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Retraction

Retracted: Physical Exercise Monitoring System Based on Computer Somatosensory Technology

Security and Communication Networks

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Security and Communication Networks has retracted the article titled "Physical Exercise Monitoring System Based on Computer Somatosensory Technology" [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 Editorial Board.

References

[1] H. Li, W. Lei, and Z. Zhao, "Physical Exercise Monitoring System Based on Computer Somatosensory Technology," *Security and Communication Networks*, vol. 2022, Article ID 7808414, 8 pages, 2022.
[2] L. Ferguson, "Advancing Research Integrity Collaboratively and with Vigour," 2022, https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/.

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Research Article

Physical Exercise Monitoring System Based on Computer Somatosensory Technology

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Aiming at the problems of poor convergence, slow acceleration, and low throughput in traditional physical exercise monitoring systems, a physical exercise monitoring system based on computer somatosensory technology is proposed and designed. The whole structure of the physical activity monitoring system was created from the hardware and software, according to the research. Human body posture monitoring sensor module, communication connection module, power supply module, main control unit module, sensor module, and other pieces make up the hardware section. To improve detection performance, computer somatosensory technology is used in the software design to gather physical activity posture data. Also, for experimental comparison and verification, we employ system convergence, acceleration, and throughput as indicators. Experimental results show that the improved method can effectively improve system convergence, increase system acceleration, and increase system throughput, which has certain advantages in use.

1. Introduction

With the rapid development of our country's economy and the advent of the information age, people are full of desire to care about their health. Physical exercise has become people's pursuit of a healthy lifestyle, achieving a healthy, happy, and peaceful life, which has become a common habit for sports enthusiasts. The state advocates the use of electronic technology products to promote the development of full-product physical exercise, so that scientific and technological products serve the entire people's physical exercise. Health concerns have gotten increased attention as a result of fast changes in many contemporary residents' lives, such as nutrition, job, sleep, entertainment, and social contact, as well as population ageing, environmental changes, and growing pressure. Physical activity is not only a reflection of the human body's fundamental functions but also a vital approach to enhance health [1]. Some diseases such as Parkinson's syndrome can cause sports function damage. Patients with chronic diseases such as diabetes must maintain proper physical exercise every day to assist treatment. The elderly need physical exercise testing and exercise testing to report unexpected conditions, and athletes need physical exercise monitoring and guidance training. Physical exercise monitoring is very important for personal health monitoring and health management [2]. Obtain the physical exercise monitoring data of the human body, provide corresponding exercise services based on this, and remind people to adjust their lifestyles to better realize their own health management.

In recent years, the development of short-distance wireless communication technology, sensor technology, and computer somatosensory technology has made the realization of physical exercise monitoring systems more convenient, and physical exercise monitoring equipment has become increasingly miniaturized and intelligent [3]. Among them, the physical exercise new system with wearable devices has small physical and psychological interference to the human body. The traditional physical exercise monitoring system mainly puts the three-way sensor and the gyroscope in the gait research of Parkinson's syndrome, measuring the exercise intensity, monitoring the exercise status, and dealing with the abnormal conditions that appear or may appear in a timely manner. And, it provides corresponding services to get effect with physical exercise monitoring and routine, which is the purpose of motion detection technology [4]. However, this kind of method has certain limitations, and its applicability needs to be expanded to make it conform to the physical exercise monitoring of the regular population and provide a basic basis for people's regular physical exercise.

2. Research on Physical Exercise Monitoring System

Physical exercise monitoring is to evaluate the physical state of the individual through continuous monitoring. The exercise intensity is widely used in vital signs monitoring, fitness and health services, and other fields. It is widely used in vital sign monitoring, fitness and health services, and other fields. In everyday life, the physical exercise monitoring system for individual or family users must monitor the essential exercise parameters in the simplest manner possible in order to analyse the physical activity pattern and the user's health state [5]. The working mode of the current physical exercise monitoring platform is mainly connected by the mobile terminals such as smartphones and tablet computers, realizing physical exercise data monitoring, data storage, data sharing, and so on. The entire system involves the integration of technology and knowledge in many fields, such as human-computer connect, wireless communications, and databases.

The physical exercise monitoring system provides functions such as analysis, storage, and alarm of physical exercise data based on the measurement of the state parameters of the exercise. Some studies divide the physical exercise monitoring system into equipment layer, middle layer, and management layer. The equipment layer refers to various sports data acquisition equipment, including equipment with various sensing technologies [6]. The middle layer connects sports services equal to somatosensory technology data and is a communication channel between the device layers. Generally, wireless communication sensor networks are used, and Bluetooth or Zigbee technology is often used to form individual domains. The management layer relies on network access technology to provide sports data management, storage, and analysis and realize the release of sports data and health services.

3. System's Overall Structure Design

In order to accurately obtain personal physical exercise data and realize effective monitoring, a physical exercise monitoring system based on computer somatosensory technology is designed. The modified system includes sensor modules, processing modules, communication modules, power modules, etc. Its architecture is shown in Figure 1.

