Application of Internet of Things Framework in Physical Education System

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Abstract

In order to improve the effect of physical education, based on the Internet of Things technology, this paper combines sensor technology to construct a physical education system based on the Internet of Things framework. Based on the characteristics of system integrated multi-sensor in the collection of environmental characteristic parameters, this paper designs the system's multi-sensor data fusion model from the perspective of sensor type classification. Moreover, this paper combines the actual needs of physical education to construct the framework of the Internet of Things physical education system. In addition, this paper verifies the performance of the system through comparative experiments, and statistically researches the results and analyzes the data by mathematical statistical methods. The experimental research results show that the physical education system based on the framework of the Internet of Things can play an important auxiliary role in the physical education of college students.

Keywords: Internet of Things framework, Physical education, System, Sensor network

1 Introduction

For a long time, colleges and universities have been working hard on how to improve the teaching effect under the teaching mode where teachers are active and students are passive. At present, with the increasingly vigorous development of information technology and the improvement of school infrastructure construction, the concept of physical education is gradually changing. The concept of teaching is turning to "give full play" to the main role of students and the leading role of teachers and strive to advocate open and inquiry-based teaching and strive to expand the time and space of physical education courses. Inquiry-based instruction is a teaching assistant strategy in which the educator leads the students in the process of giving answers, developing methodologies, and interpreting results. Teachers consistently seek knowledge to support their studies via enquiry. The teacher must create opportunities for scientific investigation because the practice of classroom assessment fosters confidence in the class and allows schools to access chances with your thoughts and lessons learned. Both the students and teachers build skills and mental habits [20]. Under the guidance of teachers, students should have the freedom to choose the content of the course, choose the teacher, and choose the class time independently, so as to create a vivid, lively and active learning atmosphere. On the other hand, the popularization of higher education is an inevitable trend of China's economic and social development. It greatly alleviated the shortage of talents, met the needs of the people to a certain extent, and made important contributions to the development of socialist construction. However, from another perspective, the expansion of college enrollment also makes the teaching resources of colleges and universities relatively tight. With the continuous increase of resources in universities, there is also a demand for more reasonable and full use of existing teaching resources. The physical education club model is one of many physical education method reforms. It has strong practicality in the aspects of open teaching, expanding the time and space of physical education courses, and giving full play to students' autonomy and subjective initiative. At the same time, it is also extremely operable in making full use of the school's own physical education resources [1]. Physical activity can help youngsters cope with tension and worry. Sports tell students how to be more self-disciplined. They could use this personality in all facets of their lives, from efficiently managing their feelings to becoming more self-motivated in school. Physical activity aids in the development of confidence in youngsters [21].

Although network teaching has its obvious advantages and characteristics, it is not an omnipotent teaching method and cannot completely replace traditional teaching methods. Teachers' networking is centered on the production of innovative connections based on mutual professional identity and learning experiences. Most meetings include time for casual social events to encourage these contacts. In online teaching, teachers can interact with students in time to help group students solve various problems that arise in the learning process. However, the interpersonal communication between teachers and students has become weak in online teaching, and it is difficult for teachers to pay attention to the subtle spiritual and psychological changes of students in the learning process, and it becomes difficult to guide the healthy growth of students' mind and body. These are the advantages embodied in traditional teaching, and it is irreplaceable for online teaching. Students benefit from online teaching because it offers an impartial atmosphere for social relationships, which aids in the development of skills such as setting limits, understanding collaboration, and compassion. These abilities are critical for developing social interactions as a youngster and as an adulthood. With the rapid development of computer technology and network communication technology, the combination of the two has gradually been introduced into the

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teaching field, which has promoted the transformation of traditional education. In contemporary China, the people's living income level is constantly improving. Even in remote rural areas, the popularization of computers has a certain scale, and the continuous improvement and low cost of the national communication network infrastructure have made it possible for schools to carry out online teaching. With the support and help of national policies and funds, major universities across the country have established their own teaching networks, and some universities have implemented online teaching of major courses. Moreover, many distance education platforms have even been established between various schools, through which teaching resources have been fully utilized [2].

Nowadays, the use of devices and electronic innovations in learning has broadened to meet the needs of teaching methods, writing procedure, providing visualization and real-world environments to focus on improving critical reasoning, and enhancing coordination through Web and other communications networks, as well as graphical interfaces such as spreadsheets, database systems, and word processors. By enhancing the rate of training, decreasing expenses connected with educational methods or program delivery, and development project instructor time, online education possibilities and the adoption of information resources and other technology can boost great speaking [24].

Physical education, as a kind of bilateral teaching activity, has a very significant practicality in the process. In the course of lectures, teachers should give explanations and demonstrations at the same time, and deepen students' understanding through visualized teaching methods, so as to enable students to have higher and more comprehensive qualities and adapt to more advanced physical training and teaching, teaching training and management, and scientific research in the future. The sports network teaching system constructed in this paper is based on campus network, Internet and other hardware, and fully exerts the effectiveness of the network. Moreover, this paper widely promotes and uses the new teaching method of online teaching in a true sense. This is a problem that the industry needs to pay attention to and solve at this stage. Online classes demand more drive and personality than traditional classroom programs. One or maybe more educators and colleagues can keep a pupil responsible for their course performance in a school. Online courses, on the other hand, require us to set your own objectives, track out performance, and manage expectations.

This study uses sensor methods to develop a physically educational systems based on the Internet of Things foundation in attempt to optimise the impact of physical training using Concept of Internet of things [25].

