Hindawi
Security and Communication Networks
Volume 2022, Article ID 9806539, 1 page
https://doi.org/10.1155/2022/9806539

Retraction

Retracted: Computational Technologies in Internet of Things and Big Data Technology for Physical Exercise Rehabilitation System

Security and Communication Networks

Received 18 November 2022; Accepted 18 November 2022; Published 7 December 2022

Copyright © 2022 Security and Communication Networks. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Security and Communication Networks has retracted the article titled "Computational Technologies in Internet of Things and Big Data Technology for Physical Exercise Rehabilitation System" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the Chief Editor.

References

[1] N. Zhao, Y. Yan, X. Han, G. Zhang, and L. Chen, "Computational Technologies in Internet of Things and Big Data Technology for Physical Exercise Rehabilitation System," *Security and Communication Networks*, vol. 2022, Article ID 4193500, 12 pages, 2022.
[2] L. Ferguson, "Advancing Research Integrity Collaboratively and with Vigour," 2022, https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 4193500, 12 pages
https://doi.org/10.1155/2022/4193500

Research Article

Computational Technologies in Internet of Things and Big Data Technology for Physical Exercise Rehabilitation System

Nana Zhao,[1] Yinzhong Yan,[2] Xiao Han,[3] Gaofei Zhang,[4,5] and Long Chen[6]

[1]*College of Art and Physical Education, Gangneung-Wonju National University, Gangneung 210-600, Republic of Korea*
[2]*Basic Department, Zhengzhou Information Engineering Vocational College, ZhengZhou 462121, Henan, China*
[3]*Basic Teaching Department, Luohe Vocational College of Food, Luohe 462000, Henan, China*
[4]*Department of Sports, Xinxiang Medical College, Xinxiang,453003, Henan, China*
[5]*Physical Education College, Zhoukou Normal University, Zhoukou, 466001, Henan, China*
[6]*Physical Education College, Xuchang University, Xuchang 461000, Henan, China*

Correspondence should be addressed to Long Chen; 201807097@hhstu.edu.cn

Received 12 March 2022; Revised 24 March 2022; Accepted 1 April 2022; Published 19 May 2022

Academic Editor: Muhammad Arif

Copyright © 2022 Nana Zhao et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Traditional exercise rehabilitation mode information is closed, it is difficult for users to obtain exercise rehabilitation information, and the exercise rehabilitation data of users are not fully utilized. With the combination of big data technology and the Internet of Things and exercise rehabilitation, we also face the problem of processing massive amounts of data. Whether these data can be used well has become the key to obtaining good business benefits and improving user experience. This paper applies the Internet of Things and big data technology to the physical exercise rehabilitation system to improve sports data processing and combine with the big data processing technology to explore the factors affecting exercise rehabilitation to improve the effectiveness of physical exercise rehabilitation. Moreover, this paper proposes a posture recognition algorithm based on human vision and defines the human posture described by the feature, which improves the classifier's ability to classify different posture data. Finally, this paper carries out experimental analysis to verify the effect of the method proposed. The research results show that the method constructed in this paper has a good physical exercise rehabilitation effect.

RETRACTED

1. Introduction

With the acceleration of modernization and urbanization, people's physical condition is declining year by year, and the current situation is worrying. However, in the process of urbanization, more and more people are also paying attention to the importance of health and starting physical exercise rehabilitation. However, as people continue to overexploit nature, the natural environment is deteriorating day by day, the living environment is deteriorating, and the air quality has not improved, which casts a shadow on outdoor exercise rehabilitation. Moreover, due to traffic jams and the lack of maturity of the civilized consciousness of motor vehicles, it is difficult to guarantee the safety of people in outdoor activities. Therefore, indoor sports exercise rehabilitation equipment slowly began to enter people's homes [1].

The important improvement on getting back, retaining, or amending powers that you need for the rehabilitation industry is one of the tasks of exercise rehabilitation. It might be a physical, mental, or cognitive function. This exercise therapy increases survival rates, speeds up recovery, and lowers the risk of cognitive impairment. This aids in the discovery and rebuilding of muscular strength, endurance, and power, as well as the modification of key characteristics such as flexibility and mobility. The technique of using the direction of a return to an individual's optimum degree of independence in critical tasks is known as functional rehabilitation. The priority of a person's functional tasks varies as much as the person to whom they are applied. It is critical to recognize rehabilitation as a process aimed at reducing the loss associated with stages such as preliminary assessment, admission and intake evaluation, programme design, rehabilitation and continuous progress, and discharge planning, among others.

At present, the development status of our country's exercise and rehabilitation industry is not optimistic. Moreover, most domestic exercise and rehabilitation places still use outdated management methods, and the management concepts are relatively backward. As a result, the management of exercise and rehabilitation places is exceptionally cumbersome and inefficient, not conducive to its long-term development. It is not conducive to the excellent development of the exercise rehabilitation industry in our country [2]. Therefore, it is necessary to use efficient and convenient management methods to change the current situation of the exercise rehabilitation industry in our country and promote the rapid development of the exercise rehabilitation industry.

In recent years, in the exercise rehabilitation industry, more and more people have begun to like exercise rehabilitation and joined the team of exercise rehabilitation. Therefore, exercise rehabilitation has become a trend and a new way of life. The country is also paying more and more attention to people's exercise rehabilitation. The State Council's No. 46 document raised national exercise rehabilitation to the height of the national strategy, requiring vigorous development of exercise rehabilitation leisure projects. Moreover, it creates an atmosphere of exercise rehabilitation, encourages exercise rehabilitation activities, and promotes the sports industry to become an important force in economic transformation and upgrading [3].

When exercise rehabilitation becomes "Internet+," a new exercise rehabilitation paradigm will emerge. In this setting, a novel exercise rehabilitation strategy known as "Internet + exercise rehabilitation" has arisen. In the "Internet Plus" age, the quantity of application data created by people from all walks of life has skyrocketed, and more and more businesses are grappling with the difficulty of processing huge volumes of data. Exercise therapy combined with Internet+ will certainly result in huge application data. To acquire the information buried behind these huge exercise rehabilitation data, big data platforms will have to evaluate and interpret them. With the advent of big data concepts, more businesses are realizing that these huge volumes of data hold a wealth of information. Through the analysis and processing of huge volumes of data, the value buried behind the data may be discovered. With the integration of "Internet+" and exercise therapy, the exercise rehabilitation business is also challenged with processing large volumes of data. The ability to effectively utilize these data has become critical to gaining strong economic advantages and increasing user experience.

Traditional exercise rehabilitation mode information is closed, it is difficult for users to obtain exercise rehabilitation information, and the exercise rehabilitation data of users are not fully utilized. In today's society, people use various smart devices to record their own sports information, such as Xiaomi's "smart bracelet," WeChat's "WeChat sports," and QQ's "sports platform." The popularity of "Internet+" has changed people's access to information. For exercise and rehabilitation, exercise rehabilitation APP is the perfect embodiment of "Internet + exercise rehabilitation." Nowadays, mobile smartphones are popular, and more and more people are accustomed to using exercise and rehabilitation apps to help them exercise and recover. Some high-quality exercise and rehabilitation apps such as "Gudong Sports" and "Keep" have tens of millions of users and walk into anyone. In the exercise rehabilitation room, you can see that many users are doing exercise rehabilitation training following the APP video tutorials. While these exercise and rehabilitation apps provide rich functions, some problems and areas can be improved: First, the exercise and rehabilitation apps on the market now only obtain content from the server and display it to the user. The user is on the exercise rehabilitation equipment. The generated data cannot be obtained; data interaction with exercise rehabilitation equipment cannot be performed. Second, there is no real real-time update of data.

