. Administrators have permissions to create users, delete users, query user information, assign roles, and associate users [19]. Rehabilitation coaches have the authority to query patient information, query training records, query and delete postures, and add, delete, modify, and query training information [20].

2.3. Realization of Intelligent Measurement and Control. The intelligent measurement and control module includes 7 modules: data reception, posture feature calculation, three-

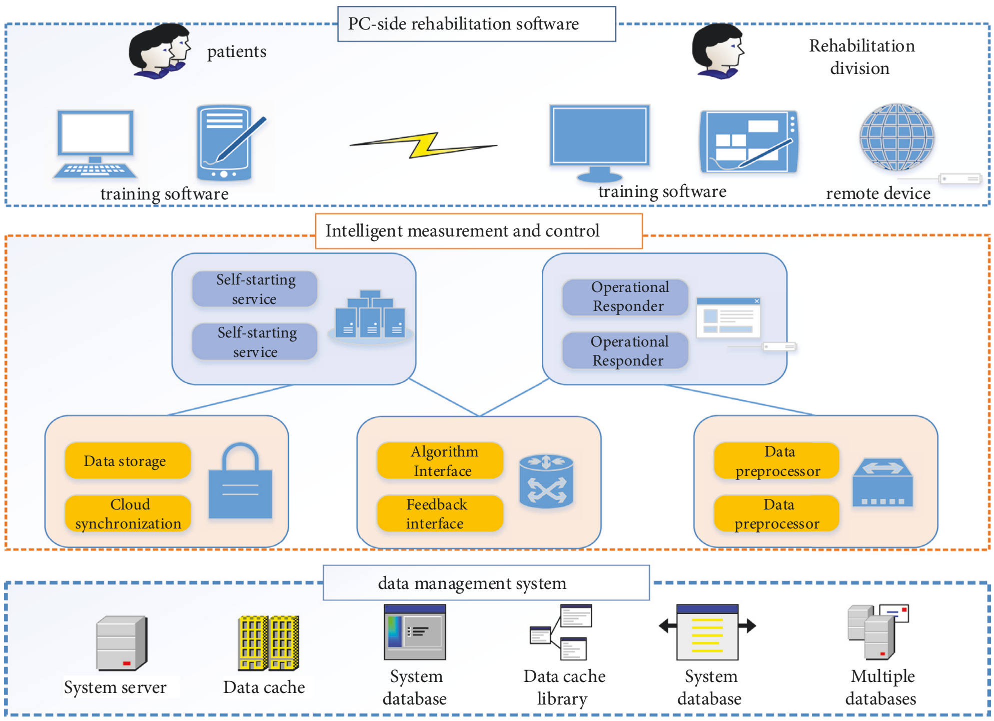


Figure 1: Overall system architecture diagram.

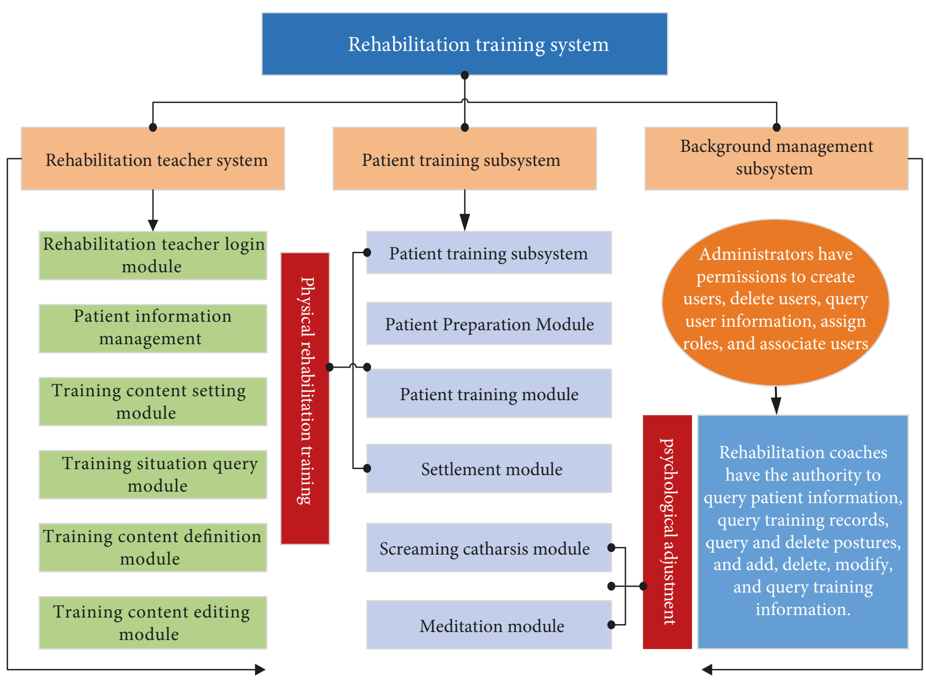


Figure 2: Functional diagram of the rehabilitation training system.

dimensional simulation, posture matching, action matching, action acquisition, and rehabilitation games. The overall software module division and data flow are shown in Figure 3.

