

## Research Article

# Application Practice Analysis of Ice and Snow Sports Training Assistance System Based on Internet of Things

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Teachers play an essential role in physical culture, and they are not only responsible for analysis and guidance but also responsible for formulating specific training methods and training rhythms according to athletes' personalities. Computer technology has developed rapidly into the 21st century. In sports training, some researchers have also started to analyze and generalize physical activity and movement patterns using IoT technology. Not only can it analyze the rules of specific sports science, but it can also use computers to intentionally infiltrate sports facilities to provide advanced technical support to effectively improve training and science. In this article, IoT technology is introduced to study the auxiliary system for ice and snow sports training. Before designing the system, this paper plans the system architecture in detail, including the principle of stability, the simplicity and practicality, and the principle of low price. Using this auxiliary system, the sensitivity of the lower limbs of ice and snow athletes was trained in this paper. The sensitivity scores of 5 athletes before the experiment were 50, 54, 49, 38, and 35, and the scores after the experiment were 32, 26, 31, 35, and 30, and the sensitivity was significantly improved.

## 1. Introduction

With the accelerated growth of computer technology, people are beginning to incorporate the Internet of Things and other technologies to organize scientific exercise, thus completely abandoning the traditional experience-based exercise training. Visual observation exercises are commonly used in traditional sports, and integrated with IoT technology, a method for improving sports movements is proposed to assist athletes in training. In this way, it can get rid of the state of purely relying on experience in traditional sports training, realize intuitive sports analysis and guidance, and scientifically improve the level and performance of athletes.

Whether an ice and snow athlete has the ability to perfectly present the complex movements of the lower limbs is an important criterion for evaluating whether they are excellent, and an essential point to support this ability is the agility of the lower limbs of the athlete. Only with a high degree of sensitivity can athletes be able to accurately, cleanly, and quickly complete specific movements or shapes

in complex transformations and maintain the balance and stability of the body.

The innovation of this paper is the introduction of IoT technology. Based on the principles of stability, simplicity and practicality, and low price, this paper designs a flow chart of the sports test system and provides auxiliary training for the lower limb sensitivity of ice and snow athletes. The stability and packet loss rate of the auxiliary training system are tested in harsh and normal environments. This paper lists four common methods for improving fast movement ability and obtains the sensitivity data of athletes before and after training.

## 2. Related Work

Regarding the Internet of Things, relevant scientists have done the following research. The special features of the Internet of Things include the wide range of objects of the Internet, devices and networks, and the large number of self-generated events, making it very difficult to develop a

wide variety of applications and services. Razzaque et al. describe a set of secondary IoT software requirements and provide a complete view of midrange solutions that can meet these requirements. They also highlight open research questions, challenges, and future research directions [1]. Mostafa et al. propose an IoT-based flood status prediction model to facilitate the prediction of river flood conditions. The IoT-FSP model applies the IoT architecture to facilitate the flood data acquisition process and three machine learning (ML) algorithms, namely, decision tree (DT), decision forest, and random forest, for the flood prediction process. The results show that the IoT-FSP model successfully completes the data acquisition and prediction tasks, and the average accuracy of the threefold cross-validation results reaches 85.72% [2]. Stojkoska and Trivodaliev aim to bridge the gap between existing modern smart home applications and the possibility of integrating them into an IoT environment. To efficiently integrate smart home devices into IoT-based solutions, they propose a general framework by combining various elements of IoT architectures/frameworks proposed in the existing literature. The commonalities identified in the research can provide a solid foundation for IoT developers of future smart home solutions [3]. Kshetri's proposed role of blockchain in improving IoT security would be appreciated. This shows how blockchain solutions can surpass the current cloud server-based IoT ecosystem in many ways. He focused on how blockchain-based authentication and access control systems can solve some key IoT security issues. He analyzes and details the role of blockchain in monitoring vulnerable resources in supply chains associated with IoT devices [4]. Mostafa et al. propose that medical devices that create the medical IoT will be reviewed based on scientific research and commercial results. It has a specialized architectural design, including healthcare analyzer hardware and software for additional diagnostics and data storage. Today, portable devices are widely used in health monitoring applications. One of the greatest parts of digital data acquisition is sensor. In the last few years, with the development of the semiconductor technology, the study of all sensor parameters has been close to realization [5]. With the features of IoT devices, sAs-limited memory, and computing ability, a new platform is needed to efficiently process data. Alrawais et al. address the issues of security and privacy in the IoT context and provide a facility to improve the dissemination of certificate revocation messages between IoT devices to enhance security. Alrawais et al. also proposed possible research methods for using computers to improve the security and privacy of the IoT environment [6]. Today, traditional business models are changing and people are using them for various e-commerce functions. As the innovative Internet revolution, Internet of Things has become a new e-commerce platform. Zhang and Wen presented an IoT e-commerce model especially conceived for IoT e-commerce. It deals with a number of factors of traditional e-commerce models and enables copyright deals and IoT payments through P2P transactions and blockchain-based smart contracts [7]. These methods provide some references for research, but due to the short time and small sample size of the relevant research, this research has not been recognized by the public.