Based on the foregoing study, this article uses the Internet of Things and big data technologies in the physical exercise rehabilitation system to enhance sports data processing. It uses big data processing technologies to investigate the aspects that influence exercise rehabilitation in order to increase its efficacy.

The Internet of Things (IoT) is a network of linked data processors that can sense, gather, and exchange data through the Internet. Big data, on the other hand, is defined as massive amounts of data originating from a variety of sources that are larger than average in size, number, quantity, magnitude, or scope to handle using standard methods. For the predetermined activation of the IoT process, big data businesses collect high-quality and sensitive data. In this case, massive amounts of data are collected in real time and stored using various storage technologies in order to categorize unstructured data into structured data utilizing IoT. Big data analytics take into account unstructured data collected by IoT devices and organize them into digestible condition datasets that teach businesses how to improve operations. Big data analytics technologies will improve performance against updated data, and new data categorization features will be introduced to big data companies.

2. Related Work

Physical fitness qualities are where a person makes the five components that make up total fitness, body composition, cardiovascular endurance, flexibility, muscular endurance, and muscular strength, to execute some measurable quality components such as agility, balance, coordination, power, reaction time, and speed task. Meanwhile sports specific technical skills are when a person makes decisions and specific procedures to move one's body to perform an action (dribbling, passing, and shooting) to gain a technical skill that can include taping, performing special tests, and splinting.

The fuzzy comprehensive evaluation (FCE) function is an artificially estimated Fuzzy value concerning fuzzy mathematics. This estimation of fuzzy outcome is practical and reliable in the physical exercise rehabilitation system.

RETRACTED

Meanwhile, the Analytic Hierarchy Process (AHP) is used to organize and analyze input decisions by using mathematics and the mental characteristics of a particular person. It provides a rational model for a demanded determination by quantifying by the following steps: identify the decision, options, and criteria, conduct pairwise comparisons, and calculate the importance weight of each criterion. Finally, the fuzzy Analytic Hierarchy Process is a systematic way of Analytic Hierarchy Process (AHP) developed with fuzzy comprehensive evaluation. The fuzzy AHP method is used in a way similar to that of the method of AHP. It is just that the fuzzy comprehensive evaluation and Analytic Hierarchy Process method sets the Analytic Hierarchy Process scale into the fuzzy scale to be accessed.

In the 1880s, the United States, as the first nation to investigate physical fitness, widely implemented fitness testing. Kraus did not put the physical exam into the public view until 1954, when he compared the data of American children with those of European youngsters. Surprisingly, the physical fitness of American children was much lower than that of European youngsters in this comparison examination. At the time, this surprise outcome drew a lot of attention from people from all areas of life. Furthermore, the outcome was dubbed "a report that stunned the president" by the media.

President Eisenhower recognized the necessity of this at the time and established the Presidential Committee on Young Constitution to coordinate the development of youth physique throughout the country. As a result, physique research has risen from obscurity to national prominence [4]. With financing from the University of Michigan, AAHPERD (American Alliance for Health, Physical Education, Recreation, and Dance) conducted the first national juvenile physical fitness study in 1958. Later, in 1965 and 1975, with financing from the Federal Office of Education, AAHPERD performed physical surveys of young people throughout the United States. The President's Council on Physical Fitness and Sports (PCPFS) and the Federal Department of Health performed a physical fitness study of all school workers countrywide in 1985 [5].

Regarding the physical fitness research of young people, in addition to the various physical fitness tests in school sports, there are also regional censuses in different places, and there is also a national youth physical census every ten years. In short, the physical research work in the United States is highly targeted and planned. Regarding physical fitness assessment methods, the original Kraus-Weber test failed to cover all the content involved in the physical fitness test [6]. Then, AAHPERD proposed a test method involving 7 indicators, but all the indicators in this method are sports indicators, and there are no indicators related to health status [7]. In subsequent national censuses, physiological indicators representing health gradually replaced indicators showing exercise ability. By the early 1990s, the physiological index representing health had replaced entirely the physiological index representing exercise ability in physical fitness assessment. It can be seen from the development of physical fitness research in the United States that the focus of physical fitness research has gradually changed from athletic ability to health status [8]. This shows that the United States has changed its understanding of the concept of physique, which has closely linked physique and health and eventually developed it into a scientific discipline. Japan is also a country with relatively early research on physical fitness [9], and it has preserved all the growth and development data of all adolescents and children since 1898.

Japan has been conducting surveys on teenagers' physical exercise capacity since 1879, incorporating eight physiological markers of physical structure and exercise ability. Japan performed the most comprehensive national physical examination in history on the eve of World War II. Then, starting in 1949, all pupils in the United States were evaluated five times in athletic ability, strength, and flexibility. With the advancement of technology and growing economic strength, Japan has increased its investment in national fitness testing and developed numerous physical testing schemes for individuals of all ages since the 1970s. In 1967, Japan started administering physical examinations to its citizenry. The Ministry of Education, Culture, Sports, and Culture omitted the yearly "Physical Strength and Athletic Ability Report" in favour of evaluating the level of physical fitness based on test results. It developed appropriate exercise prescriptions for focused exercise therapy at the same time [10].

To assess athletes' physical fitness, the literature [11] used fuzzy comprehensive assessment and analytic hierarchy procedures. The assessment methodology may represent the tested athletes' particular physical fitness level and provide scientific and fair evaluation findings. The literature [12] employed fuzzy comprehensive assessment to assess Chinese teenagers' physical fitness using three primary influencing elements and four cultivation aspects. To thoroughly measure the variations in physical fitness of each individual, the literature [13] employed the fuzzy comprehensive evaluation approach to separate physical fitness into four aspects: speed, endurance, agility, and flexibility. The literature [14] employed a clustering approach to assess the outcomes of college freshmen's physical fitness tests and it offers constructive suggestions based on the findings. The fitness impact of women aged 20 to 65 years was evaluated using a backpropagation neural network in the literature [15]. Only 3.28 percent of the time was there a difference between the correctness of the assessment result and the actual test result. The literature [16] objectively analyzed the 100-meter race using a fuzzy comprehensive assessment and a neural network to represent sports and obtain the necessary accuracy. The model may be used to simulate and forecast sports performance and give quantitative athlete selection criteria. Adult gender, age, weight, steady-state heart rate, running speed, and maximal oxygen consumption of exercise were all predicted using a neural network model developed in the literature [17]. The prediction result is more accurate than the prediction result of multiple linear regression analysis. At present, the physiological indicators involved in the physical fitness assessment methods adopted by our country for citizens mainly include three physiological indicators of human body shape and structure, body function, and essential quality [18]. The physical

RETRACTED

RETRACTED

fitness assessment method adopted is a total score for the average weight of each index.

3. Physical Exercise Vision Algorithm Based on Human Vision

The central nervous system (CNS) controls most functions of the body and mind. Central nervous system comprises the brain and the spinal cord. The brain is the centre of our thoughts, the interpreter of our external environment, and the origin of control over body movement.

The human visual system is composed of the visual central nervous system of the eye and the brain, which mainly includes the eyeball, retina, lateral knee, and visual cortex, as shown in Figure 1 [19].

Visual perception system is the accomplishment of assigning meaning to the visible spectrum for making the surrounding environment by colour vision, scotopic vision, and mesopic vision. The visual perception system compiles with the three levels for describing decisions from the entropy engaged with the aid of eyes using sensory stimulation and selection, organization, and interpretation. The visual perception system also improves the brain's ability to fight reading, writing, and movement [20].