2 Related Work

[3] proposed the TEAM Model smart classroom project, which realized the integration and automation of hardware equipment. In the software, it realizes the integration of digital teaching equipment electronic whiteboard, video booth and instant feedback system. [4] analyzed some problems in multimedia classrooms and proposed a smart classroom model for a new classroom environment, which includes the description of the management of the equipment in the classroom and the perception and adjustment system of temperature and air quality. [5] analyzed the application of the Internet of Things in the classroom management, logistics service, and safe campus of colleges and universities in more detail. [6] introduced the application of smart campus education based on the Internet of Things, which mentioned a kind of teaching information service and logistics management of a mobile information system. [7] used the smart classroom as the background to study and discuss network planning through network simulation and drawled some useful conclusions and puts forward reasonable suggestions. It provides a reference for the planning of wireless sensor networks in future smart classrooms. [8] expounded the concept of smart classroom, gave a SMART model, combined with actual cases, and introduced construction ideas and methods for classroom construction and research. [9] analyzed the classroom teaching activities and environmental perception adjustment and put forward the problems and countermeasures that need to be solved in the construction of the Internet of Things classroom. [10] designed a multimedia classroom central control system to realize multimedia equipment control and lighting control. [11] used ZigBee technology to realize wireless control of classroom equipment, and at the same time connected WiFi and ZigBee network together, the classroom equipment can be controlled through mobile phones or tablets. [12] researched and discussed network planning through the method of network simulation, which served as a reference for wireless sensor network planning in future smart classrooms. In order to solve the problem of the waste of university classroom resources, [13] studied the setting of university self-study classrooms and proposed a mathematical model of rationally setting the location and quantity of open classrooms. [14] analyzed the definition, characteristics and functional requirements of smart classrooms, and proposed relevant construction plans. [15] proposed a method and technical implementation for monitoring and management of classroom equipment and implementing abnormal alarms. [16] designed a classroom lighting monitoring system based on ZigBee technology, which can independently control classroom lamps and monitor lamp failures. [17] designed a classroom management program based on the Internet of Things to manage classroom equipment and use multiple sensors to detect the distribution of indoor personnel. It combines the established control strategy to achieve control, and also provides an attendance management method using IC card as a voucher and provides empty classroom information for self-study students through query services.

[18] proposed a smart classroom system model and implementation method that combines specific schools and disciplines. [19] analyzed the concept and function, overall architecture and key technologies of the smart classroom. [22] used the Internet of Things technology to build a classroom lighting system in colleges and universities and used intelligent control strategies to meet the needs of lighting and achieve energy-saving requirements. [23] designed the classroom lighting automatic adjustment system, which can set the corresponding light intensity according to the different use purposes of the classroom, and automatically turn off the lights to save energy when there is no one. [26] designed and implemented a classroom management system to monitor the environment and the status of teaching equipment in real time. [27] designed a multi-level collaboration system based on Wi-Fi and RS-485 protocols to monitor environmental parameter information, population statistics, and personnel distribution information to realize intelligent control decisions and reduce

energy waste. In addition, it also has attendance registration and security monitoring functions. [28] proposed a people counting technology based on the combination of multiple pairs of infrared pairs of tubes and RFID, which displays the number of people in the classroom and course information in real time through the display screen. [29] used NRF905 to achieve wireless transmission, used VB language to design the control interface, and built a security supervision system that is suitable for laboratories with population statistics, accident alarms, and environmental monitoring.

3 The Overall Design of the Data Fusion Structure of the Intelligent Physical Education Area Monitoring System

Multi-sensor data fusion algorithms have different classification schemes from different angles. In the paper, the data fusion processing method classified by sensor type is selected to design the data fusion structure. In the data fusion technology classified by sensor type, the data fusion of similar sensors is the data fusion of the measurement data from multiple sensors that measure the same parameters, and the correlation and mutual support of the parameters between the sensors are calculated. Multi-sensor meter (MSM), also referred to as multi monitoring, allows for the detection of different gases at the same time. Photo-ionization detection (PID) technique is also used in certain MSM, allowing the very same device to identify volatile organic chemicals. A single sensor and its associated analogue or digital signal conditioning equipment, with processor in and on the same packaging or separate from the sensor's component [30]. When abnormalities and large errors occur, the sensor data can be corrected with the data of other sensors to improve the accuracy and reliability of the data, and to ensure that the functional degradation of a single sensor will not affect the functions and decision-making of the entire system. Sensors that are diverse on automotive cognition, information in an object connection with a hierarchy propositional unification. Camera and 3D LiDAR data descripting multi-features of items are robustly modelled and identified. Conflict resolution fusion rules help to resolve uncertainty in associations. Heterogeneous sensors Data fusion is to fuse the measurement data of multiple sensors that measure different parameters according to certain criteria or weights to give an analysis of the environmental status of the target monitoring sports teaching area. Localization in interior spaces using multidimensional sensing information and data fusion. The platform is built on a versatile and adaptable sensor unit that may be worn by a user and includes a wide range of sensing devices such as sensor devices, centrifugal and electromagnetic sensors, and indicators. The capacity to combine inputs from many radars, laser scanner, and webcams to generate a single representation or vision of the world around a vehicle is known as sensor fusion. Also, because intensities of the many sensors are balanced, the final model is more appropriate [31]. Multi-sensor data fusion is a new technology that is being used in Division of Defense (DoD) sectors like computerized target tracking, military monitoring, and autonomous driving navigation system, as well as non-DoD applications like complicated equipment tracking and psychiatric condition.

The design of the multi-sensor data fusion mathematical model is the core of the system data fusion analysis. The design of the model depends on the actual needs of the system, environmental conditions, communication capacity and reliability requirements, which directly affect the algorithm selection, structure, and performance of the model. And scale.

The intelligent sports teaching area monitoring system monitors the target monitoring sports teaching area in real time by arranging multiple sensor nodes. Each sensor node integrates a temperature and humidity sensor, a gas concentration sensor, a light intensity sensor and a human infrared sensor; Humidity sensors are electronics instruments that enable and transmit the humidity and air temperature of the air surroundings, such as in the atmosphere, ground, or restricted places, in which they are installed. Humidity readings reveal the amount of moisture present in the atmosphere. Electronic equipment that identifies and distinguish various types of gases are known as gas sensors. They're typically employed to detect and monitor dangerous or explosive gases. Radiance, which could be used to detect much more than the brilliance of a laser intensity, is measured using light sensors. The light sensor can also be used to relation to relevant transmission distance since this illuminance diminishes as the sensors travels far from a constant light.

Since it transforms an IR of a human body to an electric signal immediately, a human infrared sensor device may identify human habitation not just in movement and also when it is not [32]. The multi-parameter monitoring structure carried out by the sensor, the system is designed as a two-layer data fusion analysis model structure according to the sensor type, as shown in Figure 1.

The system designs the data fusion structure into a two-layer structure according to the classification of sensor types. The first layer fusion is for the data fusion of sensors with the same parameters, and is also data-level fusion. The weighted least squares method is used to perform data fusion on the same type of sensors from different nodes. Analyze the similarity between sensors, reduce the impact of environmental noise and sensor errors on the measurement results, and improve the accuracy of sensor monitoring data; the second layer of data fusion is the data fusion of sensors that measure different parameters, and it is also a decision-level fusion. Fuzzy comprehensive evaluation (FCE) is a synthesized appraisal approach based on fuzzy arithmetic, and the validation results is realistic and dependable, making it widely utilised in the hydrocarbon, architecture, and other areas. Conventional two-valued logic believes that a statement will be either true or false. Fuzzy logic argues that everything is a difference of perception and existing processes two-valued reasoning. The data after the first level of data fusion uses the fuzzy comprehensive evaluation method in the fuzzy mathematics theory to comprehensively evaluate the environmental conditions of the target sports teaching area based on several environmental characteristic parameters, assigning different weights to each environmental characteristic parameter, and finally output data fusion analysis the result of. After the system data fusion model is established, the modeling and simulation are first performed in MATLAB software, and then the C language program is exported through MATLAB, and transplanted to the data storage and analysis processing module ITX-M30 to realize the independent operation and processing of the intelligent sports teaching area monitoring unit.