### 3. Methods of Auxiliary System for Ice and Snow Sports Training

*3.1. Internet of Things.* IoT technologies include tracking any controlled object or objects in real time, as well as communication and communication with high-frequency measurement technology, a global positioning system, and infrared sensors. It receives all vital signals such as sound, light, heat, electricity, and information technology. And it uses all possible means to connect to the Internet, to establish information communication between and among objects and people everywhere, and to achieve smart identification, identification and control between and among objects and procedures. IoT is a traditional network-based data storage and telecommunication networks, allowing the formation of an interconnected Internet of Things in different physical units that can operate independently of each other [8].

The essence of the Internet of Things is to achieve comprehensive understanding, wide networking, and intelligent processing. Among them, the observation and communication capabilities of objects have a major role to play in the application and development of IoT. Wireless sensor network technology is designed to detect lots of touching nodes in a specific area and view and receive ad hoc multinet network object data through wireless connections between nodes. It includes traditional sensor and internet technologies and is one of the leading software and add-on technologies at the end of IoT [9].

The application field of the Internet of Things involves all aspects and is used in infrastructure fields such as industry, agriculture, environment, transportation, logistics, and security. It effectively promotes the intelligent development of these aspects, making the limited resources more rationally used and distributed, thereby improving the efficiency and benefit of the industry. Applications in fields are closely related to life, such as home furnishing, healthcare, education, finance and services, and tourism. It has greatly improved in terms of service scope, service method, and service quality, which greatly improves people's quality of life. In the field of national defense and military, although it is still in the research and exploration stage, the impact of IoT applications should not be underestimated. From equipment systems, such as satellites, missiles, aircraft, and submarines, to individual combat equipment, the embedding of IoT technology has effectively improved military intelligence, informatization, and precision. It has greatly improved military combat effectiveness and is the key to future military reforms.

The primary characteristic of IoT is as following. From the point of view of things and communication processes, the information established in the context of the interaction between things and things and between people and things is an important element of the IoT. The essential features of IoT can be summarized as the concept of mutual compatibility through common sensing, data transmission, and intelligent processing:

- (1) General concept. Devices can use detection devices such as RF detection, QR codes, and smart sensors to collect various information about the data

- (2) Dependable transfer. With the consolidation of the Internet and radio networks, object messages can be delivered in reality and precisely, enabling the exchange and interchange of information
- (3) Intellectual management. A wide range of intellectual technologies are used to evaluate and manipulate the data and information collected and communicated to enable intelligent surveillance and regulation [10]

The perception relationship between IoT is very heterogeneous. The Internet of Things must be based on an open, multi-layered, and scalable network architecture to achieve networking, interoperability, and interoperability between different information. The Internet of Things not only refers to the sensor network nor is it equivalent to the ubiquitous network but is included in the concept of the ubiquitous network, including the sensor network and the network that intersects with the communication network, the Internet, and the industry-specific network.

The IoT ranging method is to measure the power of the received signal. On the premise that the power of the transmitted signal is known, the propagation loss of the signal is converted into distance through the known signal fading model, so as to calculate the coordinates of the unknown node according to the estimated distance between multiple nodes:

$$L(\alpha) = L(\alpha_0) - 10p \log \frac{\alpha}{\alpha_0} - \left\{ \begin{array}{l} p_w \times W_{AF} \cdot P_w < C \\ C \times W_{AF} \cdot P_w \geq C \end{array} \right\}, \quad (1)$$

$$L\left((\hat{\omega} - \omega)(\hat{\omega} - \omega)^T\right) \geq \text{CRLB}(\hat{\omega}) = \text{tr}(H^{-1}), \quad (2)$$

$$\text{error} = \sqrt{L\left(\sum_{i=1}^n (\tilde{m}_1 - m_i)^2 + (\tilde{n}_1 - n_i)^2\right)}, \quad (3)$$

where,  $L(\alpha)$ : Actual measured signal strength,  $L(\alpha_0)$ : Signal strength at reference distance,  $p$ : Decay index,  $p_w$ : Number of walls between anchor nodes and unknown nodes,  $C$ : Threshold at which the signal passes through the wall,  $W_{AF}$ : Attenuation factor for signal passing through walls or obstacles.