Various objects in nature emit light or reflect light, and the eyeball mainly completes the optical processing of the human visual perception system. Natural objects use light as a carrier to enter the eyeball and pass through the lens and cornea to form a light signal transmitted to the retina. The photoreceptive cells on the retina perform a series of physical and chemical transformations on the received light signals, convert them into bioelectrical signals, and complete the primary processing of visual information. The image of the scene (inverted image) is presented on the retina, which is then transmitted to the lateral geniculate body. The lateral geniculate body is a transfer station that regulates the quantity of information that may travel through it. The lateral geniculate nucleus (LGN) is one of the thalamic sensory projection nuclei and is involved in basic visual processing. The lateral geniculate body reacts to and analyzes the information received before sending it to the visual cortex of the brain. The visual cortex is the most sophisticated region of the brain, since it completes the advanced processing of visual information. To create vision, visual information is fully examined by the visual cortex's processing, judgement, and memory (upright three-dimensional image). The whole visual information processing process from the human eye to the brain is very complex, yet it is a process that evolves from basic to complex and from low level to high level.

For images, the features of the human visual system mainly include brightness sensitivity, frequency sensitivity, multichannel decomposition, and masking effects.

3.1. Brightness Sensitivity. Brightness sensitivity is a circumstance in which bright lights cause detriment vision. An alternative name for brightness sensitivity is photophobia. Photophobia is a familiar sensation that is related to various quality conditions.

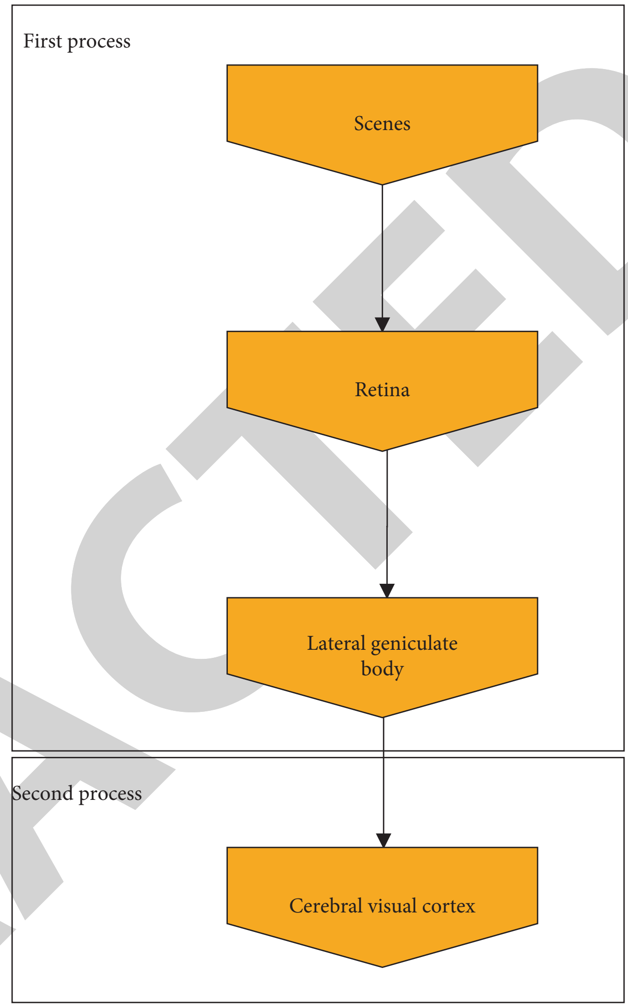

FIGURE 1: Block diagram of the human visual perception system.

The relative brightness increment $\triangle B$ can be used to measure the brightness perception increment $\triangle S$, as shown in the following formula [19]:

$$\triangle S = K\frac{\triangle B}{B}, \quad (1)$$

where B represents objective brightness.

The perceived brightness can be obtained by integrating the above formula, as shown in the following formula:

$$S = \mathrm{K}\ \ln\ B + K_0 = \mathrm{K}'\mathrm{lg}B + K_0. \quad (2)$$

In the above formula, K' = K ln10, and K is a constant. K is a constant, and its value is related to the average brightness of the image. In the normal brightness range of the human eye, the value of K can be set to 1. According to formula (2), it can be seen that the human eye's subjective perception of brightness S of the image is linear with the logarithm of the actual brightness B of the image, which is the primary content of the Weber-Fechner law.

3.2. Frequency Sensitivity. The act of gathering the functional significance resonance between the system's internal oscillation and the signal entering an electronic system is known as frequency sensitivity. The effect retrieves the indicator of frequency sensitivity for signal encoding as a consequence of the outcomes of frequency sensitivity.

A metric for determining the nature of a space declaration based on one's ability to identify and evaluate colour conflicts in a fixed-size object, the contrast sensitivity function aids in the observation and analysis of variations in colour patterns. When examining objects with no distinct outlines against the backdrop, the contrast sensitivity function (CSF) is important.

The capacity of the visual perception system to identify targets from prior experiences is measured by visual contrast sensitivity. Contrast sensitivity is determined by the size of the pupil. When the pupil size is changed from negative to positive, it affects contrast sensitivity on the beginning spectrum. If the pupil size is changed from positive to negative, it affects contrast sensitivity on both ends of the spectrum. Frequency sensitivity is usually expressed by the contrast sensitivity function (CSF), which reveals the human eye's sensitivity to sine wave stimuli of different frequencies. The frequency response formula of a relatively common human visual system is as follows [21]:

$$H(w) = (a + bw)\exp(-cw). \tag{3}$$

In the above formula, w is the radial frequency directly opposite to the viewing angle, the unit is cycle/degree and a, b, and c are three constants that determine the shape of the human visual system curve.

3.3. Multichannel Decomposition and Masking Effect. Multichannel decomposition is the recycling of significant functions with a plant or animal to build its body. Multichannel decomposition is the procedure through which the dead particles break down and are converted into simpler forms.

The multiple channels of the visual mechanism interact and influence each other so that the visual effect produced is the best. The multichannel decomposition characteristics of a static grey image are characterized by spatial frequency and direction characteristics.

For the masking effect, the definition in the literature is quoted here. The literature points out that the masking effect is a visual phenomenon: the positive presence of one visual information will overwhelm or conceal another visual information that can be perceived, making it impossible or difficult to be detected at all.

Scholars' research on the human visual system attempts to model the visual perception characteristics of the image content of the human eye to simulate the entire processing process of visual information from the human eye to the brain. The main application of the human visual system is to measure the quality of the image. The quality of the image mainly includes the fidelity and intelligibility image. The HVS-based image quality evaluation uses a mathematical formula model instead of the human eye to objectively evaluate the quality of the image. The more consistent the evaluation of image quality is with the subjective evaluation of the image, the more accurately the human visual system based on the human visual system model reflects the human visual system [22].

The basic framework of the traditional HVS model is shown in Figure 2. The framework includes five parts: brightness adaptability, multichannel decomposition, contrast sensitivity function, masking effect, and error merging. These five parts reflect the process of natural images being processed by human eyes and brain to form neural images, which are related in sequence [23].

Figure 3 shows a block diagram of the VDP model. It can be seen from the figure that the specific implementation process of the VDP model is slightly more complicated than that in Figure 3, but it follows the five steps in Figure 2.

In Figure 3, the VDP model is constructed to make the physical exercise effect output based on the physiological test. The original and restored images of input are processed in the four strategies, such as compiling the amplitude concerning the nonlinearity [24]. The contrast sensitivity function (CSF) accesses the amplitude nonlinearity of input signal for evaluating the signal's frequency to determine the VDP model for the physical exercise rehabilitation system. This helps to find the DCT with the improvement of the human visual system model.

Visual descent point (VDP) is an important pattern for decentralizing a stable approach from a model-driven architecture to a narrow platform that extends from the stage to the audience.

The VDP is working with a tool to block the rage and bring some attribute of being steadfast to nonprecision actions intended to deal with a problem. Missed approach points are often near the end of the runway. This gives you the latitude to drop down to the minimum descent altitude and then drone along until the bitter end.