The sensing device in Figure 1 integrates transmission equipment such as a three-way acceleration sensor, a microprocessor, and an antenna, which are used to collect physical exercise data and perform data processing, make physical exercise status identification, and realize physical exercise time statistics, and then the processed calculation result is transmitted to the smart terminal through the low-energy Bluetooth device [7]. The interactive device is a smart terminal, a smartphone supporting Bluetooth 4.0BLE, or a specially designed Bluetooth terminal device. The intelligent terminal receives the underlying monitoring data, presents the monitoring results in the form of icons, etc. through a graphical interface, has certain control functions for the sensing equipment, and uploads the data to the server when appropriate. The web service system is used to implement functions such as collecting and storing monitoring data, user management, and important information push.

This system function and characteristic are designed as follows:

Physical exercise monitoring: collect sensor data in real time, judge the user's physical exercise state through corresponding algorithms, and realize state switching.

Abnormal monitoring and alarm: when there are abnormal conditions such as falls, fainting, rapid heartbeat, etc., enter the abnormal monitoring, record the abnormal conditions, determine the severity of the abnormality through the corresponding algorithm, and decide whether to make an alarm.

State recognition: effectively judge the user's state, realize the recording, carry out the corresponding conversion according to the recorded data and type, and then realize the statistics of the length of physical exercise and the degree of physical exercise [8].

Wireless communication: the sensor device communicates with the smart terminal through the Bluetooth low-energy protocol to realize data transmission, storage, and presentation of physical exercise data. In the event of a serious abnormal situation, an alarm message is issued and transmitted to the relevant personnel via the wireless network of the smart terminal.

Low power consumption: the system can ensure continuous operation for a long time and can effectively manage the power supply.

Lightweight: it has small size, is light weight, which is easy to carry, and has little impact on users' normal activities.

Environmental adaptability: it can operate stably in an outdoor environment and has a certain degree of self-adaptability in a relatively harsh environment.

Scalability: a unified interface is used to facilitate the addition of sensors, somatosensory equipment, and other components.

3.1. Human Body Posture Monitoring Sensor Module. According to the system requirements, the ADXL362 accelerometer from ADI, the MAG3110 magnetometer from Freescale, and the MS5611 barometer from MEAS were selected to compare similar products from multiple manufacturers.

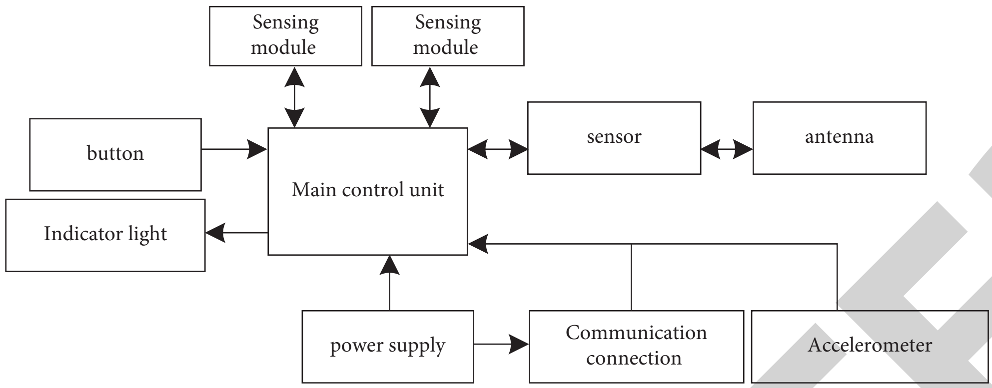

Figure 1: The structure diagram of the physical exercise monitoring system.

ADXL362 is an ultra-low-power, 3-axis digital output accelerometer with up to 12 bits. The power consumption is less than 2 μA when the output data rate is 100 Hz. It is 270 nA. Unlike accelerometers that use power duty cycle to achieve low power consumption, ADXL362 does not alias the input signal through under-sampling. It uses the full data rate to sample the entire bandwidth of the sensor, which can achieve true system-level energy saving [9].

In order to save energy and facilitate the connection with the processor, the altimeter and accelerometer use SPI communication interface to connect to the processor to achieve better energy consumption control. At the same time, connect the movement trigger terminal pin of the accelerometer to the P2.0 port of the processor, and MAG3110 uses IC to connect with the processor. The specific connection principle is shown in Figure 2.

3.2. Communication Connection Module. CC2430 works in the 2.4 GHz ISM band to meet the application of Zigbee technology and has the characteristics of low cost and low power consumption. It contains a high-performance 2.4 GHz DSSS radio frequency transceiver core and an industrial-grade 8051 core as well as 8KB RAM and powerful peripheral modules. The connection to the processor is shown in Figure 3.

3.3. Power Supply Module. The selection of the power supply chip and the design of the power supply mode are the two primary components of the power supply module. A lithium battery charge management chip and a system power regulator chip are two elements of the power chip to be chosen. A lithium battery with a voltage of 3.7 V and a capacity of 250 mAh powers the system. During charging, the maximum charging current cannot exceed its capacity [10]. As a result, for charging, a chip with a charging current of about 300 mA is used.