Then, the distance between anchor node 1 and the unknown node is

$$D_1 = \frac{[(\omega_2 - \omega_1) + (\omega_4 - \omega_3)] \times v}{2}, \quad (4)$$

$$F = L - (y + x)^{-1} \cdot T, \quad (5)$$

$$J = -\frac{1}{2}HDH, \quad (6)$$

where,  $v$ : The speed of the signal.

The trilateration method is a commonly used positioning algorithm based on ranging. It only needs to know the distance from the unknown node to the three anchor nodes and establish a mathematical formula and solve it,

and then, the coordinates of the unknown node can be obtained:

$$\left\{ \begin{array}{l} \sqrt{(m - m_1)^2 + (n - n_1)^2} = D_1 \\ \sqrt{(m - m_2)^2 + (n - n_2)^2} = D_2 \\ \sqrt{(m - m_3)^2 + (n - n_3)^2} = D_3 \end{array} \right\}, \quad (7)$$

$$\varepsilon(v) = \frac{R(u_i) - Td_{u_i, u_i+1}^\alpha}{Q(u_i)}, \quad (8)$$

$$Fge_j = \frac{(R_1 \cdot D_1)(R_2 \cdot D_2) \cdots (R_k \cdot D_k)}{R_j \cdot D_j} = \frac{\prod_{i=1}^k R_i \cdot D_i}{R_j \cdot D_j}, \quad (9)$$

where,  $(m, n)$ : Coordinates of unknown nodes,  $D_1, D_2, D_3$ : The distance from the unknown node to the corresponding anchor node.

The triangulation method locates the unknown node according to the angle information between the unknown node and the three anchor nodes:

$$\left\{ \begin{array}{l} \sqrt{(m_1 - \alpha_1)^2 + (n_1 - \beta_1)^2} = R_1, \\ \sqrt{(m_2 - \alpha_1)^2 + (n_2 - \beta_1)^2} = R_1, \\ \sqrt{(m_1 - \alpha_2)^2 + (n_1 - \beta_2)^2} = 2R_1^2 - 2R_1^2 \cos \theta, \end{array} \right. \quad (10)$$

$$Sr_j = \frac{R \cdot Fge_j}{\sum_{i=1}^k Fge_i \cdot N_i}. \quad (11)$$

Using the least squares method, the coordinates of point D can be obtained as

$$\hat{T} = (B^T B)^{-1} B^T a, \quad (12)$$

$$\left\{ \begin{array}{l} E_{tx}(l, z) = E_{elec}l + \omega_{amp}lz^2, \\ E_{Rc}(l) = E_{elec}l. \end{array} \right. \quad (13)$$

The centroid location algorithm does not require ranging:

$$g = (\lambda + 1 - C) \times G, \quad (14)$$

$$\overleftarrow{E}_w^i = \left( E_w^i + \sum_{k=1}^n E_w^k \right) / n + 1, \quad (15)$$

$$E_{ave} = \sum_{i=1}^n \overleftarrow{E}_r^i / n, \quad (16)$$

$\lambda$ : The number of signals to be sent within  $g$  time,  
 $G$ : Time interval between signal transmission,  
 $C$ : Constant,  $(0 < C < 1)$ .