The Visual Descent Point (VDP) is a specified point on a nonprecision straight-in approach from which you may fall below the minimum descent altitude; it is determined by subtracting the landing zone from the minimum descent altitude and fractioning the result by 300. The DCT approach permits transforming a signal into basic frequency components, which may then be applied to the descent altitude result. This incorporates the DCT of the input signal as well as the linear combination effect. The average value of the DC coefficients acquired by DCT transformation of all block pictures of the original image is measured by the weighted basis functions that are connected to its frequency components.

Meanwhile, the blocked DCT is used to replace the multichannel decomposition in the human visual system model, which combines contrast sensitivity, masking effect, and error merging. The Watson vision model employs deep learning algorithms to analyze images concerning the function like scenes, objects, and content. The Watson vision model supplies cooperative surrounding conditions with the DC coefficient to rectify the efficient visual recognition custom models. The primary function should emphasize the automatic graphical visual recognition for classifying images concerning the scenes, objects, and custom content. When the Watson vision model is used for image quality

RETRACTED

RETRACTED

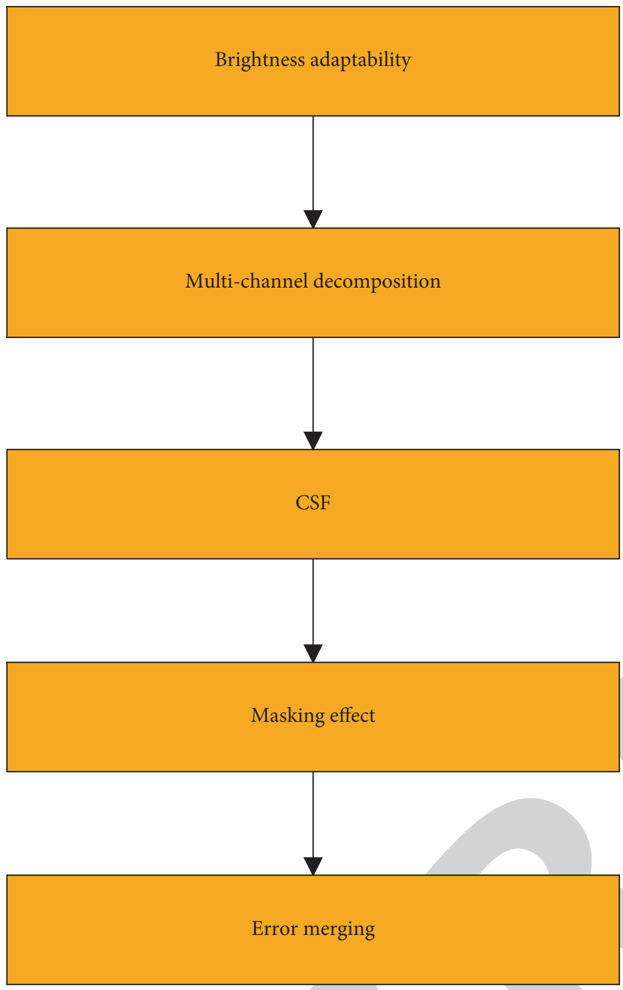

Figure 2: Typical HVS model framework.

evaluation, the difference between the original image and the distorted image is more in line with the subjective measurement of human perception of the distance of the image [25].

The brightness masking threshold is related to the DC coefficient of each image block and the contrast sensitivity table. For each DCT block, the calculation of its brightness masking threshold is shown in the following formula:

$$t_{L_{i,j}} = t_{i,j}\left(\frac{C_k}{\overline{\mathrm{DC}}}\right)^a. \quad (4)$$

In the above formula, $t_{i,j}$ is the value of JND in Table 1, C_k is the DC coefficient of the current DCT block, and $\overline{\mathrm{DC}}$ is an expected display brightness or the average value of the DC coefficients obtained by DCT transformation of all block images of the original image. Under normal circumstances, $a = 0.649$.

From formula (4), it can be seen that the relatively bright area in the image can tolerate a more significant modification change [26].

3.4. Contrast Masking. For each DCT block, the calculation of its contrast masking value is shown in the following formula:

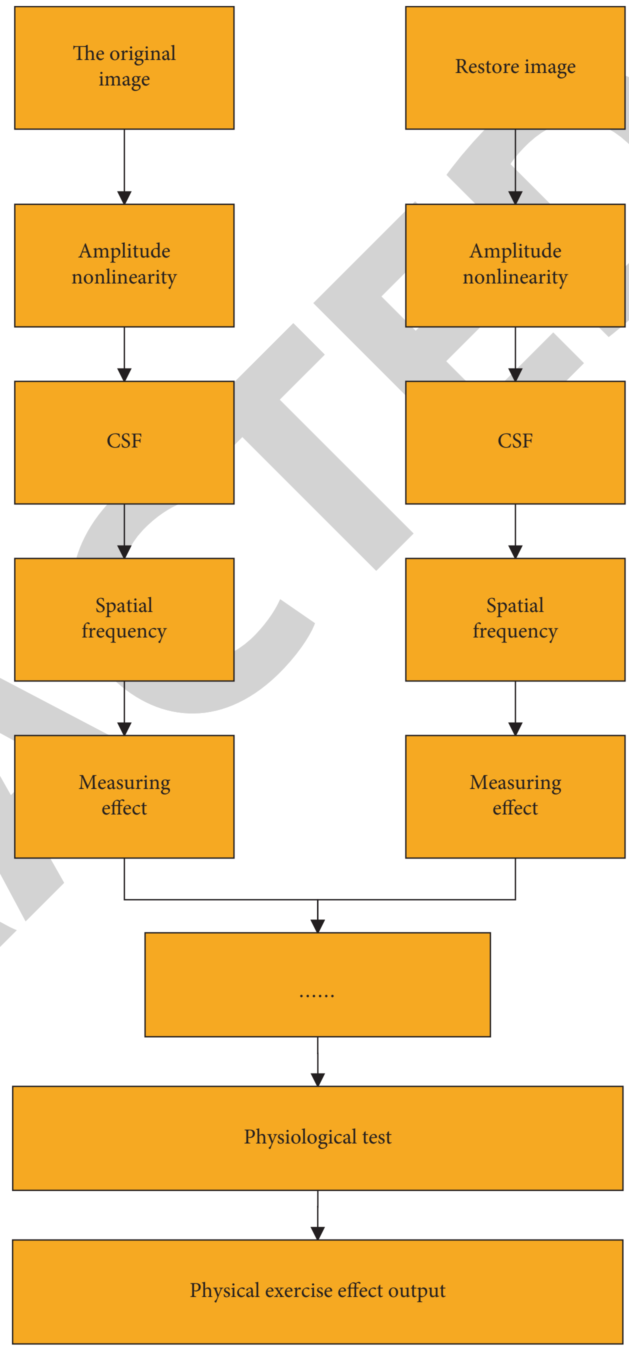

Figure 3: VDP model.

$$t_{C_{i,j}} = \max\left\{t_{L_{i,j}}, |\mathrm{DCT}coef_{i,j}|^{w_{i,j}} \cdot t_{L_{i,j}}^{1-w} j\right\}. \quad (5)$$

In the above formula, $t_{L_{i,j}}$ represents the brightness masking threshold, $w_{i.j}$ is a constant, and its value is affected by the frequency coefficient, and the value of $w_{i.j}$ is different when the frequency coefficient is different. Generally speaking, $w_{0.0} = 0$, and the value of the remaining $w_{i.j}$ is taken as 0.7 (all the values of $w_{i.j}$ can also be taken as 0.7).

The contrast masking threshold indicates the adjustable size of each item in the DCT coefficient of each image block within a JND range. L is the DCT coefficient of the image

RETRACTED

Table 1: Evaluation of physical exercise rehabilitation system.