The largest current consumption in the system is the communication module, which is close to 30 mA. The total current consumption of other parts is much smaller than that of the communication module, and the total current consumption is less than 5 mA [11]. Therefore, the system is divided into two types of power supplies. The efficiency of the power chip is extremely low at 5 mA, so a voltage reference source LT6656 is used to supply power for small current power requirements [12]. The maximum pressure difference can be stabilized at 10 mV. Its own current consumption is only 850 nA.

The power supply design of each module, with the different power consumption level of each device in the system, is needed to consider that the power supply voltage also has certain differences. The system employs multiple power supply modes to achieve low power consumption power management, and the power supply part is designed with three power supply methods. GSEL0 and GSEL1 are set to select the data output precision. The data are outputed in binary complement form like 8-bit, 12-bit, or 14-bit, which can be accessed through the I2C bus interface [13]. Second, except for the wireless communication module, the power consumption of the single-chip processor module is the largest part of the total power consumption, and the total power consumption of all sensors is less than one-tenth of the single power chip’s consumption, and the single chip and the sensor have the same power supply voltage. Since the entire power consumption is modest, the microprocessor and sensor may share power supply [14]. Because the conversion efficiency of ordinary power chips is very low at low current, the voltage reference source LT6656 is used for power supply to achieve higher power conversion efficiency [15]. Finally, the working sequence of altimeter and magnetometer in human body posture monitoring determines that power can be directly supplied through the IO port of the single-chip microcomputer. The circuit design schematic diagram of the power supply module for the physical exercise monitoring system is shown in Figure 4.

3.4. Key Control Module. The design of the key control module of the system is very important. It communicates with the main controller through MAX3490 chip to convert the serial port to RS-422 interface [16]. The main controller sends instructions to display system power supply current and voltage and system state alarm instructions to the control chip of the system state monitoring unit through a RS-422 bus. The system state monitoring unit controls the chip minimum system and LCD display. The main control unit chip of this article adopts AVR series single-chip

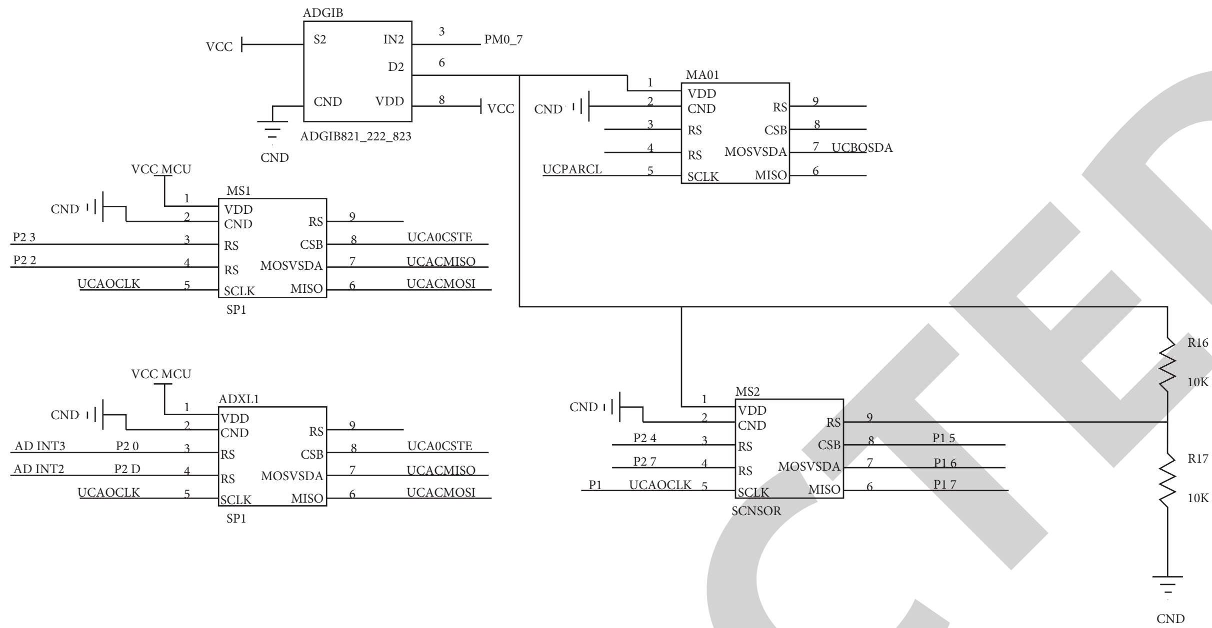

Figure 2: Schematic diagram of human body posture monitoring and sensing.