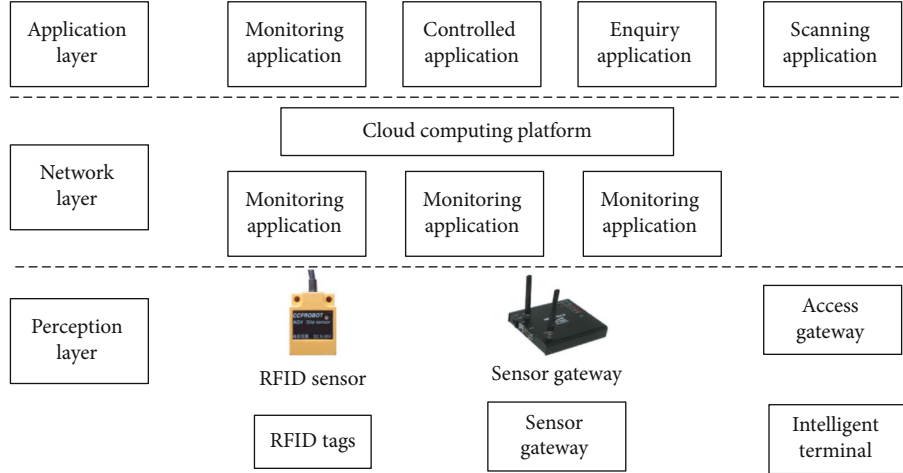


FIGURE 1: Internet of Things architecture.

Calculate the communication success rate with each anchor node:

$$R = \frac{H_{\text{recv}}}{H_{\text{sent}}} \times 100\%, \quad (17)$$

$$\mu(v) = \frac{P(u_i) - Kd_{u_i, u_i+1}^\lambda}{E(u_i)}, \quad (18)$$

where,  $H_{\text{recv}}$ : The number of anchor node signals received by unknown nodes,  $H_{\text{sent}}$ : The total number of signals sent by the anchor node.

In the IoT positioning algorithm, CRLB reflects the influence of distance measurement error on positioning error:

$$K(d|\delta) = \prod \frac{e^{(d_{j,k} - \sqrt{(x_j - m_k)^2 + (y_j - n_k)^2})/2\omega_{j,k}}}{\sqrt{2\pi\omega_{j,k}^2}}, \quad (19)$$

$$\begin{aligned} \ln K(d|\delta) = C - \sum & \frac{\left(d_{j,k} - \sqrt{(x_j - m_k)^2 + (y_j - n_k)^2}\right)^2}{2\omega_{j,k}^2} \\ & - \sum \frac{\left(d_{j,i} - \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}\right)^2}{2\omega_{j,i}^2}. \end{aligned} \quad (20)$$

IoT technology cognition is based on information technology and intelligent technology. Based on the Internet, information and data are the elements, and the storage, calculation, and other processing links of structured and unstructured data are the process, relying on technical means to achieve accurate, quantitative, and controllable technological cognitive forms. The relevant characteristics are as follows: (1) informatization (from material and energy to information, virtualized associated control, operating

costs, etc.), (2) interactivity (data transmission, real-time feedback adjustment, etc.), (3) digitizing (mass storage and efficient computing and storage and computing capabilities such as cloud technology), (4) intelligent predictability (e.g., e-commerce platforms such as Amazon or Alibaba will recommend related products based on consumer purchase behavior records and intentions) and strong analytical control (such as quantitative control, which can achieve quantitative analysis), and (5) feedback control and application (specific practices such as Internet of Vehicles, smart public transportation, smart home, telemedicine, etc.) and monitor data by measuring parameters to achieve quantitative control (reliability, stability, and safety of control). Relying on the support of specific engineering technology and science and technology theory to optimize it also needs to be learned and improved [11].

The IoT architecture is organized at three levels. The underlying level is the sensing level used to make sense of the data. The intermediate level is the network layer, which is responsible for transmitting data. The top level is the apply layer used to build the IoT application interface, as seen in Figure 1.

IoT technology can be divided into three layers: perception layer, network layer, and application layer. The technologies of the perception layer include RFID technology, sensor technology, short-range wireless communication, embedded systems, and self-organizing networks. Technologies at the network layer include cognitive radio, service capability development, and easy-to-buy integration. Technologies at the application layer include resource virtualization, middleware, data sharing, and intelligent computing.

What really promotes the fast growth of IoT is the premise of constant technological innovation. In the process of the development of the IoT, its core technologies include radiofrequency identification technology (RFID tag) and intelligent information equipment [12].

The data acquisition system is a collection system that realizes the user's demand data by means of the software and hardware products of the computer (or microcontroller). Today, with the fast growing information technology,

the production and life of people are almost completely covered by information. People's requirements for information acquisition are getting higher and higher. How to abstract this useful information into valid data that can be recognized by computers is the first problem to be solved. How to interconnect this information is also a pressing issue. The latter solution usually uses IoT technology, as well as data collection systems, as a bridge between the computer and the external physical environment, occupying an important position in the Internet of Things technology.