In the process of realizing the intelligent measurement and control module process, the intelligent measurement and control technology and algorithm are a very important part. This paper uses intelligent measurement and control technology to obtain the coordinates of 25 human body joint points. In order to reduce the amount of calculation, this paper filters the joint points and only processes the data of the remaining 17 joint points, which greatly reduces the amount of data and facilitates calculation.

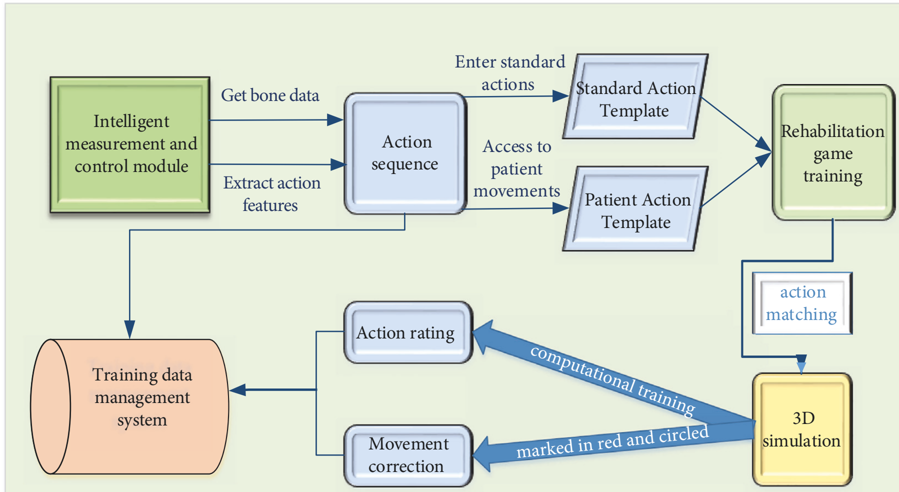


Figure 3: Intelligent measurement and control module and data flow diagram.

2.3.1. Extraction of Measurement and Control Signs. The extraction of measurement and control signs is used for the real-time acquisition of human movement data. Currently, the commonly used motion acquisition technologies mainly include wearable devices and video tracking technology. The system uses sensors based on video tracking technology to collect motion data. It has three lenses: RGB color camera, infrared transmitter, and infrared receiver.

Since the coordinate data of each joint point acquired in real time by the intelligent measurement and control technology is greatly affected by individual differences, this paper selects the joint rotation angle as the action feature and obtains 18 angle features from the coordinates of the 17 joint nodes. The following takes the right arm as an example to introduce the calculation method of the angle feature:

(1) The angular characteristics of the elbow joint of the right arm are shown in Figure 4. To calculate the angle feature, it is necessary to construct a set of vectors on both sides of the included angle, and according to the calculation formula of the joint angle, we can obtain the following equation:

$$\angle SRQ = \arccos \frac{RS \vec{\bullet} RQ}{|RS| \bullet |RQ|} RQ. \tag{1}$$

(2) The angle feature of the right arm shoulder joint on the YOZ plane, as shown in Figure 4, is the angle between the plane QPQ and the plane SRQ, which can be obtained according to the calculation formula of the angle between the space plane:

$$\angle T = \arccos \frac{N_1 \vec{\bullet} N_2}{|N_1| \bullet |N_2|} N_2. \tag{2}$$

Here, N_1 and N_2 are the normal vectors of plane QPQ and plane SRQ, respectively.