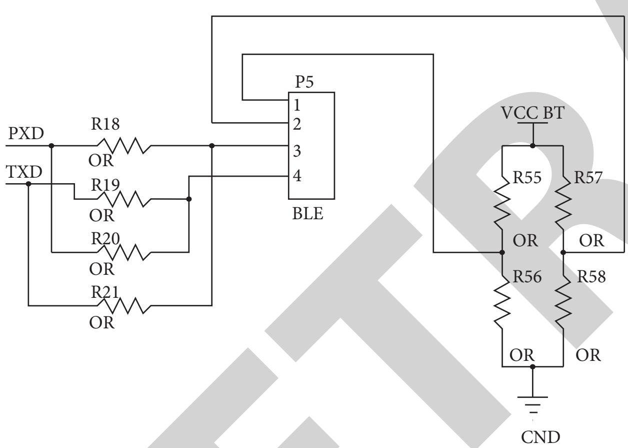

Figure 3: Schematic diagram of communication connection.

ATmega16A. ATmega16A is a high-performance, low-power 8-bit AVR microprocessor [17]. It adopts an advanced RISC structure and has a performance of up to 12MIPS when working at 12 MHz. It has two programmable serial USARTs [18]. The ATmega 16A used in universal synchronous, asynchronous serial receiver and transponder, is a highly flexible serial communication device [19]. It has full-duplex operation, optional asynchronous or synchronous operation, flannel operation provided by the master or slave, high-precision baud rate generator, three independent interrupts, multiprocessor communication mode, double-speed asynchronous communication mode, and so on [20].

ATmega16A has abundant resources and free development environment. Based on the above advantages, we choose ATmega16A as the system main control chip [21]. The circuit is shown in Figure 5.

3.5. Sensor Module. There are two primary kinds of regularly used acceleration sensors employed in various physical activity modes [22]. One kind is a gyroscope-improved angular velocity sensor. The KXTJ9-1007 acceleration sensor included in this article can track acceleration changes in many directions [23]. Figure 6 depicts the circuit of this module.

The power supply voltage range of KXTJ9-1007 chip is 1.71 V~3.6 V, and the selectable measurement ranges are 2g, 4g, and 8g. GSEL0 and GSEL1 are set to select the data output precision. The data are output in binary complement format like 8-bit, 12-bit, or 14-bit, which can be accessed through the I2C bus interface.

The I^2C bus is mainly used for synchronous serial communication between a master device and one or more slave devices. The I^2C bus is a two-wire serial interface composed of a serial clock line (SCL) and a serial data line (SDA). The master device provides a serial clock signal to the slave device through the SCL, and the slave device can place the clock line signal in a low state, forcing the master device to wait until the slave device is idle and release the clock line. The master and slave devices send and receive data in both directions through SDA [24].

4. Software Design

Introduce computer somatosensory technology in the software design process to improve performance. First, use the somatosensory device to select any two different coordinates $A(x_1, y_1, z_1)$, $B(x_2, y_2, z_2)$ which can be transformed into the traditional space coordinate system by using the translation and directionality of the vector. The composed vector $\overrightarrow{AB}$ can be regarded as the vector derived from the coordinate origin. The conversion formula is

$$\overrightarrow{AB} = (x_2 - x_1, y_2 - y_1, z_2 - z_1). \quad (1)$$

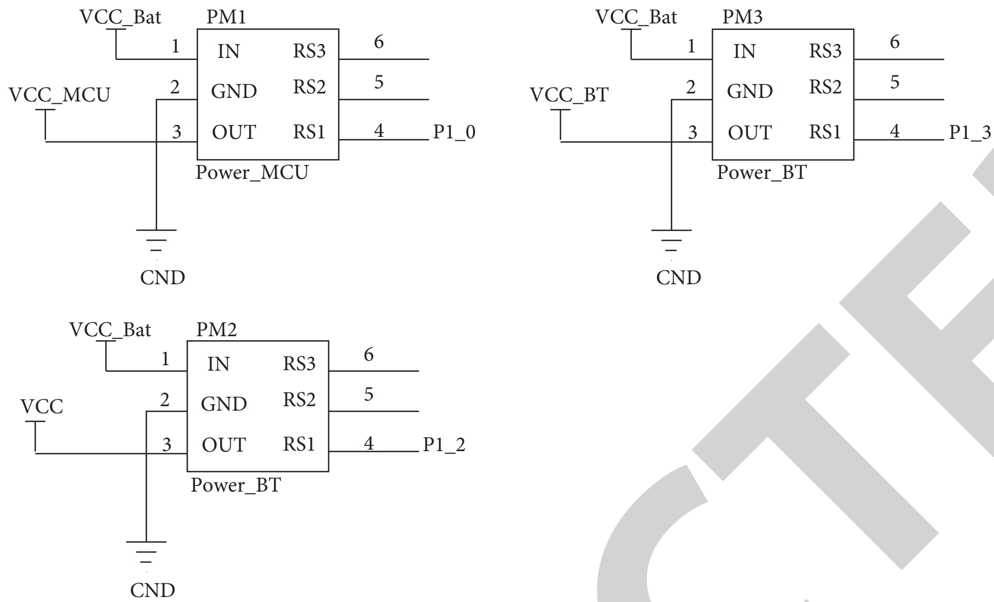

Figure 4: Schematic diagram of the power supply interface circuit.