Number	Physical exercise rehabilitation effect
1	89.9
2	93.4
3	83.7
4	82.3
5	82.5
6	85.7
7	82.8
8	82.3
9	91.6
10	85.1
11	84.7
12	89.4
13	93.0
14	90.2
15	87.0
16	92.5
17	91.2
18	90.2
19	85.2
20	94.0
21	88.7
22	91.6
23	89.2
24	82.4
25	93.9
26	85.1
27	90.7
28	91.1
29	87.7
30	93.8
31	91.2
32	84.8
33	87.2
34	87.8
35	82.1
36	88.9
37	91.9
38	93.2
39	85.1
40	84.0
41	85.8
42	87.6
43	93.6
44	88.2
45	93.9
46	85.0
47	89.5
48	87.7
49	82.2
50	87.6
51	88.6
52	87.4
53	93.1
54	90.7
55	89.8
56	86.8
57	85.7
58	87.0
59	82.2
60	92.0
61	86.1
62	87.2
63	86.9
64	87.4
65	87.1
66	90.3
67	90.7
68	87.3
69	90.2
70	84.1
71	88.5
72	90.7

block. It can be seen that the contrast masking threshold calculated according to formula (5) is a maximum operation.

3.5. Error Combination. The Minkowski error, unlike the normal mean squared error, is less susceptible to outliers. Each instance error is squared by the mean squared error, which contributes outliers to the overall error [27]. The following factors may be able to help you avoid this:

Step 1: Filter is the first step. Prepare the environment for testing

Step 2: Using the usual mean squared error, remove outliers from the posttest analysis

Step 3: Using the mean squared error, calculate the value of the outlier test analysis

Step 4: Use the enormous contribution of outliers to the overall error to determine the underlying distribution

Step 5: Decide on the value of the loss index that is less affected by outliers

The Watson vision model uses Minkowski and error merging for each individually adjustable element in the DCT space. The calculation of the perceptual difference $d_{i,j}$ of the image in the unit of JND at the (i, j)-th frequency is shown in the following formula:

$$d_{i,j} = \frac{E_{i,j}}{t_{C_{i,j}}}. \quad (6)$$

In the above formula, E is the error image obtained from the difference of the DCT coefficients of the original image and the test image. It can be seen that $d_{i,j}$ is a value in ND, and the image quality evaluated is inversely proportional to $d_{i,j}$. The smaller the value of $d_{i,j}$, the higher the image quality. The error combination using Minkowski sum is shown in the following formula:

$$D(I_o, I_w) = \left(\sum_{i,j} \left| d_{i,j} \right|^{\beta} \right)^{1/\beta}. \quad (7)$$

In the above formula, the value of β is taken as 4.

The general human visual system model divides different spatial frequency bandwidths and observation angles into different channels. The difference is that the Watson visual model treats each DCT block in space as a separate visual channel.

Although the human visual system is exceedingly complicated and nonlinear, most approaches for modelling the human visual processing mechanism employ only linear or nearly linear methodologies. According to Wang et al., raw picture pixels are not independent of one another but rather have an association link that is more strongly represented in spatially neighbouring pixels. The significant structural link between the item and the backdrop in the picture is preserved thanks to the high correlation between pixels. The brightness and contrast of a picture have little to do with the structural information of the items in the scene. Figure 4 depicts the structure of the visual model based on this knowledge.

The Structural SIMilarity (SSIM) index is a systematic way of measuring the similarity between two images. The Structural SIMilarity (SSIM) index model relates to the act of perceiving image quality degradation. The degradation is deviated based on data compression and data transmission losses. Using the circularly symmetric Gaussian weighting function, the Structural SIMilarity (SSIM) index handles the complete acknowledgement metric that demands two images with SSIM values to extend between −1 and + 1 (generally 0.97, 0.98, and 0.99). The identical images are consoled by the SSIM values of +1. At the same time, nonidentical images are consoled by the SSIM values of −1 sliding window size 11 × 11.

If two images are similar and the similarity is equal to 90-100%, while other images are usually less than 70%, then this structural similarity indicator measurement (SSIM) is generally considered to be better because it has less error prevention with high PSNR which means good image quality.

This is derived from the following derivation for the standard deviations:

$$r * (x, y) = \sigma_{xy}\sigma_x\sigma_y. \tag{8}$$

We have that $\sigma_x\sigma_y \neq 0, 1$.

When both standard deviations are zero, it will determine that more effort is needed to study human responses to contrast-detail phantoms. At the same time, the structure similarity index (SSIM) framework can be used to perform gradient processing on the content partition.

In the SSIM model, the constituent elements of image structure information include brightness, contrast, and structure. If it is assumed that the original image signal and the distorted image signal are x and y, respectively, the similarity measurement of x and y is

$$S_{\text{SSIM}}(x, y) = [l(x, y)]^{\vartheta}[c(x, y)]^{\beta}[s(x, y)]^{\gamma}. \tag{9}$$

In the above formula, α, β, $\gamma > 0$ are the weight adjustment parameters. $l(x, y)$ is the brightness comparison function, $c(x, y)$ is the contrast comparison function, and $s(x, y)$ is the structure comparison function. The specific definitions of these three functions are

$$\begin{aligned} l(x, y) &= \frac{2u_x u_y + C_1}{u_x^2 + u_y^2 + C_1}, \\ c(x, y) &= \frac{2\sigma_x\sigma_y + C_2}{\sigma_x^2 + \sigma_y^2 + C_2}, \\ s(x, y) &= \frac{\sigma_{xy} + C_3}{\sigma_x\sigma_y + C_3}. \end{aligned} \tag{10}$$

For an 8-bit grayscale image, $L = 255$. u_x and u_x are the mean values of signals x and y, respectively, which reflect the brightness information. σ_x and σ_y are the standard deviations of signals x and y, respectively, reflecting the contrast information. σ_{xy} is the covariance of signals x and y, which reflects the similarity of their structural information, where L is the dynamic range of the pixel value.

The measure Q of the overall image quality is the average of the evaluation measures of all the pixel signals in the image. The quality of the test image is directly proportional to the value of Q. The larger the value of Q, the better the quality of the test image.

$$Q_{\text{SSIM}}(X, Y) = \frac{1}{M}\sum_{J=1}^{M} S_{\text{SSIM}}\left(x_j, y_j\right). \tag{11}$$

In the above formula, M is the total number of pixels in the image.

4. Physical Exercise Rehabilitation System Based on Internet of Things and Big Data Technology

This article uses the sensors on the fitness equipment to detect the user's exercise data and power generation and writes the data into the NFC chip on the fitness equipment and reads the data from the NFC chip through the mobile application with NFC function and uploads them to the cloud server.

For security reasons, NFC chips are used in electronic identification papers and keycards to allow short-range, wireless communication between two devices via an antenna. The devices connect through NFC with the assistance of a payment card and a payment terminal for contactless payment systems whenever the antenna supports short-range communication. This method may be used to replace or complement contactless suspension systems. The scatternet, on the other hand, is a network of interconnected piconets which protects the activity of transmitting data between more than eight machines.

Users may review fitness statistics, power production, and historical data at any time via the app, and data can be updated in real time using WebSocket instant messaging technology to achieve the "Internet Plus" and fitness combo. Figure 5 depicts the design idea's structural diagram.