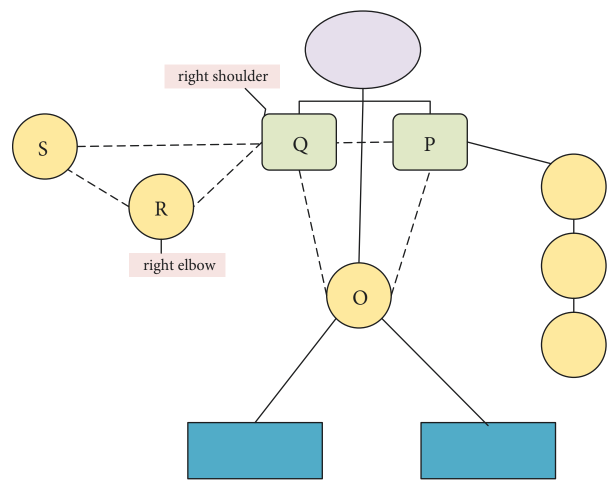


Figure 4: Angle feature map of the elbow joint of the right arm.

$$\begin{aligned} \vec{N_1} &= \vec{PQ} \times \vec{PO} = \det \begin{vmatrix} PQ_X PQ_X PQ_Z \\ PO_X PO_Y PO_Z \end{vmatrix}, \\ \vec{N_2} &= \vec{PQ} \times \vec{PO} = \det \begin{vmatrix} RQ_X RQ_X RQ_Z \\ QS_X QS_Y QS_Z \end{vmatrix}. \end{aligned} \tag{3}$$

Finally, all the angle features are put into a set R, which is used to determine the unique action.

$$R = \{\phi_1, \phi_2, \ldots \phi_d\}. \tag{4}$$

2.3.2. Entry of Standard Actions. In order to standardize the template actions entered by the system as much as possible, each set of actions is entered by multiple people, the action feature set of multiple people is obtained, and the average value is processed as the final template feature of the action [21]. After the collection of all actions is completed, the obtained template action feature sets are connected into a string according to the action sequence and stored in the database.

2.3.3. Matching of Training Movements. For the same action, due to individual differences, the speed of the action will be divided into fast and slow, resulting in differences in the action sequence on the time axis. The dynamic time warping algorithm can be used to find the best alignment of the two sequences. The main idea of this algorithm is to regularize the test sequence and template sequence through the expansion and contraction of the time series, calculate the matching degree between the sequences, and find the shortest path [22].

The patient training action sequence and the standard action sequence are defined, the lengths are h and k, respectively, and the value of each point in the sequence is the feature value of each frame in the action sequence.

Using a dynamic programming algorithm to solve the shortest path can greatly reduce the amount of computation. Construct a $h \times k$ matrix grid, as shown in Figure 5, the matrix elements (i, j) represent the Euclidean distance between the two points a_i and f_j.

$$B(a_i, f_j) = (a_i + f_j) \times (a_i - f_j). \tag{5}$$

The optimal regular path is the path with the smallest cumulative distance from to (h, k) in this grid. The state transition equation of the cumulative distance $\alpha(i, j)$ is

$$\partial(i, j) = B(a_i, f_j) + \min \partial(i+1, j+1) \times \partial(i+1, j). \tag{6}$$

Note that, the minimum cumulative distance is $M(E, F)$ and the path length is L, then the average similarity of the paths is

$$DTW(E, F) = M(E, F) * L. \tag{7}$$

When the similarity is less than the standard threshold set by the system, the two action sequences are matched successfully.

2.3.4. Training and Assessment. The DTW distance can reflect the similarity between the patient's movement and the standard movement. This paper designs a set of movement evaluation and correction system based on the DTW algorithm and selects the parts containing more human movement information, and the left and right symmetrical four parts (shoulder, elbow, hip, and knee), including a total of 12 angular features. Each angle feature is scored as follows:

$$R_P = R_T + (M - M_n) * L_P. \tag{8}$$

Here, R_P is the rating of Angle characteristics, R_T is the total score, and the system sets the total score to 10; M is the DTW distance value, M_n is the minimum value in the effective value range of the DTW distance; L_P is the loss parameter of the action, and different skeleton nodes correspond to different loss parameters. The final score V

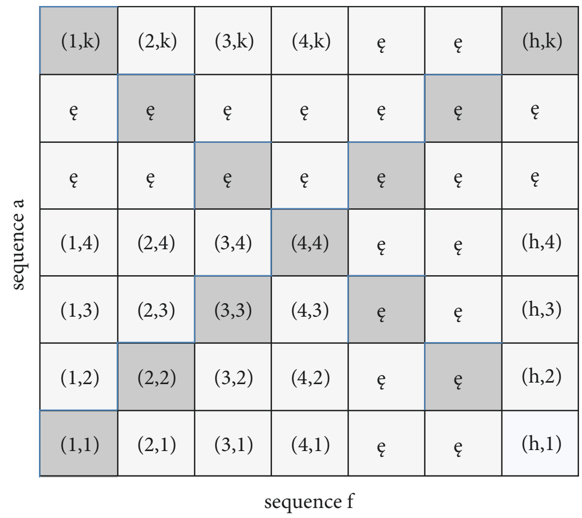


FIGURE 5: $h \times k$ matrix grid.

for each action is the average of the scores of the 12 angular features.

$$V = \frac{m}{n} \sum_{p}^{n} n = 1 \times V_P, \tag{9}$$

Here, V_P is the grade of the angle feature.