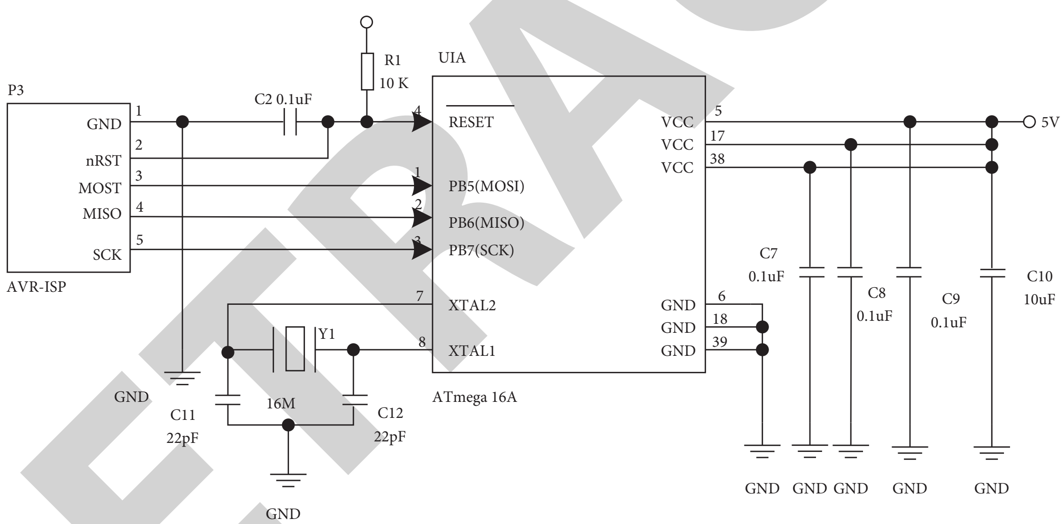

Figure 5: Circuit diagram of the main control chip.

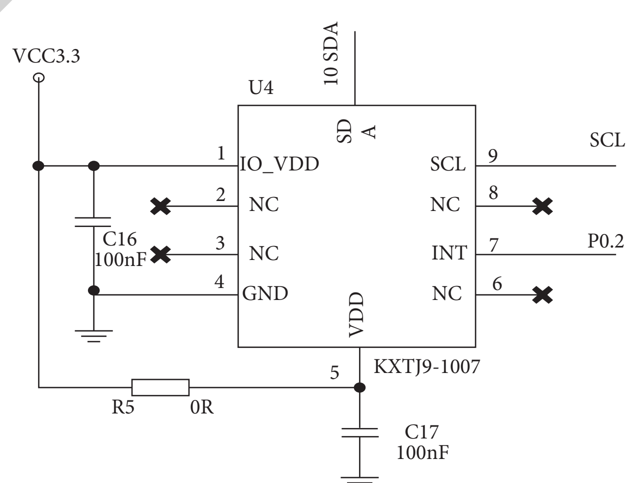

Figure 6: Sensor circuit module diagram.

Using the above method, the vector between the various joint points of the human body can be composed, and then the angle between the two vectors can be calculated, that is, the angle between the visual joints [25]. Taking the three joint points of the left hand, left elbow, and left shoulder in the actual V-shaped posture of the left arm of the human body as an example, the body and joint points are simplified, and the physical exercise action is mapped in the three-dimensional coordinate system, as shown in Figure 7.

At this time, you only need to calculate the angle θ between the vectors $\overrightarrow{ES}$ and $\overrightarrow{EH}$ to get the angle of the elbow joint formed by the three points of the shoulder, elbow, and hand in space. The formula is as follows:

$$\begin{aligned}\overrightarrow{ES} &= (Sx - Ex, Sy - Ey, Ez - Sz),\\ \overrightarrow{EH} &= (Hx - Ex, Hy - Ey, Ez - Hz),\\ \cos\,\theta &= \frac{\overrightarrow{ES}\cdot\overrightarrow{EH}}{|\overrightarrow{ES}||\overrightarrow{EH}|}.\end{aligned} \tag{2}$$

The shoulder rotation angle α can also be calculated in the same way. As shown in Figure 8, α is the angle formed by the plane XOY and the plane formed by the two vectors $\overrightarrow{ES}$ and $\overrightarrow{EH}$. Using the normal vectors of the two planes, the rotation angle α can be obtained, which is calculated as follows.

The normal vector of the XOY plane is as follows:

$$\overrightarrow{n_2}(0, 150, 0). \tag{3}$$

The normal vectors of the plane formed by $\overrightarrow{ES}$ and $\overrightarrow{EH}$ are as follows:

$$\overrightarrow{n_1} = \overrightarrow{EH} \times \overrightarrow{ES}. \tag{4}$$

From this, the shoulder rotation angle α can be obtained as

$$\cos\,\alpha = \frac{\overrightarrow{n_1}\cdot\overrightarrow{n_2}}{|\overrightarrow{n_1}||\overrightarrow{n_2}|}. \tag{5}$$

The method of extracting the bone features of the direct angle of the joint points by the above-mentioned space vector method and extracting a series of the features can reflect the posture bone features at different moments. Use these somatosensory features as the state description for creating the priority state machine to achieve the accuracy and completeness of the physical exercise posture monitoring.