Each device adds an offset value to the estimated clock to keep it consistent with the master device clock to achieve the effect of synchronization. A piconet network is the type of

RETRACTED

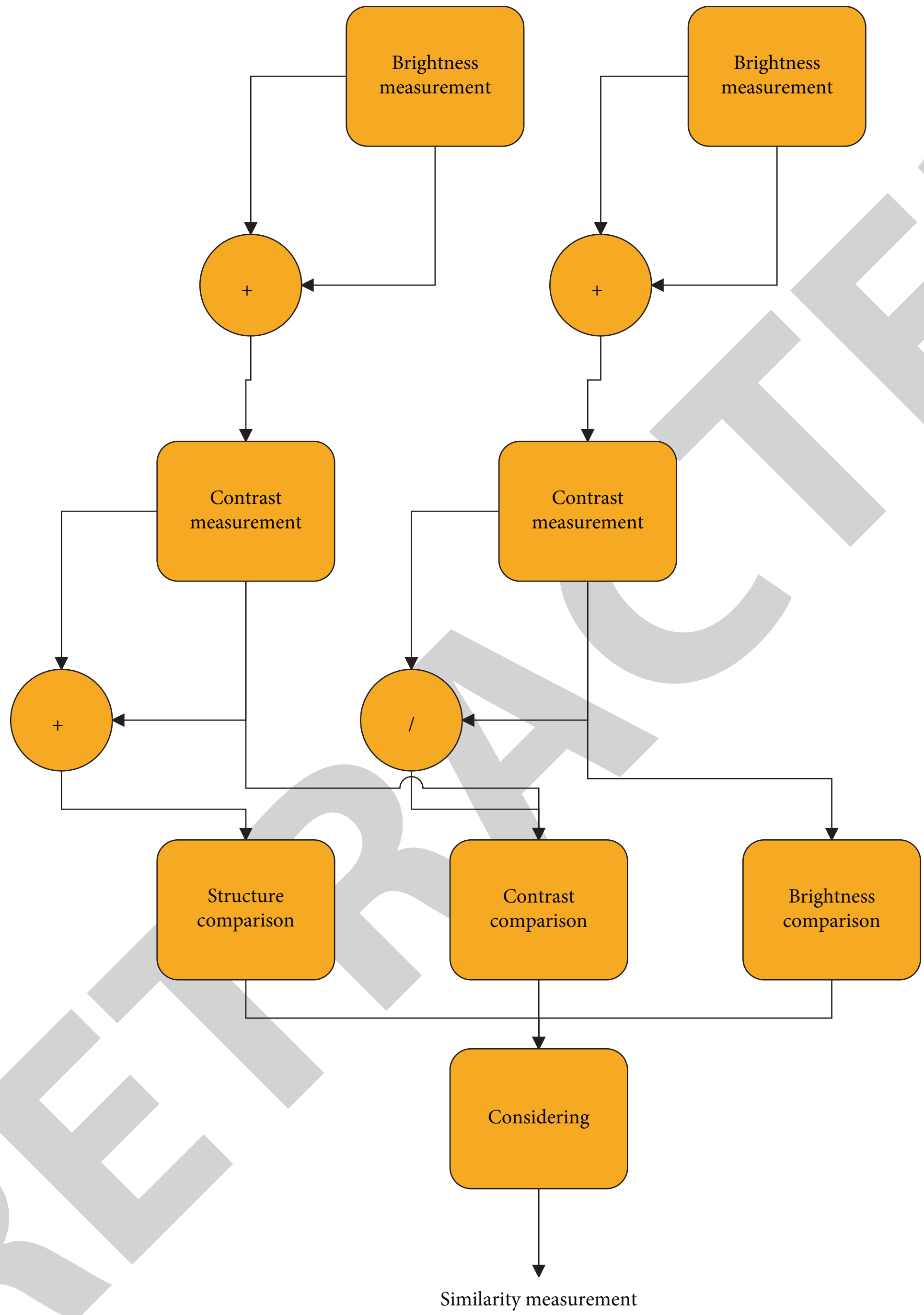

FIGURE 4: SSIM model.

RETRACTED

connective procedure protocol organized between two divides through Bluetooth. A scatternet consists of many reciprocally connected piconets that defend conveying information between more than 8 instrumentality invented devices. Moreover, a channel is shared between piconet networks, and the constituent members communicate through the channel. A scatternet is formed by connecting many piconet master devices, allowing communication among the piconets. The master and slave devices' roles may be swapped, resulting in a larger communication range. The development of a distributed network, on the other hand, is restricted, and the frequency restriction can only link 10 piconet units. The scatternet's construction is shown in Figure 6.

The user logs in to the system through a browser or WeChat program, and the accessed URL is resolved by DNS domain name to find the corresponding server host. The request will be intercepted and received by Tomcat in the server and then handed over to the system software processing layer. After authentication and authorization, the business logic requested by the user is processed. The overall architecture process is shown in Figure 7.

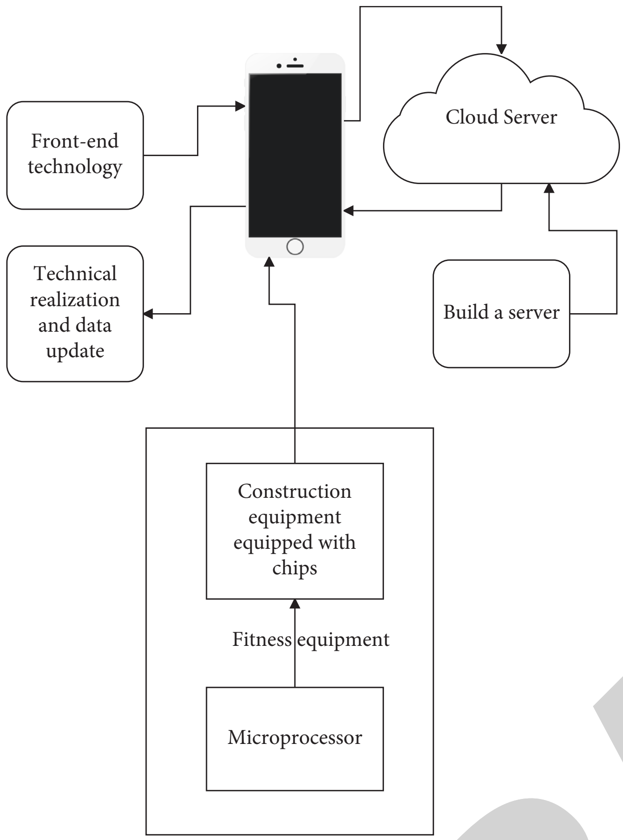

Figure 5: The structural block diagram of the design idea of the "Internet + fitness" system.

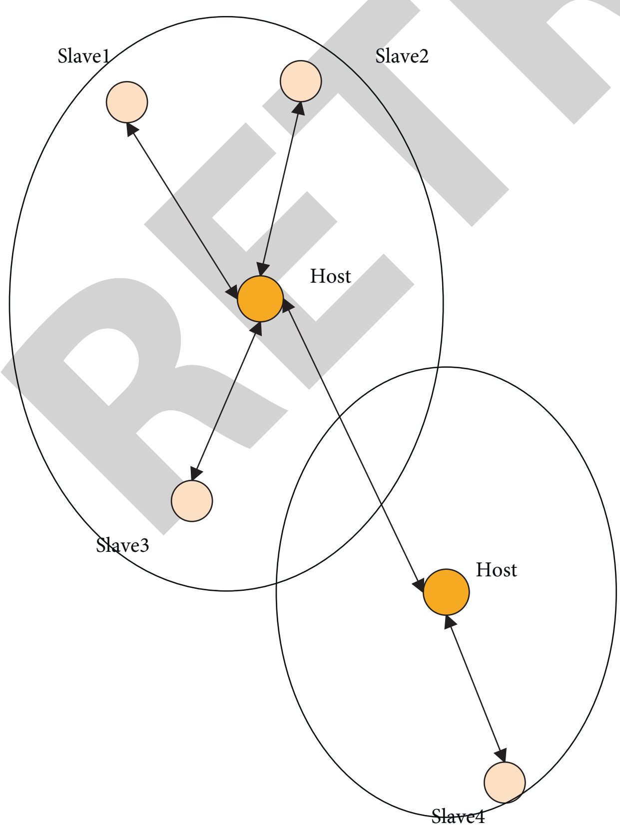

Figure 6: The structure of the scatternet.