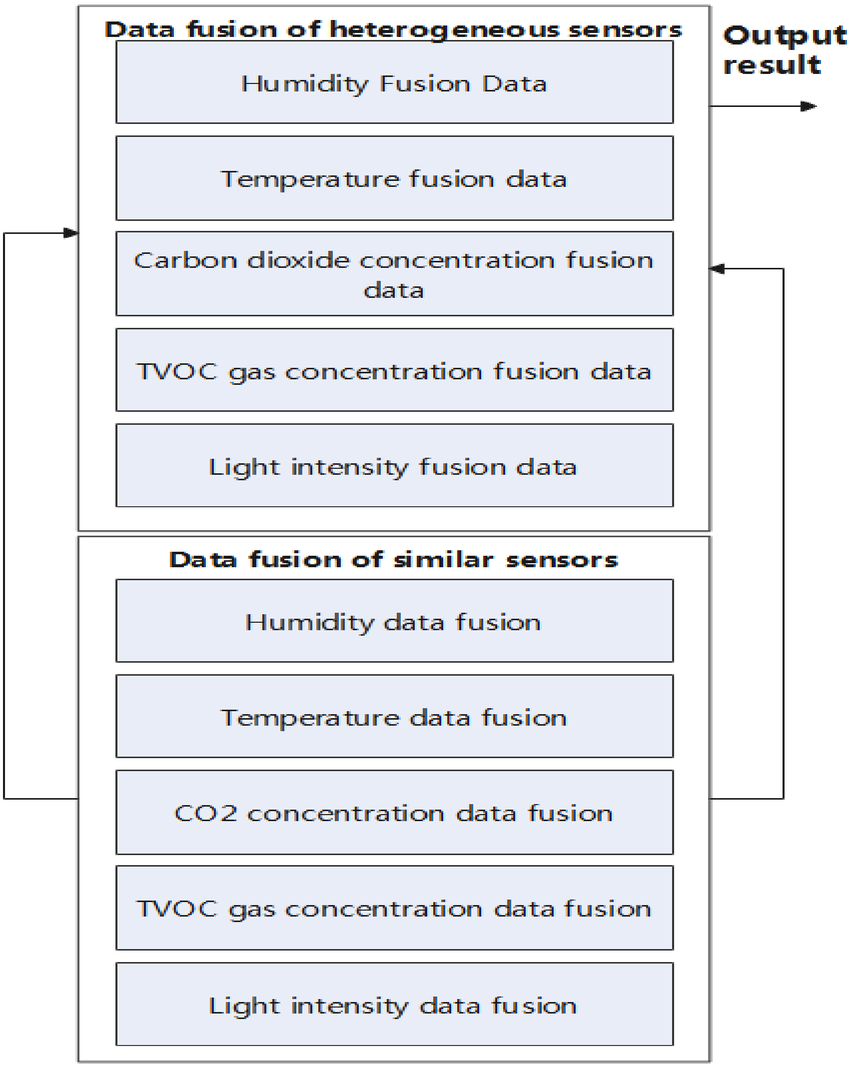

Figure 1. Structure diagram of system data fusion

Before performing subsequent system data fusion modeling and analysis, we first make the following assumptions about the system:

1. Each data is defined as two-dimensional data, and only the direct relationship between data and time changes is considered.

2. Multiple sensor nodes refer to the same time coordinate system, and the start time and sampling frequency of data collection are the same.

3. Each data is independent of each other, and there is no correlation and mutual interference between each data.

4. The sensor's measurement parameters include environmental noise interference and the sensor's own noise are Gaussian white noise, which obeys a normal distribution.

Least Square (LS) is based on the error theory. It determines the best function match of the data by finding the smallest square of error. It is a method with the smallest error and the highest accuracy in data processing. The least squares analysis is a powerful procedure for choosing the best fit for a group of data locations by reducing the total of the locations' deviations or regression coefficients from the predictable. Its goal is to draw a straight line that minimizes the sum of squares of a distortion introduced by the linked calculations' solutions. Weighted Least Squares (WLS) is based on the least squares method, giving each data a different weight. It gives larger weights to data with smaller errors and smaller weights to data with larger errors to reduce the impact of data with larger errors on the system. The weighted least squares method is suitable for dynamic data systems by fusing the raw data collected by sensors. Sensors are linked together via gateway, which allow devices to send gathered data to the cloud service. The knowledge is then transferred to your desktop or mobile phone, giving you immediate access to any and all tracked actions. Therefore, in the system, by using the weighted least square method to estimate the raw data of the same sensor collected by each sensor node, the data fusion function model of the same sensor is obtained, which can eliminate and replace when the data has large errors and improve the accuracy of the measured data. Instead, weighted least squares represents the behavior of the designer's randomness, and it can be applied to models with linear or non - linear coefficients. Weighted least square method is a fast strategy that works well with small samples.

The specific calculation process for data fusion modeling of similar sensor data based on the weighted least squares method is shown in Figure 2.