In order to evaluate the actions more intuitively and concisely, the system finally gives five evaluation levels of "A, B, C, D, and E" according to the scores. At the same time, the score of each angle feature is compared with the average score, the skeleton node with the lower score is found, and the corresponding point is marked in red and circled on the screen to achieve the effect of correcting the action.

2.4. Experimental Design and Testing. In order to verify the function and performance of the intelligent measurement and control algorithm and the system, the algorithm and function tests were carried out on the system in the test environment, as shown in Table 1. It includes login function, user management function, patient information, posture management, motion management, training management, and training record management functions.

Experimental steps: first, enter 6 actions as templates. According to the above-given method, each template action is collected 5 times to complete the establishment of the template library. In the test session, 10 healthy subjects were selected to perform 6 actions in random order and with different degrees, each action was performed 10 times, and a total of 600 identification and evaluation operations were performed. Export the 600 test score records from the data management system and compare them with the subject test process recorded by the system. According to the action number recognized by the system, the correct recognition rate of the action is determined. According to the rating level and correction information given by the system, the evaluation accuracy is determined.

Table 1: Experimental test environment.

Server	Web environment	CPU	RAM (GB)	Hard disk	Operating system
Alibaba Cloud	IP: 168.105.36.201	4 nuclear	16	1 T	win11 64 bit
Huawei M2	IP: 168.105.36.225	4 nuclear	3	512 M	Android 12

Evaluation index: in the experimental process, the algorithm and system are tested and analyzed by several indexes such as detection accuracy, response error rate, operation accuracy, and root mean square error time ratio.

3. Results and Analysis

3.1. Detection and Analysis of Algorithms. In order to verify whether the intelligent measurement and control algorithm is feasible, it is necessary to measure the detection accuracy of three independent algorithms. To this end, we invited 10 patient volunteers, 10 healthy volunteers, and three medical experts to participate in the trial. Volunteer action completion standards are shown in Table 2.

20 volunteers each performed 20 sets of actions according to the game, which were evaluated by the system and the medical expert group, and the accuracy of the system's detection was checked and approved based on the opinions of the medical expert group. After measurement, taking the evaluation results of the expert group as the standard, we obtained the correct rate results of the evaluation of three independent algorithms. The intelligent measurement and control algorithm is denoted as A, the neural simulation algorithm is denoted as B, and the triple evaluation algorithm is denoted as C, as shown in Figure 6.

According to the experimental results in Figure 6, we can preliminary set the confidence of the three algorithms. According to the relationship of the correct rate, we roughly set it as $C1 = 36\%$, $C2 = 33\%$, and $C3 = 31\%$. The confidence parameter can also be modified according to the opinions of medical experts so that the system can better adapt to the actual situation.

As shown in Figure 7, after verification, we obtained relatively accurate evaluation results, with an average correct rate of 93.9% for the patient group and 94.5% for the healthy staff. This shows that the intelligent measurement and control algorithm has good convergence speed and network generalization ability, and the obtained output results are very close to the ideal value, which are in good agreement with the expected output results. It can be seen that the intelligent measurement and control algorithm method is suitable for the control requirements of rehabilitation training and can well complete the task of detecting the rehabilitation status of patients.

3.2. System Stress Testing and Analysis. Stress testing is an important part of system testing. By simulating the situation of a large number of users operating the system at the same time, it can predict the performance of the system under the condition of a large number of concurrent requests. This system uses Jmeter to stress test the complex trend graph data query interface. The test parameters and test results are shown in Table 3.

It can be seen from Table 3 that when the number of cycles is 1000, with the continuous increase of the number of user requests, the average user response time and the 90% response time continue to increase. The response time of 90% of the requests did not exceed its value, and the error rate was almost 0. The stress test results show that the system can run stably with acceptable concurrency.