5. Analysis of Results

This paper uses convergence, acceleration, and throughput as comparative indicators, as well as a physical exercise monitoring system based on WLAN and mobile phone APP (system in [4]) and physical exercise monitoring based on somatosensory recognition technology, to verify the effectiveness of the improved design system. Physical activity

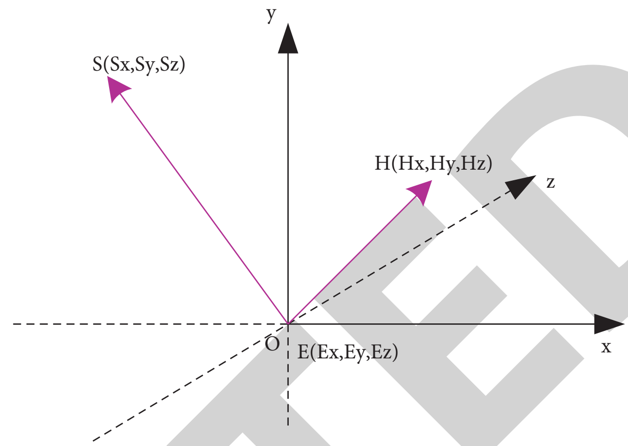

Figure 7: Action coordinates are mapped to the three-dimensional coordinate system.

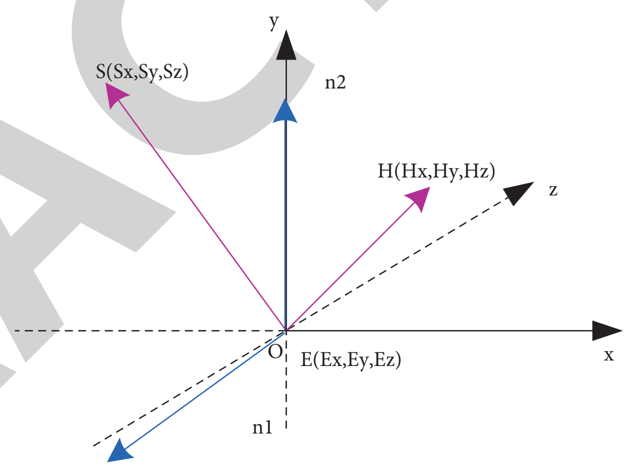

Figure 8: Calculation of shoulder.

monitoring system based on computer somatosensory technology as developed in this paper is verified with system shown in literature [6].

5.1. Convergence Comparison Analysis Results. The comparison test results of the convergence performance of different systems are shown in Figure 9.

The data in Figure 9 show that the convergence performance of the physical exercise monitoring system designed in this paper is better than the convergence performance of the physical exercise monitoring system based on WLAN and mobile phone APP and the physical exercise monitoring system based on somatosensory recognition technology, owing to the fact that the system designed in this paper is based on somatosensory recognition technology. Computer somatosensory technology is used in the software development process to speed up system convergence. When the system of literature [4] is used, its convergence performance decreases with the increase of the number of iterations, but its overall convergence performance is higher than that of the system designed in this paper and the system

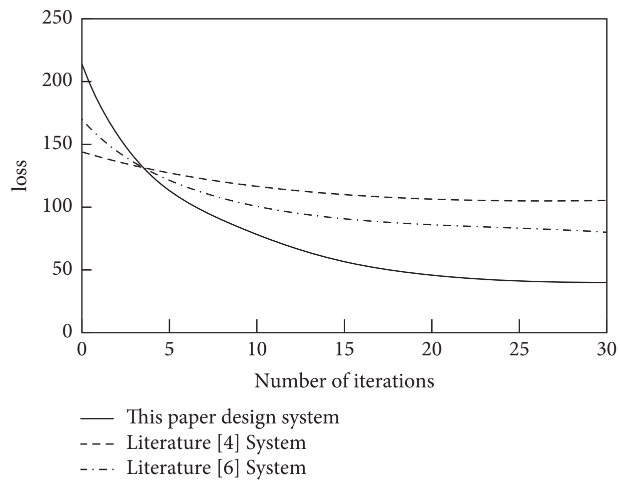

Figure 9: Convergence performance test results.

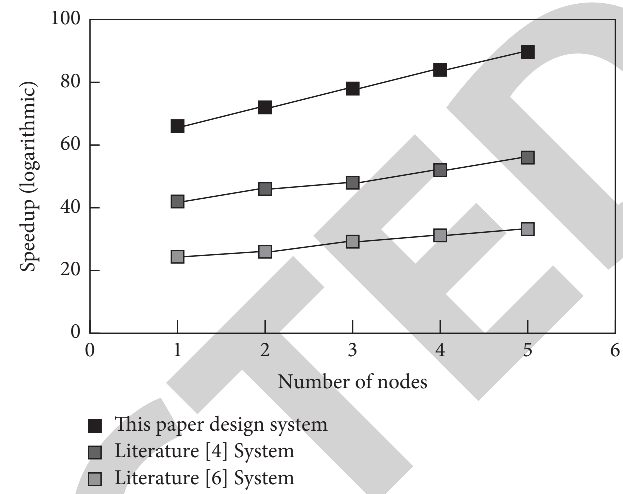

Figure 10: Parallel speedup test results.

of literature [6]; when the system of literature [6] is adopted, its convergence speed is lower than the system designed in this paper, but with the number of iterations increasing, the convergence performance gradually decreases, which is worse than the system designed in this paper. It can be seen that the system designed in this paper has certain advantages. It can be seen that the system designed in this paper has certain advantages.