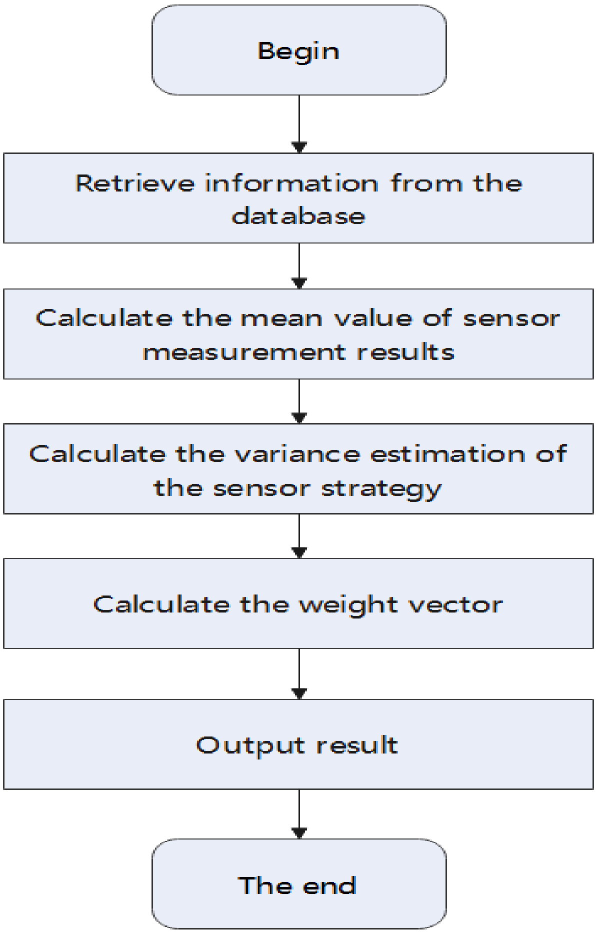

Figure 2. Flow chart of data fusion of similar sensors

1) We assume that there are n sensors in the target physical education teaching area, the real measurement value of the system is the one-dimensional measured vector x, and the n measurement values of the system are the n-dimensional system measurement vector Y, $Y=\left[y_1,y_2,\cdots,y_n\right]^T$ .The environmental noise interference and the noise of the sensor itself are uniformly expressed as an n-dimensional noise vector e, $e=\left[e_1,e_2,\cdots,e_n\right]^T$ .Then the observation equation for n sensors to detect a certain environmental feature state parameter of the system is:

$$Y=Hx+e \tag{1}$$

Among them, $H=\left[1,1,\cdots,1\right]^T$ is a known constant vector of n dimensions.

2) The least squares fitting method is that at each point of $x_i,\left(i\in\left[1,n\right]\right)$, the sum of squared errors of $\hat{y}=H\hat{x}+e$ calculated from y_i and the estimated value $\hat{x}$ of the true value x is the smallest. From the above formula and matrix operation rules, the sum of squared errors $A_W\left(\hat{x}\right)$ can be obtained, which can be expressed as:

$$A_W\left(\hat{x}\right)=\left(Y-H\hat{x}\right)^T W\left(Y-H\hat{x}\right) \tag{2}$$

Among them, the positive definite diagonal weighting matrix is $W=diag\left(w_1,w_2,\cdots,w_n\right)$. At this time, the least squares estimate of h when the above formula takes the minimum value can be expressed as:

$$\hat{x}=\left(H^TWH\right)^{-1}H^TWY \tag{3}$$

3) From the definition of the noise of the sensor measurement parameters in the system construction premise hypothesis, it can be known that the measurement noise in the system is Gaussian white noise and obeys the normal distribution. Gaussian white noise (GWN) is a zero-mean, stable and harmonic natural occurrence described by the following key assets such as any two GWN values, no matter how important in time, are linearly independent. The autocorrelation function of a GWN is directly impacted by this characteristic. The measurement data of each sensor are

independent of each other, and the noise of each sensor is also independent of each other, so noise e_i and noise $e_j\left(i,j\in[1,n];i\neq j\right)$ are independent of each other. Probability is a mathematical concept that describes the possibility of something happening. Weather events, for example, are used by climatologists to forecast the likelihood of rain. Probability theory is utilized in microbiology to examine the relationship among concentrations and the incidence of serious health outcomes. It can be deduced from probability theory:

$$E\left[(x-y_i)(x-y_j)\right]=E(x-y_i)\cdot E(x-y_j)=0 \tag{4}$$

If ε_i is defined as the measurement variance of each sensor, the noise vector e conforms to the following characteristics:

$$E(e)=0 \tag{5}$$

$$E\left(e_i^2\right)=E\left(y_i-x\right)^2=\varepsilon_i^2 \tag{6}$$

4) The estimated error $\tilde{x}$ of x can be expressed as:

$$\tilde{x}=x-\hat{x} \tag{7}$$

The sum of squares of the estimated error $\tilde{x}$ of x can be obtained as:

$$E\left[\left(x-\hat{x}\right)^2\right]=E\left\{\sum_{i=1}^{n}\left[\left(\frac{w_i}{\sum_{i=1}^{n}w_i}\right)^2\varepsilon_i^2\right]\right\} \tag{8}$$

The above formula is used to find the partial derivative of w_i. When the partial derivative is zero, the sum of squares of the error $E\left[\left(x-\hat{x}\right)^2\right]$ is the minimum value of $\tilde{x}$.At this time,

$$w_i=\frac{1}{\varepsilon_i^2} \tag{9}$$

The estimated value $\hat{x}$ of the true value x can be obtained as:

$$\hat{x}=\frac{\sum_{i=1}^{n}\frac{y_i}{\varepsilon_i^2}}{\sum_{i=1}^{n}\frac{1}{\varepsilon_i^2}} \tag{10}$$

Therefore, it can be seen from the above formula that the accuracy of the estimated value $\hat{x}$ of x is closely related to the size of the measurement variance. The calculation result of the sensor measurement error square ε_i^2 will directly affect the calculation result of $\hat{x}$.

The system can obtain the estimated state variance of the first-level data fusion result through the weighted least square method:

$$E\left[\left(x-\hat{x}\right)^2\right]=\frac{1}{\sum_{i=1}^{n}\frac{1}{\varepsilon_i^2}} \tag{11}$$

It can be seen from the above formula that the estimated variance of the system is smaller than the measurement error of any sensor in the system. When we use the arithmetic average estimation method to perform the data fusion of the first layer of similar sensors, the estimated state variance of the first layer data fusion result is calculated as:

$$E=\frac{1}{n^2}\sum_{i=1}^{n}\varepsilon_i^2 \tag{12}$$

By comparing the above two formulas, we can get:

$$\frac{1}{\sum_{i=1}^{n}\frac{1}{\varepsilon_i^2}}\leq\frac{1}{n^2}\sum_{i=1}^{n}\varepsilon_i^2 \tag{13}$$

The above formula shows that the data fusion effect based on the reason of weighted least square technique outperforms the classic maximum absolute estimating method for data integration. I.e., measurement error was coupled with the optimal balanced least - squares approach to build an optimum balanced matrix, which reduced information fusion faults to a minimal.

5) Calculate the measurement variance ε_i^2 of the sensor

In order to improve the accuracy of the fusion data, historical data needs to be processed, and the limitation of the actual operating capacity of the processor may not be able to meet the requirements of the processor when processing the historical data. Therefore, the method of variance recursion is used in data processing, which can reduce the amount of historical data that needs to be stored to a certain extent.