3.3. System Usability Testing and Analysis. Usability testing is one of the most commonly used system evaluation methods. It is to test the use of the system, find out its existing usability problems, and conduct a more complete and comprehensive evaluation of it. This test invited 100 medical workers with typical behavioral characteristics as the tested users, with varying degrees of experience in rehabilitation nursing and medical device use. The simulation operation is carried out through the prepared system software prototype, and the operation process is performed by the staff to time the stopwatch and records the information. In this experiment, different medical workers were used for multiple experimental tests to obtain the average, so as to ensure the accuracy of the experimental results and the applicability of various occasions, as shown in Figure 8.

From the test results in Figure 8(a), it can be seen that the subjects' operation of system login and settings is relatively smooth. The user operation time is between 69 and 85S, and the operation accuracy rate is above 80%. This shows that the design of the software interface prototype of the rehabilitation training system can meet the requirements in terms of usability, and it is more reasonable and efficient in terms of interaction logic and operation process and can meet the needs of users.

This paper uses a five-point scale to measure the satisfaction information of the tested users. Twelve questions are set in the questionnaire, and multiple questions are set for satisfaction such as ease of use, ease of learning, aesthetics, interest, and professionalism. The test results are shown in Figure 8(b).

From the values in Figure 8(b), it can be calculated that ease of use accounts for 25.2%, ease of learning accounts for 15.5%, aesthetics accounts for 19.4%, fun accounts for 20.4%, and professionalism accounts for 19.4%. It shows that the testers are satisfied with all aspects of the system design, and their opinions are relatively unified.

Table 2: Volunteer action completion criteria.

Evaluation standard	A	B	C	D	E
Similarity range	$D > 90\%$	$80\% < D \leq 90\%$	$70\% < D \leq 80\%$	$60\% < D \leq 70\%$	$0\% < D \leq 60\%$
Recovery situation	Full recovery	Recover well	Partial recovery	Slight improvement	Not yet restored

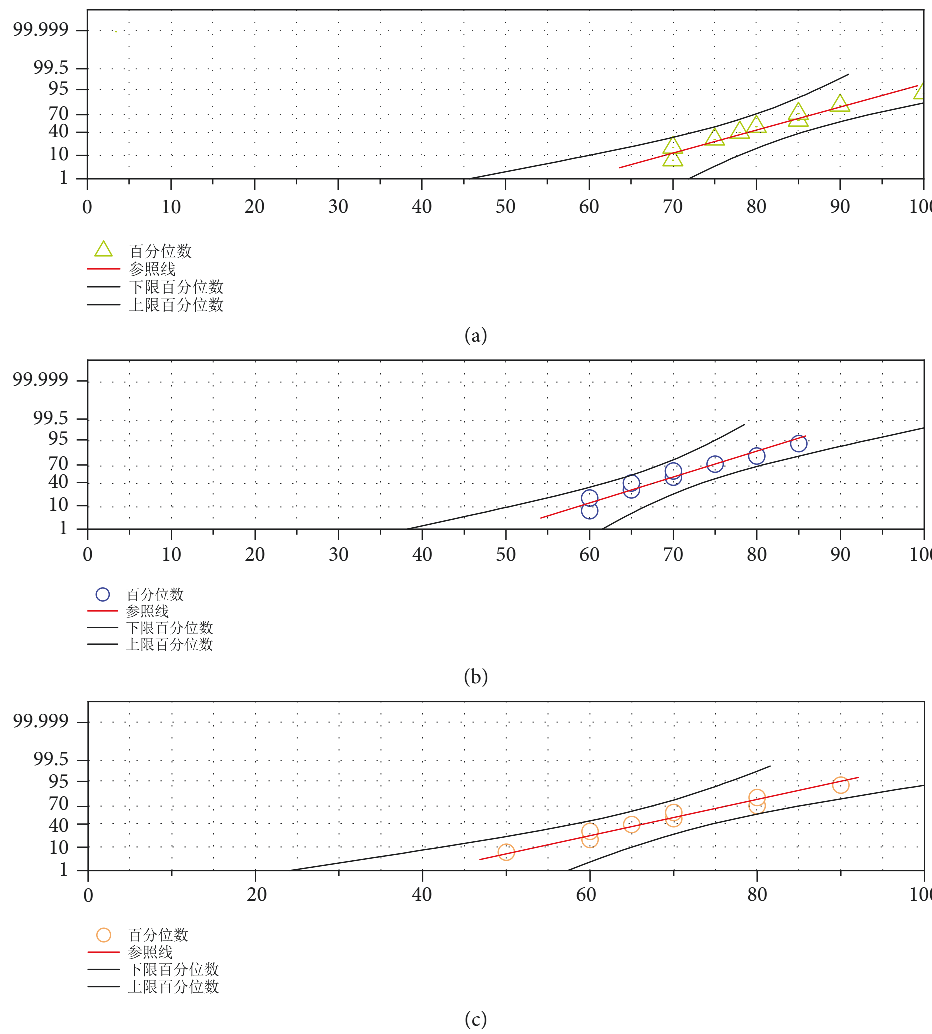


Figure 6: Accuracy results of three independent algorithm evaluations.