For physical exercise monitoring systems based on WLAN and mobile phone APP (system in [4]), physical exercise monitoring systems based on somatosensory recognition technology (system in [6]), and sports systems based on computer somatosensory technology, the parallel acceleration ratio is used as the test index. Figure 10 shows the test results for the exercise monitoring system (the system described in this article).

The parallel acceleration ratios of the three physical exercise monitoring systems all increase as the number of nodes increases, according to Figure 10, but the increase in the parallel acceleration ratio of the system in the literature [4] and the system in the literature [6] is much lower than that of this paper. The parallel speedup ratio of the design system is also lower than the parallel speedup ratio of the system designed in this paper under the condition of the same number of nodes because the system designed in this paper will adjust the physical exercise information in real time according to the user's physical information during the physical exercise process. The accuracy of the system is improved, the user can realize the physical exercise monitoring process in a short time, and the parallel acceleration ratio of the physical exercise monitoring system can be improved.

The physical exercise monitoring system based on WLAN and mobile phone APP (shown in literature [4]), the physical exercise monitoring system based on somatosensory recognition technology (shown in literature [6]), and the physical exercise monitoring system based on computer somatosensory technology as designed in this article are tested to compare the throughput for these different systems. The test results are shown in Figure 11.

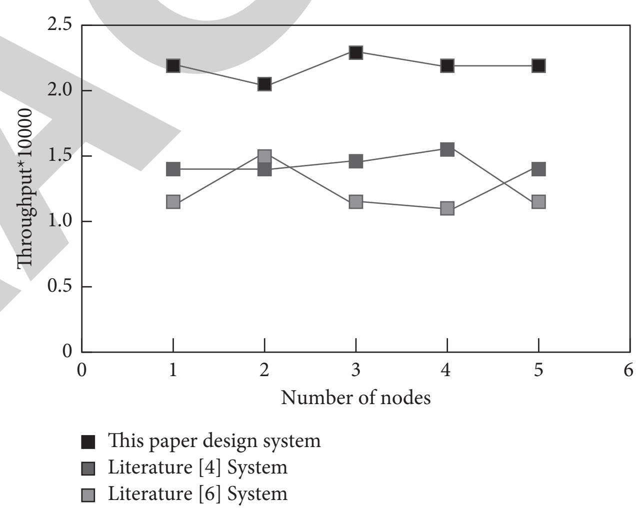

Figure 11: Throughput test results of different systems.

It can be seen from Figure 11 that with the increase in the nodes number, the processing number of the physical exercise system designed in this paper is higher than the physical exercise monitoring system shown in literature [26] and the literature [4]. In the process of physical exercise monitoring, according to the different exercise modes of the user, the physical exercise trajectory is collected, and the motion trajectory is used to determine whether the user is normal. At the same time, the system can process different exercise trajectories at the same time, which improves the physical exercise monitoring system's operation efficiency.

6. Conclusion

A physical activity monitoring system based on computer multisensory technology is suggested and aims to address the drawbacks of existing systems. The experimental findings demonstrate that when the system is developed as described in this study, the convergence is better than that of the system in [4] and the system in [6], and the acceleration and throughput are greater. In the design process, this is primarily superior than the system proposed in this work. To capture effective physical activity data and enhance monitoring efficiency, somatosensory technology has a particular use value.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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References

[1] W. Zhu, "Design and implementation of intelligent sports system based on wireless sensor network technology," *Automation & Instrumentation*, vol. 232, no. 02, pp. 82–85, 2019.

[2] B. Liu, M.-w. Wang, and L.-b. Chang, "A system of sports monitoring and fall warning for elderly," *Computer and Modernization*, vol. 5, pp. 101–105, 2020.

[3] J. Wang, "Design and implementation of rural residents' Sports intelligent information system under Android platform," *Automation and instrumentation*, vol. 231, no. 01, pp. 119–122, 2019.

[4] C. Ping, Z. Jian, and Z. Bin, "Design and application Research of College Students' daily running exercise monitoring and management system based on WLAN and mobile APP," *Bulletin of Sports Science and Technology*, vol. 24, no. 8, pp. 41-42, 2021.

[5] Y. Nanxi, F. Xiaoke, and Z. Xiaoying, "Software design of virtual reality system for upper limb rehabilitation training of construction workers," *Journal of Civil Engineering and Management*, vol. 37, no. 4, pp. 155–161, 2020.