Although the development of the Internet of Things in recent years has gradually grown into a large scale, all countries have invested huge human, material, and financial resources for research and development. However, there are still many difficult problems to overcome in terms of technology, management, cost, policy, security, etc. The specific analysis is as follows:

- (1) Unification and coordination of technical standards. The standard of the traditional Internet is not suitable for the Internet of Things. The data of the perception layer of the Internet of Things is multi-source and heterogeneous, and different devices have different interfaces and different technical standards. The network layer and application layer also have different network protocols and architectures due to different network types used and different application directions of the industry. The established unified IoT architecture and unified technical standards are the challenges facing the IoT
- (2) Management platform problems. The Internet of Things itself is a complex network system. In addition, the application fields cover all walks of life, and there is inevitably a lot of overlap. If the network system does not have a special comprehensive platform to manage information by classification, there will be a lot of information redundancy, duplication of work, and duplication of construction, resulting in a waste of resources. The application of each industry is independent, with high cost and low efficiency, which does not reflect the advantages of the Internet of Things, and will inevitably affect the promotion of the Internet of Things. The Internet of Things urgently needs a unified management platform that can integrate the resources of various industries, so that it can form a complete industrial chain model

**3.2. Ice and Snow Sports.** Ice and snow sports appeared as early as in northern China in ancient times, and it is an important life skill. Ice and snow sports are a favorite game for northerners. In the process of continuous development and enrichment of natural conditions, a unique ice and snow sports culture has been formed. It is closely related to the way of life, production, and entertainment of the minority population in the northern region, forming a special culture. This culture uses ice and snow as the environment and is represented by a variety of sports. Due to continuous improvement and innovation, well-known and easy-to-

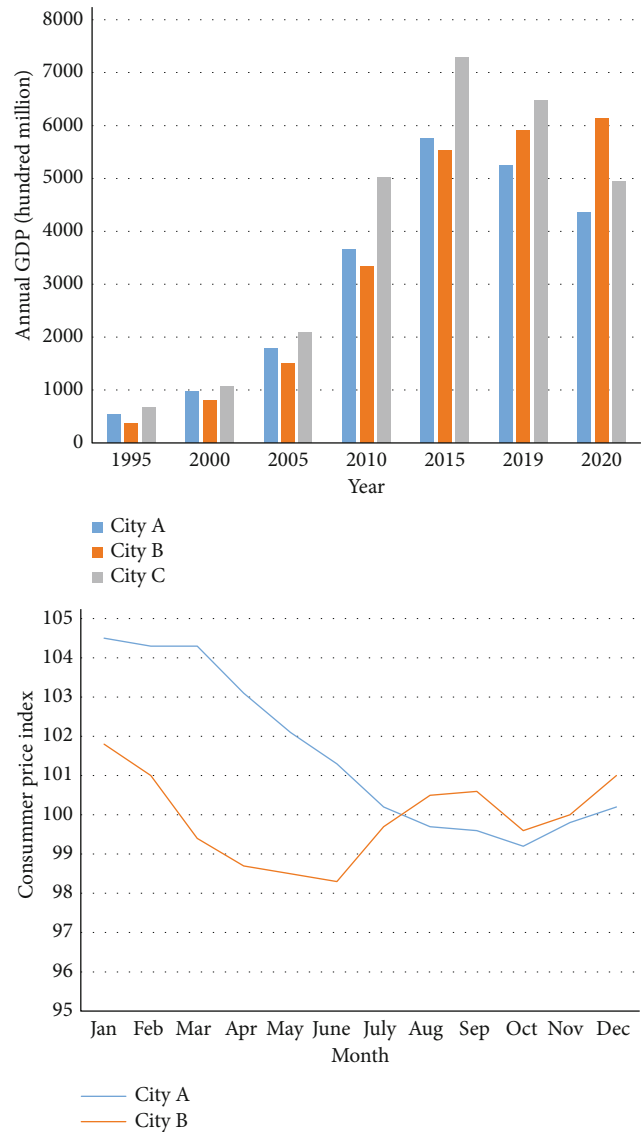


FIGURE 2: City GDP comparison and consumer price index data graph.

implement projects are gradually being updated and reached today [13].