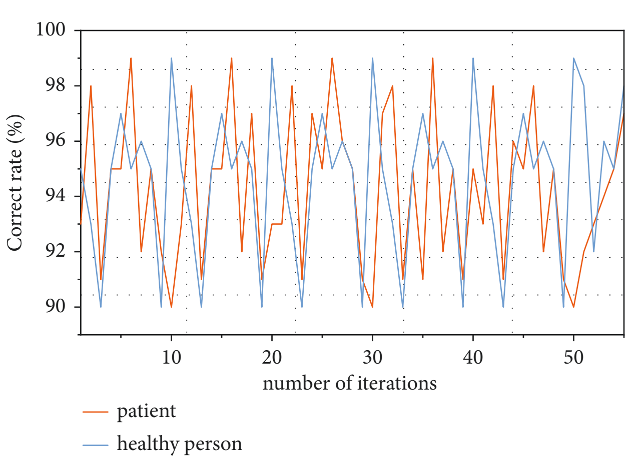


Figure 7: This system evaluates the correct rate.

Table 3: Test parameters and test results.

Concurrency	100	200	500	1000
Cycles	1000	1000	1000	1000
Average response time	256	423	1046	2024
90% response time	384	565	1319	2740
Error rate	0%	0%	0%	0.02%

3.4. System Training Effect Analysis. The system divides the data of 10 subjects into three stages: before training, during training, and after training. The root mean square error of the subject's torso shake in the left-right and front-rear directions and the time ratio of the subject's torso shake in the no-feedback zone were calculated, respectively. This experiment reflects the training effect of the system by testing the time the subjects maintain balance. The longer the