[6] L. Wen, "Design of table tennis grip training system based on somatosensory recognition technology," *Automation and Instrumentation*, vol. 30, no. 2, pp. 89–92, 2020.

[7] W. Ping-Ping, "U. Application of kinect somatosensory interaction technology in programming teaching," *Journal of Hebei Software Institute*, vol. 45, no. 22, pp. 90–95, 2019.

[8] L. Zhang, "Design of somatosensory control system based on human-computer interaction technology," *Modern Information Technology*, vol. 64, no. 7, pp. 11–14, 2019.

[9] L. V. Wei, "Gesture recognition in somatosensory game via kinect sensor," *Internet Technology Letters*, vol. 2021, pp. 69–72, 2021.

[10] B. Shi, "Wearable exercise monitoring equipment for physical exercise teaching process based on wireless sensor," *Microprocessors and Microsystems*, vol. 81, no. 12, pp. 103–110, 2020.

[11] S. RamKhanal, J. Sampaio, J. Barroso, and V M Fillipe, "Individual's neutral emotional expression tracking for physical exercise monitoring," . in *Proceedings of the International Conference on Human-Computer Interaction*, vol. 67, no. 8, pp. 59–63, Springer, Berlin, Germany, October 2020.

[12] C Ha-Young and H Chong, "A Study on the automatic vehicle monitoring system based on computer vision technology," *Journal of Korea Institute of Information, Electronics, and Communication Technology*, vol. 10, no. 2, pp. 133–140, 2017.

[13] M. Shen, S. Qi, and Q. H. School, "Intelligent home system of internet of things based on somatosensory interaction technology," *Modern Information Technology*, vol. 18, no. 17, pp. 76–79, 2017.

[14] J Qin and N Xu, "Research and implementation of social distancing monitoring technology based on SSD," *Procedia Computer Science*, vol. 183, no. 1, pp. 768–775, 2021.

[15] L Yao, X. Sheng, N. Mrachacz-Kersting, X. Zhu, D. Farina, and N. Jiang, "Sensory stimulation training for BCI system based on somatosensory attentional o," *IEEE Transactions on Biomedical Engineering*, vol. 66, no. 3, pp. 640–646, 2019.

[16] H. Barends, N. Claassen-van Dessel, J. C. van der Wouden et al., "Impact of symptom focusing and somatosensory amplification on persistent physical symptoms: a three-year follow-up study," *Journal of Psychosomatic Research*, vol. 135, no. 12, pp. 110131–110135, 2020.

[17] O. Moser, M. L. Eckstein, A. Mueller et al., "Impact of physical exercise on sensor performance of the FreeStyle Libre intermittently viewed continuous glucose monitoring system in people with Type 1 diabetes: a randomized crossover trial," *Diabetic Medicine*, vol. 45, no. 25, pp. 45–52, 2019.

[18] T. B. Hartwig, B. Del Pozo-Cruz, R. L. White et al., "A monitoring system to provide feedback on student physical activity during physical education lessons," *Scandinavian Journal of Medicine & Science in Sports*, vol. 45, no. 2, pp. 114–120, 2019.

[19] F. Grisetto, Y. N. Delevoye-Turrell, and C. Roger, "Efficient but less active monitoring system in individuals with high aggressive predispositions," *International Journal of Psychophysiology*, vol. 146, no. 3, pp. 125–132, 2019.

[20] T. D. A. Almeida, J. Nacif, F. P. Bhering, and J. G. Ribel, "DOCTraMS: a decentralized and offline community-based traffic monitoring system," *IEEE Transactions on Intelligent Transportation Systems*, vol. 20, no. 3, pp. 1160–1169, 2019.

[21] M. Valle and M. Donadio, "M Pérez|nUiz. Physical exercise as a tool to minimize the consequences of the Covid quarantine: an overview for cystic fibrosis," *Pediatric Pulmonology*, vol. 52, no. 2, pp. 32–36, 2020.

[22] B. Glover and K. Hong, "1 the impact of atrial fibrillation ablation on physical activity and quality of life," *Heart*, vol. 105, no. 7, pp. 63–69, 2019.

[23] R. Capaci and C. Scali, "A cloud-based monitoring system for performance assessment of industrial plants," *Industrial & Engineering Chemistry Research*, vol. 63, no. 12, pp. 1156–1164, 2020.

[24] A. Saeed and A. Rashid, "Development of core monitoring system for a nuclear power plant using artificial neural network technique," *Annals of Nuclear Energy*, vol. 144, no. 23, Article ID 107513, 2020.

[25] J. L. Yin, B. H. Chen, and K. Lai, "Driver danger-level monitoring system using multi-sourced big driving data," *IEEE Transactions on Intelligent Transportation Systems*, vol. 6, no. 9, pp. 1–12, 2019.

[26] V. Raghupathy, O. Ibrahim Khalaf, C. Andr閱 Tavera Romero, S. Sengan, and D. Kumar Sharma, "Interactive middleware services for heterogeneous systems," *Computer Systems Science and Engineering*, vol. 41, no. 3, pp. 1241–1253, 2022.