Because it is difficult to obtain the characteristic parameters of the target physical education area environment, the arithmetic mean $\bar{y}_m$ of the measurement results (m represents the m-th measurement result of the i-th sensor) is selected as the true value of the sensor's measurement data.

$$\bar{y}_m=\frac{1}{n}\sum_{i=1}^{n}y_{mi} \tag{14}$$

Then the measurement variance of the m-th measurement result of sensor i is estimated as $\hat{\varepsilon}_{mi}^2$:

$$\hat{\varepsilon}_{mi}^2=E\left(y_{mi}-\bar{y}_m\right)^2 \tag{15}$$

By simplifying, we can get:

$$\hat{\varepsilon}_{mi}^2=\frac{(n-1)^2}{n^2}\varepsilon_{mi}^2+\frac{1}{n^2}\sum_{j=1,j\neq i}^{n}\varepsilon_{mj}^2 \tag{16}$$

By adding and summing the measurement variance estimates $\hat{\varepsilon}_{mi}^2$ of n sensors, we can get:

$$\sum_{i=1}^{n} \hat{\varepsilon}_{mi}^2 = \frac{n-1}{n} \sum_{i=1}^{n} \varepsilon_{mi}^2 \quad \textbf{(17)}$$

The joint formula can be solved to obtain the measurement variance ε_i^2 of the sensor:

$$\varepsilon_{mi}^2 = \frac{n}{n-2}\left[\hat{\varepsilon}_{mi}^2 - \frac{1}{n(n-1)}\sum_{j=1}^{n}\hat{\varepsilon}_{mi}^2\right] \quad \textbf{(18)}$$

$$\varepsilon_i^2 = \frac{1}{M}\sum_{k=1}^{M}\varepsilon_{ki}^2 \quad \textbf{(19)}$$

Among them, M represents the total number of measurement results of the i-th sensor.

6) According to the formula,

$$Y = \sum_{i=1}^{n} y_i w_i \quad \textbf{(20)}$$

According to the above formula, the weighted least squares estimate for the sensor measurement data can be calculated:

$$\hat{x} = \left(H^T W H\right)^{-1} H^T W Y \quad \textbf{(21)}$$

7) Finally, the above mathematical modeling process is simulated in MATLAB, and the simulation results are output for data input during data fusion of heterogeneous sensors.

4 Physical Education System based on the Framework of the Internet of Things

The Internet of Things technology has three major characteristics, including: comprehensive perception, the wide application of various perception technologies; reliable transmission, to achieve reliable information sharing and interaction between objects; intelligent difference among processing and control of information in the Internet of Things. The Internet of Things system is usually divided into a three-tier architecture, and from bottom to top are the perception layer, network layer, and application layer, as shown in Figure 3.

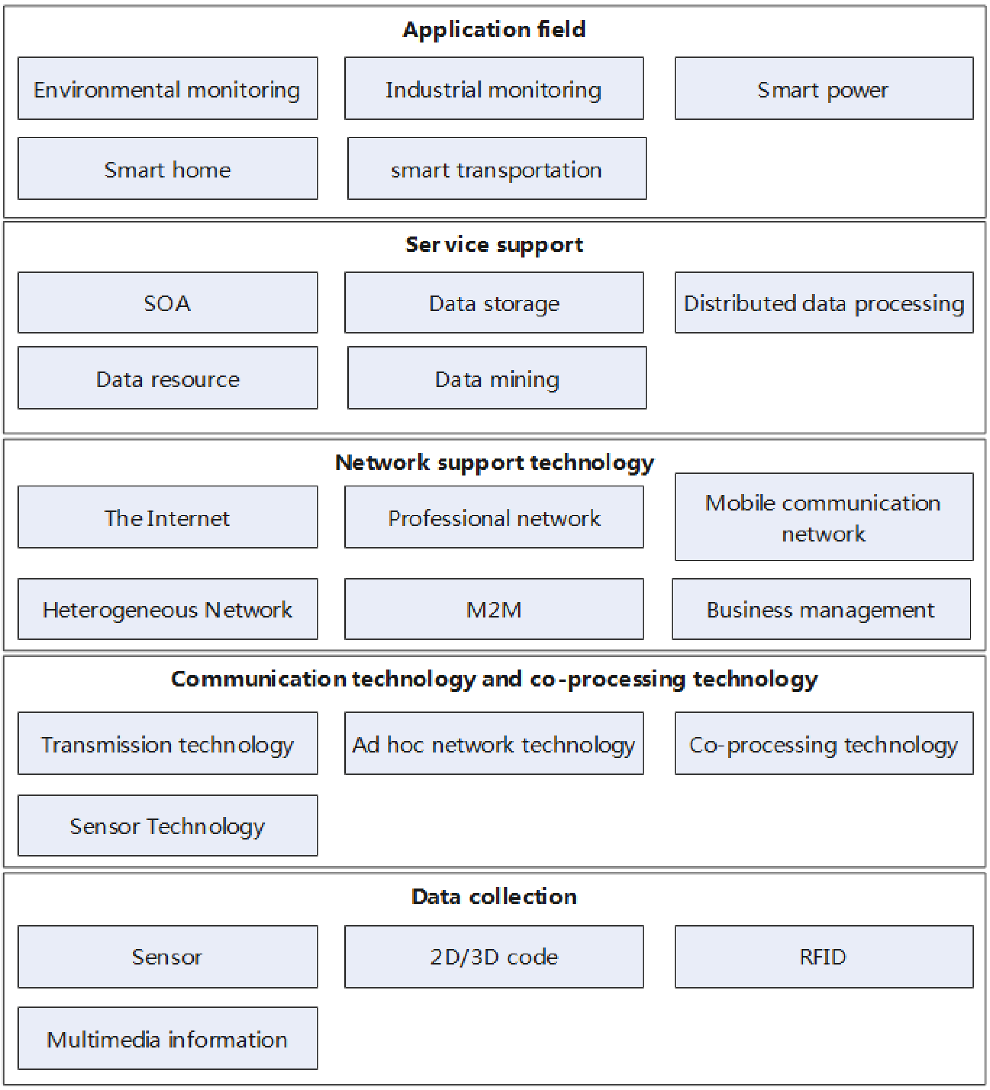

Figure 3. The three-tier architecture of the Internet of Things

It is composed of three layers: perception, network, and application. (i) The physical layer, that has sensing devices and collecting environmental information, is the perception layer. It detects certain physiological characteristics or recognizes other intelligent items in the vicinity. (ii) The network layer is in charge of establishing connections with other connected phones, network equipment, and services. Its capabilities are also utilized in the collection and reception of sensors. (iii) The application layer is in charge of providing the user with application-specific capabilities. It specifies the many applications that can be used with the Internet of Things. Smart homes, smart cities, and smart transportation are just a few examples. By placing intelligent physical education area monitoring units and sensor nodes in the target physical education area, the intelligent physical education area monitoring system can realize real-time monitoring of the on-site environment, intelligent switch control, data analysis and processing, data display, data storage, abnormal state diagnosis and other functions, as shown in Figure 4.