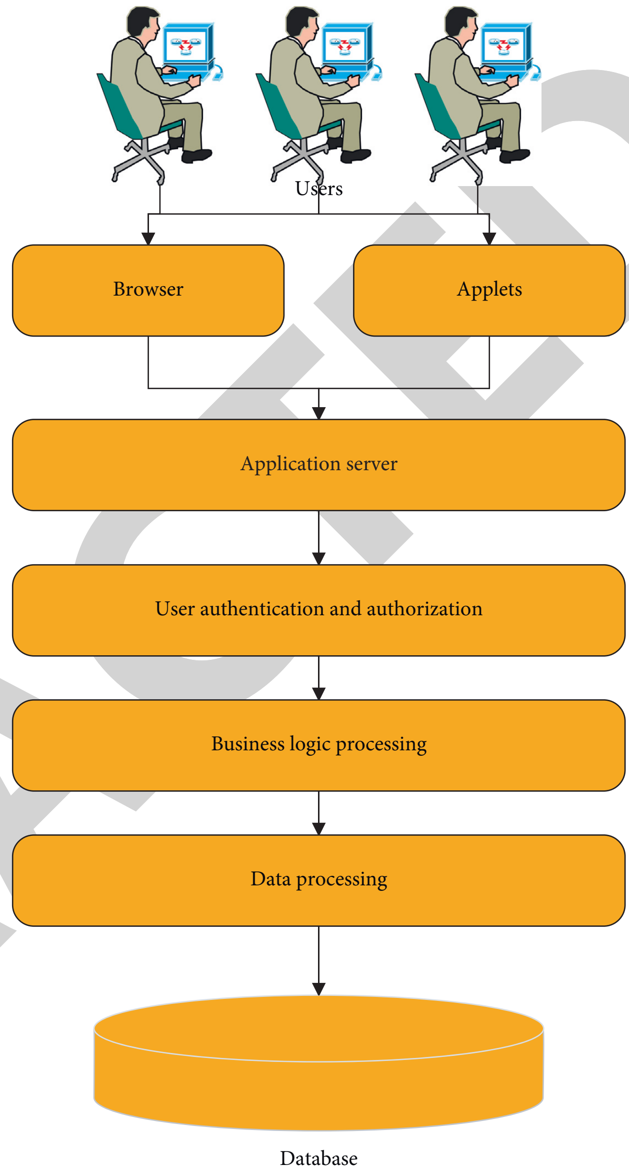

Figure 7: System architecture flow chart.

The rehabilitation system constructed in this paper can adjust the physical state of the human body and adjust the local injury of the human body, as shown in Figure 8 which shows a schematic diagram of lower limb physical exercise.

This article systematically studies the recovery process of lower extremity physical exercise and takes the lower extremity injury as an example. Figure 9 shows the schematic diagram of the recognition of lower limb injury.

The clever algorithm used in this work is used to identify the physical exercise system. A schematic layout of the recognition of exercise therapy for lower limb injuries is shown in Figure 9. Figure 10 shows how the intelligent system in this study can efficiently detect lower limb injury spots, recognize human body sports training via human bone joint points, and provide targeted views.

RETRACTED

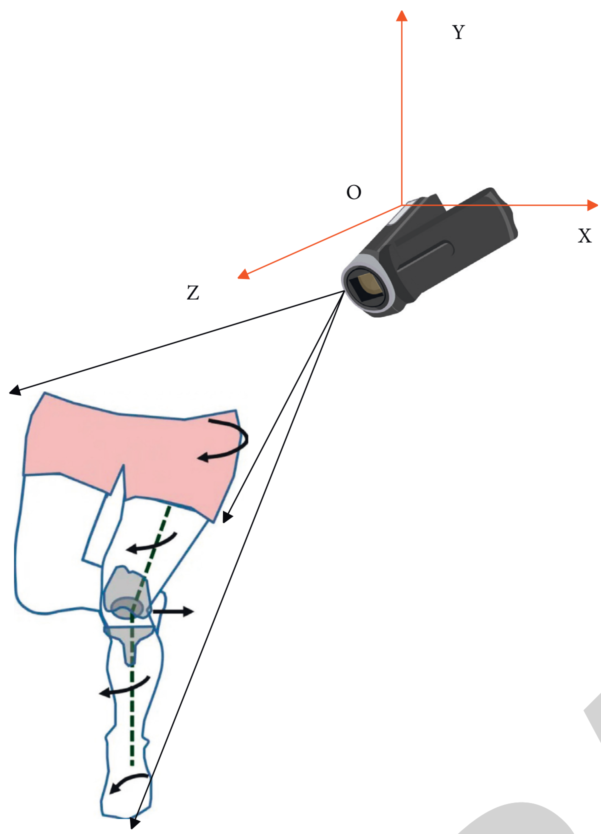

Figure 8: Schematic diagram of lower limb physical exercise rehabilitation.

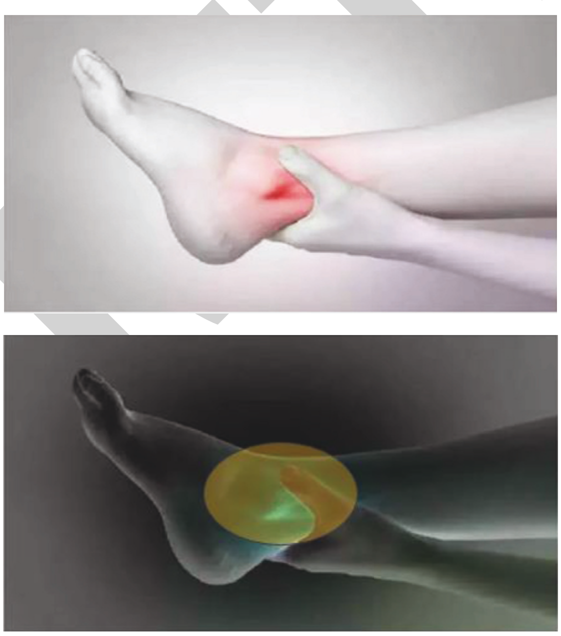

Figure 9: Diagram of the identification of the injury site.

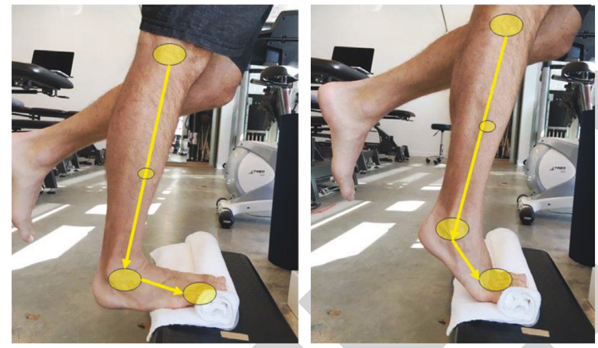

Figure 10: Schematic diagram of recognition of exercise rehabilitation of lower limb injury.

Based on the above analysis, 72 groups of physical rehabilitation exercises are used to evaluate the system of this paper. The results are shown in Table 1.

It can be seen from Table 1 that the physical exercise rehabilitation system constructed in this paper has good results.

5. Conclusion

Gesture recognition and motion recognition algorithms are essential interactive technologies in rehabilitation training. This paper combines the bone data obtained by Kinect to study the rehabilitation posture and motion recognition algorithm and combines the multirole posture and motion algorithm with virtual reality technology to build a training system that integrates training and entertainment. Moreover, this paper proposes a posture recognition algorithm based on human vision, defines the human posture described by the feature, and improves the classifier's ability to classify different posture data. The sensors on the fitness equipment are used to detect the user's exercise data and power generation, and the data are written into the NFC chip on the fitness equipment and are read from the NFC chip through the mobile application with NFC function and uploaded to the cloud server. Finally, this paper carries out experimental analysis to verify the effect of the method proposed. The research results show that the method constructed in this paper has an excellent physical exercise rehabilitation effect.