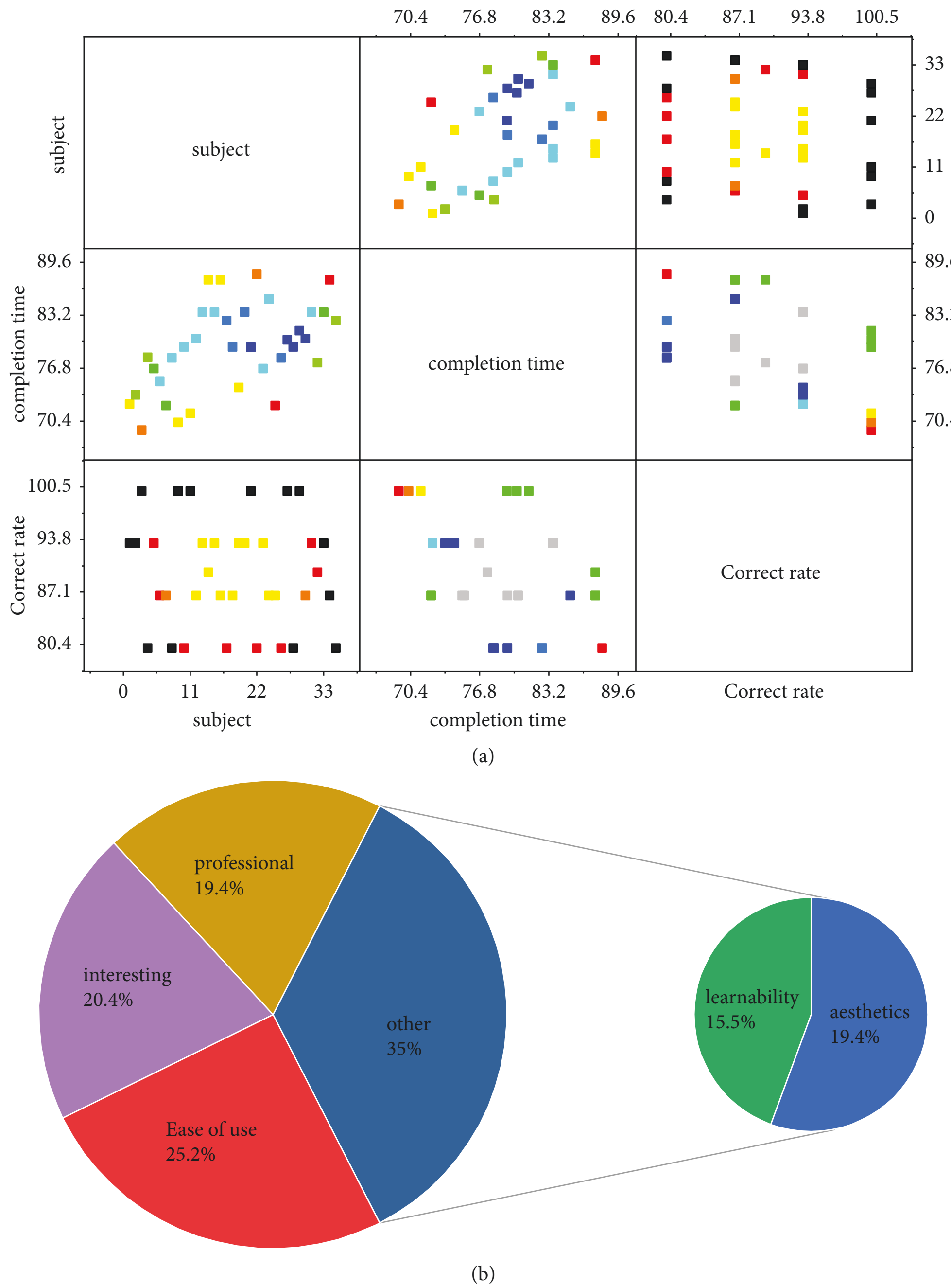


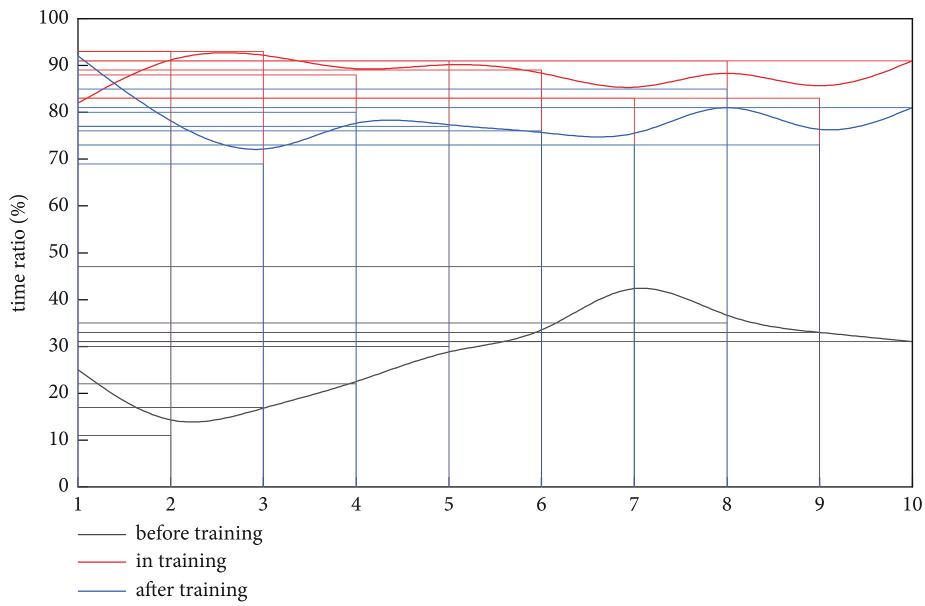
Figure 8: (a) System usability testing. (b) User satisfaction test chart.

subjects maintained their balance, the better the limb recovered and ultimately the better the exercise rehabilitation training proved.

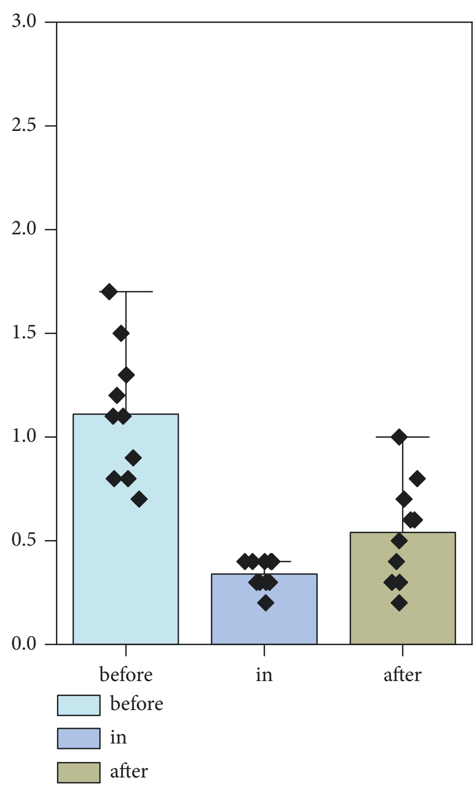
As can be seen from Figure 9(a), before training, the subject's torso shaking degree accounted for the smallest amount of time in the no-feedback zone. During training, the subject's torso shake was the largest portion of the time in the no-feedback zone. After training, the subject's torso sway accounted for less time in the no-feedback zone than during training. It shows that the greater the proportion of time, the longer the subjects maintain balance.