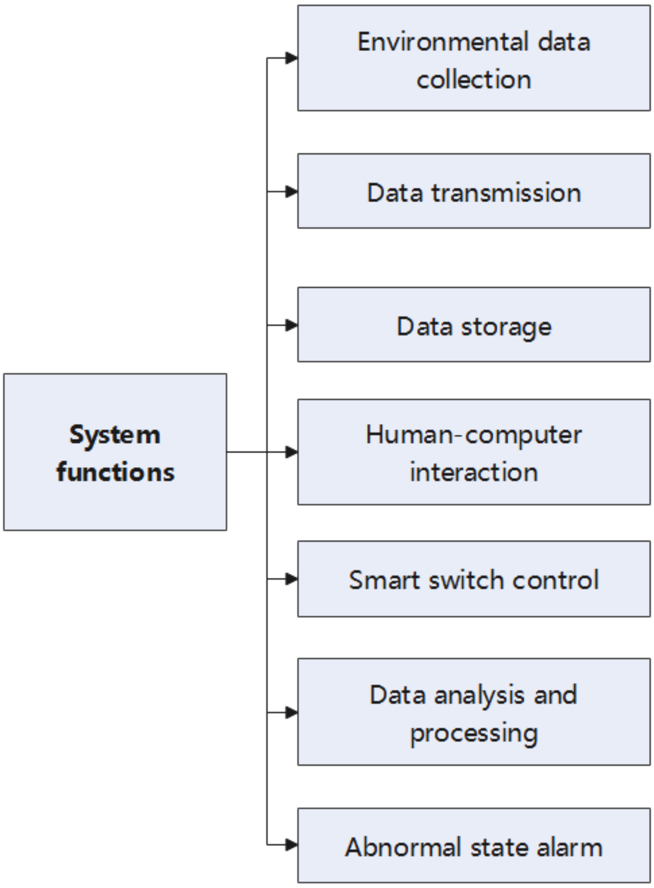

Figure 4. System function diagram

According to the three-tier system structure of the Internet of Things, in view of the diversity and uncertainty of the environmental status of the intelligent physical education area monitoring system, this paper selects the mesh network topology as the network topology of the system. Moreover, this paper builds the wireless transmission network of the system based on this and designs the coordinator node inside the intelligent physical education area monitoring unit. In addition, this paper regards the sensor node as the terminal node of the system to realize the functions of node multi-hop transmission, self-organizing network, and network self-healing. At the same time, this paper divides the intelligent physical education area monitoring system into three layers: perception control layer, network transmission layer, and application service layer, as shown in Figure 5.

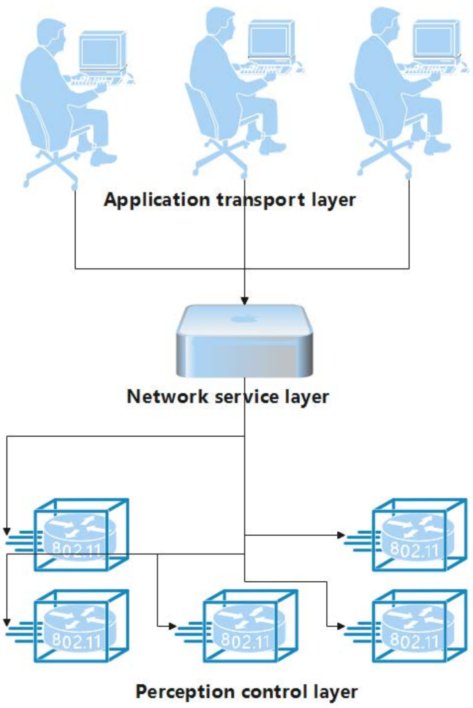

Figure 5. System overall architecture diagram

(1) **Perception control layer.** The perception control layer is composed of multiple terminal sensor nodes and routing relay nodes for wireless communication transmission. The terminal sensor node is responsible for collecting, preprocessing and transmitting the environmental characteristic parameters of the physical education area, and the routing relay node forwards the data collected by the terminal sensor node to the coordinator of the intelligent physical education area monitoring unit. (2) **Network transmission layer.** The network transmission layer is composed of a wireless communication transmission network, connecting the perception control layer and the application service layer. The wireless communication transmission network establishes a link path for bidirectional data transmission between the bottom terminal sensor nodes of the perception control layer, the routing relay node and the monitoring unit of the intelligent sports teaching area. (3) **Application service layer.** The application service layer is composed of intelligent sports teaching area control unit. As the core of the system, the intelligent sports teaching area control unit uses data fusion, data analysis and other technologies to realize data processing, display, transmission, storage, and comprehensive environmental status.

The intelligent sports teaching area monitoring unit takes the main control processing chip as the core, and designs the data transceiver module, touch display module, data storage module, data fusion modeling analysis module, power supply module, relay switch module, etc., the specific hardware structure and the inter-module The connection method is shown in Figure 6.

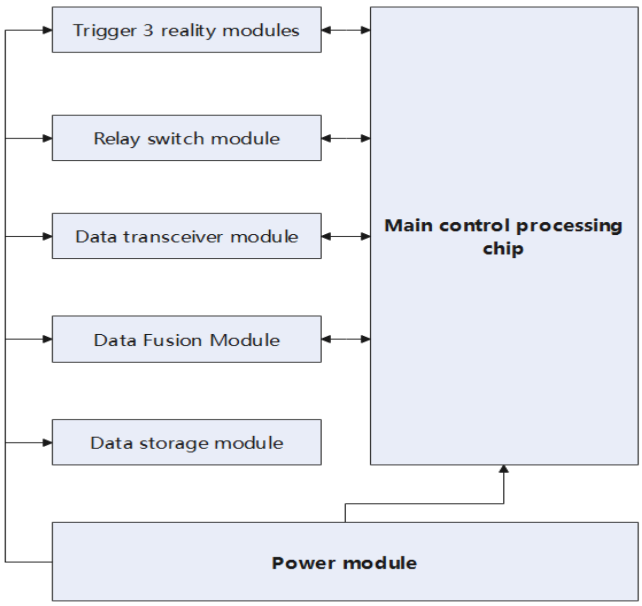

Figure 6. The hardware structure diagram of the monitoring unit of the intelligent physical education

The terminal sensor node is shown in Figure 7, including a data transceiver chip module, a sensor chip cluster, and a power supply module for power supply. The sensor chip periodically transmits the collected environmental data to the data transceiver chip through a two-way binary synchronous serial bus or a single bus through the hardware communication protocol on the circuit board. The data transceiver chip packs the data and sends it to the intelligent physical education area monitoring unit. The power module is responsible for supplying energy to all hardware components of the terminal sensor node.