Data Availability

The data used to support the findings of this study are included within the article.

Disclosure

A preprint of this paper has previously been published [28].

Conflicts of Interest

The authors declare that they have no conflicts of interest.

RETRACTED

RETRACTED

References

[1] A. H. Riley and C. Callahan, “Shoulder rehabilitation protocol and equipment fit recommendations for the wheelchair sport athlete with shoulder pain,” *Sports Medicine and Arthroscopy Review*, vol. 27, no. 2, pp. 67–72, 2019.

[2] C. A. Emery and K. Pasanen, “Current trends in sport injury prevention,” *Best Practice & Research Clinical Rheumatology*, vol. 33, no. 1, pp. 3–15, 2019.

[3] V. M. Shulyatyev and M. A. Bulavina, “Sport interview: strategy, design and content,” *Theory and Practice of Physical Culture*, vol. 7, no. 9, p. 18, 2019.

[4] L. J. Ferguson, K. T. Carlson, and D. Rogers, “Moving towards reconciliation through sport: sharing our process of exploring team saskatchewan experiences at the North American Indigenous Games,” *Journal of Exercise, Movement, and Sport (SCAPPS refereed abstracts repository)*, vol. 51, no. 1, p. 99, 2019.

[5] K. Kimasi, V. Shojaei, and M. R. Boroumand, “Investigation of safety conditions at gymnasia in different organizations,” *Journal of Humanities Insights*, vol. 3, no. 02, pp. 70–74, 2019.

[6] K. Reinhart and B. Wichmann, “The TuS Fortschritt Magdeburg-Neustadt (soccer section) in the GDR - an example of amateur socialist sport,” *Soccer and Society*, vol. 21, no. 4, pp. 408–420, 2020.

[7] C. Abanazir, “E-sport and the EU: the view from the English bridge union,” *The International Sports Law Journal*, vol. 18, no. 3-4, pp. 102–113, 2019.

[8] A. Gerke, K. Babiak, G. Dickson, and M. Desbordes, “Developmental processes and motivations for linkages in cross-sectoral sport clusters,” *Sport Management Review*, vol. 21, no. 2, pp. 133–146, 2018.

[9] A. I. Pogrebnoy and I. O. Komlev, “Sport institutions reporting to Ministry of Sport of Russian Federation: intellectual property, invention activity, patenting and legal consulting service analysis,” *Theory and Practice of Physical Culture*, vol. 2, p. 2, 2018.

[10] D. C. Ilies, R. Buhas, M. Ilies et al., “Sport activities and leisure in Nature 2000 protected area-Red Valley, Romania,” *Journal of Environmental Protection and Ecology*, vol. 19, no. 1, pp. 367–372, 2018.

[11] A. I. Kondrukh, “Practical shooting sport in Russian sport system: essential specifications and features,” *Theory and Practice of Physical Culture*, vol. 2017, no. 5, p. 27, 2017.

[12] R. Giulianotti and D. Numerato, “Global sport and consumer culture: an introduction,” *Journal of Consumer Culture*, vol. 18, no. 2, pp. 229–240, 2018.

[13] A. G. Gurinovich and G. V. Petrova, “Key priorities of physical education and sport sector budgeting laws and regulations in the Russian Federation,” *Theory and Practice of Physical Culture*, vol. 4, p. 34, 2019.

[14] M. Mountjoy, A. Costa, R. Budgett et al., “Health promotion through sport: international sport federations’ priorities, actions and opportunities,” *British Journal of Sports Medicine*, vol. 52, no. 1, pp. 54–60, 2018.

[15] J. J. Pulido, D. Sánchez-Oliva, P. A. Sánchez-Miguel, D. Amado, and T. García-Calvo, “Sport commitment in young soccer players: a self-determination perspective,” *International Journal of Sports Science & Coaching*, vol. 13, no. 2, pp. 243–252, 2018.

[16] J. Cristiani, J. C. Bressan, B. L. Pérez, R. G. Larissa, and S. R. Riller, “Clubs SOCIO-deportivos en UN municipio brasileño: ESPACIO, EQUIPOS Y CONTENIDOS [Sport clubs in Brazil: facilities, equipment and content in][Clubes socio-esportivos em município brasileiro: espaço, equipamentos e conteúdos],” *E-Balonmano.com: Revista de Ciencias del Deporte*, vol. 13, no. 2, pp. 105–112, 2017.

[17] E. Happ, M. Schnitzer, and M. Peters, “Sport-specific factors affecting location decisions in business to business sport manufacturing companies: a qualitative study in the Alps,” *International Journal of Sport Management and Marketing*, vol. 21, no. 1/2, pp. 21–48, 2021.

[18] H. Zhao, Z. Liu, X. Yao, and Q. Yang, “A machine learning-based sentiment analysis of online product reviews with a novel term weighting and feature selection approach,” *Information Processing & Management*, vol. 58, no. 5, Article ID 102656, 2021.

[19] M. Castro-Sánchez, F. Zurita-Ortega, and R. Chacón-Cuberos, “Motivation towards sport based on sociodemographic variables in university students from Granada,” *Journal of Sport and Health Research*, vol. 11, no. 1, pp. 55–68, 2019.

[20] Y. Qiu, G. Liu, B. Anand Muthu, and C. B. Sivaparthipan, “Design of an energy-efficient IoT device with optimized data management in sports person health monitoring application,” *Transactions on Emerging Telecommunications Technologies*, Article ID e4258, 2021.

[21] S. M. Hadlow, D. Panchuk, D. L. Mann, M. R. Portus, and B. Abernethy, “Modified perceptual training in sport: a new classification framework,” *Journal of Science and Medicine in Sport*, vol. 21, no. 9, pp. 950–958, 2018.

[22] J. H. Du Plessis and M. Berteanu, “The importance of prosthetic devices in sport activities for Romanian amputees who compete in Paralympic competitions,” *Medicina Sportiva: Journal of Romanian Sports Medicine Society*, vol. 16, no. 1, pp. 3197–3204, 2020.

[23] H. Song, X. Han, C. E. Montenegro-Marin, and S. Krishnamoorthy, “Secure prediction and assessment of sports injuries using deep learning based convolutional neural network,” *Journal of Ambient Intelligence and Humanized Computing*, vol. 12, no. 3, pp. 3399–3410, 2021.

[24] W. Huifeng, S. N. Kadry, and E. D. Raj, “Continuous health monitoring of sportsperson using IoT devices based wearable technology,” *Computer Communications*, vol. 160, pp. 588–595, 2020.

[25] M. Stylianou, A. Hogan, and E. Enright, “Youth sport policy: the enactment and possibilities of ‘soft policy’ in schools,” *Sport, Education and Society*, vol. 24, no. 2, pp. 182–194, 2019.

[26] G. Manogaran, P. Shakeel, H. Fouad et al., “Wearable IoT smart-log patch: an edge computing-based bayesian deep learning network system for multi access physical monitoring system,” *Sensors*, vol. 19, no. 13, p. 3030, 2019.

[27] S. A. Richmond, A. Donaldson, A. Macpherson et al., “Facilitators and barriers to the implementation of iSPRINT:A Sport Injury Prevention Program in Junior High Schools,” *Clinical Journal of Sport Medicine*, no. 3, pp. 231–238, 2018.

[28] N. Zhao, Y. Yan, X. Han, G. Zhang, and L. Chen, “Physical exercise rehabilitation system based on Internet of Things and big data technology,” *Research Square*, 2021.