As can be seen from Figure 9(b), the root mean square error of the subject's left and right torso shaking before training was $1.2 \pm 0.5^{\circ}$, and the root mean square error during and after training were $0.4 \pm 0.2^{\circ}$ and $0.6 \pm 0.3^{\circ}$, which are 67.1% and 50.3% lower than before training. Compared with before training, the root mean square error of the subject's left and right torso shake was significantly reduced during and after training. Compared with the training, the root mean square error of the left and right torso shaking of the subjects increased after training.

It can be seen from Figure 9(c) that the root mean square error of the subject's front and rear trunk shaking before

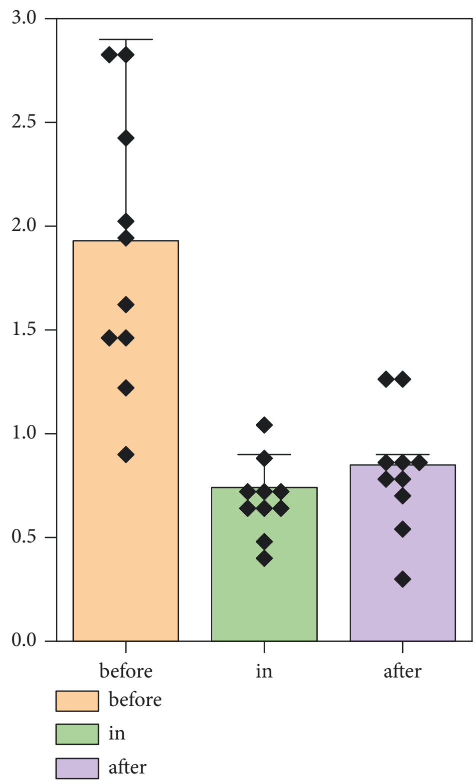


(a)



(b)

Figure 9: Continued.



(c)

Figure 9: (a) The proportion of time that the torso shake is in the no-feedback zone. (b, c) Subject's balance ability test.

training is $1.9 \pm 0.8^\circ$, and the root mean square error of the subject's front and rear trunk shaking during and after training is $0.7 \pm 0.3\%^\circ$ and $0.9 \pm 0.4^\circ$, which are 60.5% and 54.0% lower than before training. Likewise, the root mean squared error of the subject's front-to-back torso roll was significantly reduced during training and after feedback compared to before training.

The abovementioned experimental results show that the balance ability of the subjects during and after training was significantly improved compared with before training, and the time to maintain balance was also significantly increased. It shows that the rehabilitation exercise training system has the ability to train standing static balance, and the training effect is remarkable.

4. Conclusion

Based on the needs of rehabilitation practitioners, patients, and managers, combined with intelligent measurement and control algorithms and technologies, this paper builds a rehabilitation training system that can be trained independently, has high interest, can record and query training data in detail, and has good results. The system uses intelligent measurement and control technology and algorithms to identify, match, evaluate and correct patient movements in real time and organize, analyze, and visualize the training results to guide and assist patients in rehabilitation training. Finally, through experimental design, the system is applied to test 10 patients and 10 healthy volunteers, which shows that the system algorithm has good convergence speed and network generalization ability, and the average accuracy rate reaches 93.9% for patients and 94.5% for healthy volunteers. The system is simple to operate and has good stability and availability, with user satisfaction over 3.5 points; the training effect is remarkable, and it can complete the task of patient rehabilitation status detection and rehabilitation training treatment. However, the system still needs to be constantly updated and optimized to add new functions and features. The future research mainly includes the interface of PC software can be further optimized; rehabilitation training and rehabilitation games can add more strategies and increase the diversity of training and games so that users have more choices; network rehabilitation games, so that patients can play online games, to increase the fun of the game.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they are no conflicts of interest.

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