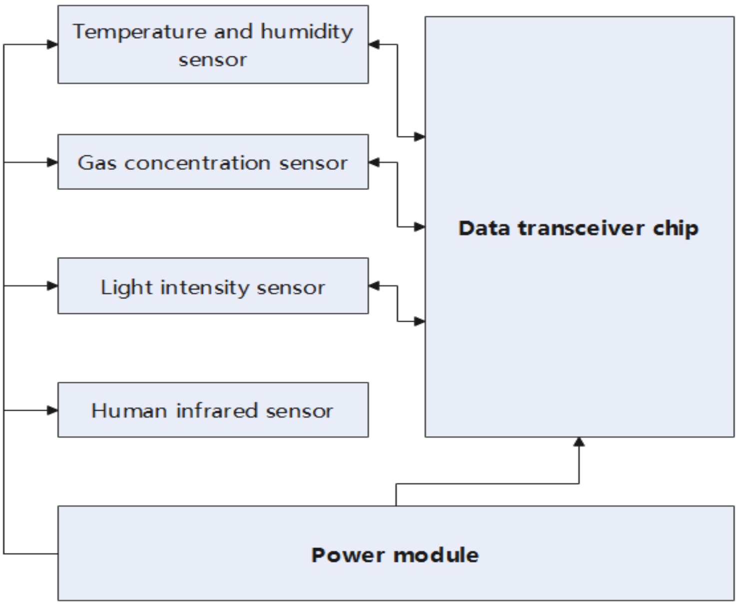

Figure 7. Hardware structure diagram of terminal sensor node

After the intelligent physical education area monitoring unit is powered on, it is initialized first, and the initialization is completed, and each module starts to work. Then, it establishes a wireless communication network, and waits for the node to join after the network is successfully established. After the node is successfully connected to the network, data transmission starts. The intelligent physical education area monitoring unit obtains the sensor data from the node and analyzes it, stores it in the database after the analysis is completed, and sends it to the display control screen for real-time display of the data. After that, it sets and operates the control relay switch according to the user's environmental characteristic parameter threshold value setting and operation. The data fusion analysis module retrieves the data stored in the database for data analysis and modeling and comprehensive evaluation of environmental conditions. According to the threshold value of the environmental characteristic parameter set by the user and the comprehensive evaluation result of the environmental state, it is judged whether there is an abnormality in the environmental state of the target physical education teaching area. If there is an abnormality, an abnormal state alarm is performed on the display control module. The terminal sensor node is initialized after power-on, and the sensor starts to work after the initialization is successful. Then, the node joins the wireless communication network established by the intelligent physical education area monitoring unit, and after successfully connecting to the network, it starts data transmission with the intelligent physical education area monitoring unit.

5 Analysis of the Effect of the Physical Education System based on the Framework of the Internet of Things

This article combines the framework of the Internet of Things to construct a physical education system and analyzes the role of the system in teaching. The test subjects in this paper are 100 students majoring in physical education in a university, and 81 test subjects remain after passing the screening. This paper uses the system constructed in this paper to monitor the status of students, and the accuracy of the system to monitor the status of students is calculated. The results obtained are shown in Table 1 and Figure 8.

Table 1. Statistical table of the monitoring effect of the physical education system based on the Internet of Things architecture on the status of students

No.	Body Monitoring Effect	No.	Body Monitoring Effect	No.	Body Monitoring Effect
1	87.2	28	79.5	55	85.5
2	80.2	29	88.2	56	86.2
3	81.8	30	82.2	57	91.4
4	85.9	31	83.5	58	90.2
5	88.0	32	89.5	59	84.4
6	90.9	33	82.3	60	79.9
7	79.5	34	79.3	61	89.3
8	85.4	35	86.3	62	79.4
9	87.8	36	89.1	63	90.5
10	83.1	37	80.7	64	79.5
11	91.5	38	88.2	65	82.4
12	79.3	39	80.2	66	88.6
13	89.4	40	87.8	67	88.0
14	89.5	41	81.9	68	82.7
15	81.4	42	82.7	69	90.8
16	88.2	43	90.0	70	90.8
17	83.1	44	83.2	71	88.6
18	79.8	45	90.7	72	86.1
19	90.7	46	79.1	73	84.7
20	91.5	47	87.9	74	80.9
21	87.9	48	85.5	75	80.8
22	80.1	49	86.3	76	84.4
23	91.9	50	81.3	77	80.2
24	86.7	51	90.5	78	84.4
25	80.3	52	88.7	79	80.7
26	84.2	53	84.8	80	86.6
27	92.0	54	85.2	81	89.2

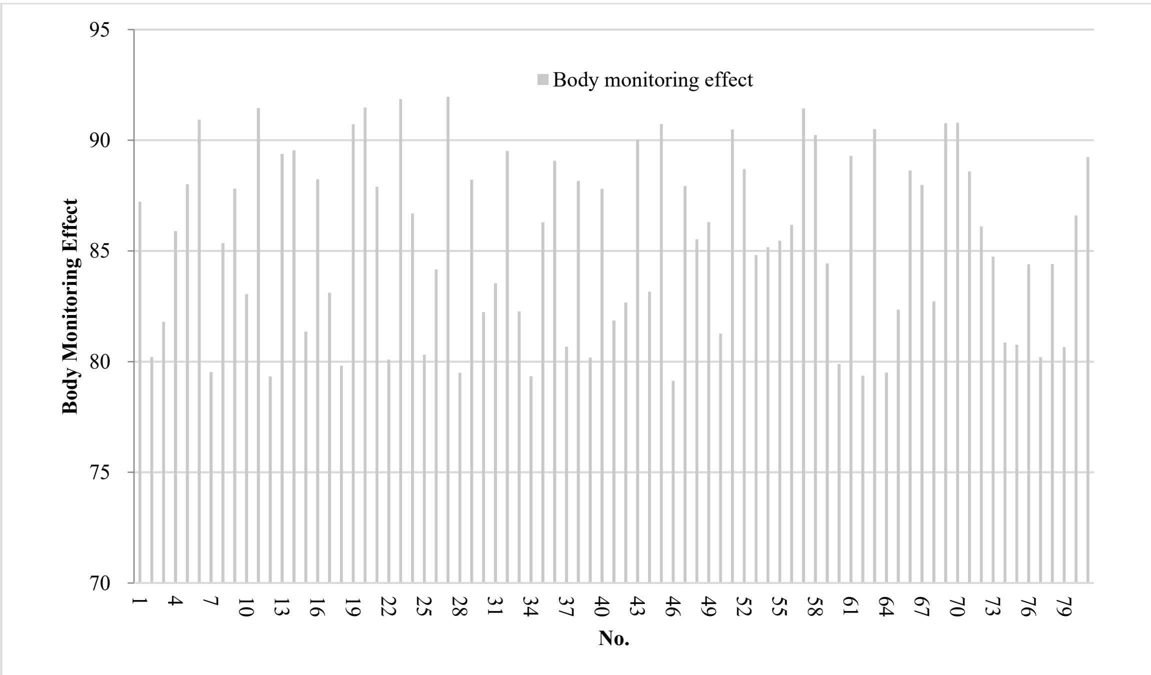

Figure 8. Statistical diagram of the monitoring effect of the physical education system based on the Internet of Things architecture on the status of students

From the above analysis results, it can be seen that the system constructed in this paper performs well in the monitoring of student status and can basically effectively monitor the status of students in physical education. On this basis, this paper evaluates the effect of the system constructed in this paper on physical education teaching, and the results obtained are shown in Table 2 and Figure 9.

Table 2. Statistical table of teaching effect evaluation of physical education system based on the framework of Internet of Things

No.	Physical Education Evaluation	No.	Physical Education Evaluation	No.	Physical Education Evaluation
1	93.6	28	81.2	55	76.8
2	92.6	29	75.0	56	84.2
3	81.4	30	88.4	57	87.8
4	74.7	31	83.6	58	90.0
5	84.1	32	92.9	59	76.1
6	78.4	33	76.4	60	91.2
7	77.0	34	75.4	61	79.1
8	81.0	35	83.7	62	87.0
9	77.8	36	71.7	63	81.6
10	78.8	37	80.5	64	74.2
11	71.8	38	71.0	65	86.9
12	90.4	39	73.2	66	81.4
13	86.3	40	78.7	67	89.8
14	87.1	41	88.2	68	75.5
15	79.3	42	78.9	69	77.0
16	82.1	43	90.4	70	72.1
17	77.7	44	91.8	71	78.4
18	75.3	45	86.4	72	92.6
19	80.3	46	87.1	73	73.2
20	76.7	47	74.4	74	91.0
21	90.7	48	87.9	75	72.1
22	72.1	49	86.4	76	71.8
23	81.7	50	75.0	77	81.9
24	90.3	51	81.0	78	92.5
25	73.7	52	91.9	79	88.3
26	85.8	53	91.3	80	90.2
27	87.1	54	86.6	81	90.9

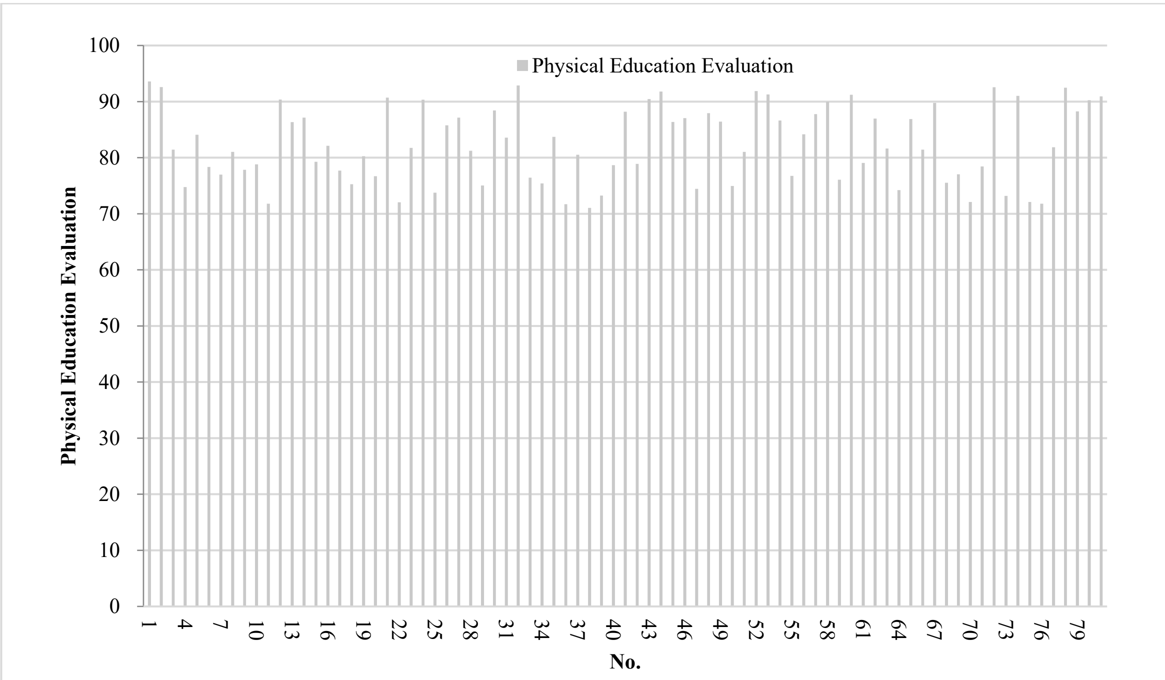

Figure 9. Statistical diagram of teaching effect evaluation of physical education system based on the framework of Internet of Things

Through the experimental analysis, it can be known that the physical education system based on the framework of the Internet of Things can play an important auxiliary role in the physical education of college students and effectively improve the effect of physical education.

6 Conclusion

Physical education management is one of the integral parts of the entire teaching management of colleges and universities, and its informatization process is almost synchronized with that of the educational administration management system. The informatization of educational administration management in universities has always been the focus of attention of various universities. In particular, the rapid development and popularization of information technology in recent years has made the level of demand for educational administration informationization at all levels of the school increase year by year. This article combines the technology of the Internet of Things to construct a physical education system based on the framework of the Internet of Things and uses the system to assist in college physical education. After that, this paper uses the model constructed in this paper to conduct experimental research on college physical education. From the research results, the physical education system based on the framework of the Internet of Things can play an important auxiliary role in the physical education of college students.

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Biography

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