The development of snow and ice sports is separate from economic support. Meanwhile, the development of snow and ice sports has a positive effect on economic growth. The development of ice and snow sports requires significant capital input. Therefore, the rise and fall of ice and snow sports is determined by the level of national and regional economic development and GDP per capita. The representative cities of ice and snow sports are shown in Figure 2. The figure shows the comparison of GDP of city A, city B, and city C in recent years and the CPI of city A and city B in 2020.

The core of the development of a country or city is spiritual character. The host city holds large-scale international events and ice and snow festivals, so that the host city can promote the Olympic spirit before the event and so that the Olympic spirit can be well integrated with Chinese

traditional culture and the construction of a harmonious society, thereby promoting the coordinated development of society, culture, and economy, promoting the rapid development of science and technology, and accelerating the rapid development of ice and snow tourism, thereby producing huge economic benefits [14].

Society is composed of many elements such as politics, economy, and culture. Only by promoting and restricting each other can they continue to contribute to the coordinated development of human society. Human civilization has continued to this day and has been constantly sublated, because culture plays an important role. A cultural power can not only demonstrate the comprehensive strength of a country or nation but also create enormous economic value through the rapid development of cultural industries. The northern region has a long cultural heritage and a long human history, which can be attributed to ice sports and snow tourism, while international competitions and large snow festivals held under favorable environmental conditions and conditions encourage the participation of local people. The dissemination of ice and snow culture can promote the development of ice and snow sports tourism and generate significant economic benefits [15].

From the perspective of market development, there are still institutional contradictions in Chinese ice and snow sports competitions, and the fundamental role of the market mechanism in resource allocation cannot be well played. Due to the fact that the ice and snow sports competition market is not yet mature, it has resulted in insufficient product supply, weak market supervision links, and lack of guidance on market consumption concepts.

The industrialization of Chinese ice and snow sports competitions is inseparable from the planning and guidance of the government. In terms of policies and systems, we must adhere to the government's macrocontrol and overall planning, vigorously support influential and competitive sports industries or groups, promote multiregional and multi-industry restructuring or cooperation, strengthen the structural adjustment and resource integration in the sports field, and improve the operation and management level of enterprises. By accelerating the transformation of government functions, we will cultivate the main body of the ice and snow sports market, strengthen the market operation mechanism of ice and snow sports competitions, and do a good job in supervision and management. In the process of industrialization development of ice and snow sports competitions, we will adhere to the basic principle of separation of management; establish a management system with separation of government and enterprise, clear rights and responsibilities, and clear property rights; actively promote the market-oriented operation mechanism of large-scale ice and snow sports activities and events with enterprises as the main body; vigorously support the construction and development of relevant enterprises, organizations, and clubs; strengthen industry control; further expand the funding channels for the development of ice and snow sports competitions; and standardize and legalize the development environment of ice and snow sports competitions.

#### 4. Experiment on Auxiliary System of Ice and Snow Sports Training

As a product that can be applied to ice and snow sports, this system needs to plan the system architecture in detail and make overall arrangements for the development progress before designing the system. In the process of operation, not only should the operation be stable and safe, but also the upgrade and maintenance of the system should be considered. Therefore, the following principles should be observed when designing the system:

- (1) As an embedded product, stability principle must ensure that the system can run stably for a long time while realizing the function. Therefore, when selecting devices, it is best to use industrial-grade devices and pay special attention to electromagnetic compatibility. In the design process of the PCB board, it is necessary to pay attention to the layout between the various electronic components and to increase the width of the power line to reduce the resistance of the loop. At the same time, in terms of software design, it is necessary to ensure the stability of the software, have good programming habits, and avoid letting the program run away
- (2) For these intelligent systems, simple and practical is a very important principle. During use, the user can use the system smoothly without performing too many complicated operations. At present, the application of many embedded products, including some smart home systems, cannot be well developed and promoted due to its multiple functions but complicated operation and impracticality
- (3) The principle of low price will consider the cost of the system of every user of an embedded system. Therefore, the low-cost system will be very competitive in the market. As the designer of the system, in order to make the system follow this principle, it is necessary to reduce the cost while satisfying the product performance. Therefore, it is necessary to spend more time on the selection of electronic components and try to choose cost-effective chips and peripheral electronic components [16]
- (4) Scalability is an important factor that needs to be considered when designing the system. This principle is strictly followed in this system, and the modules in each key technology are in the form of interfaces, which is convenient for future system upgrades and expansions

Based on the principles, the flow chart of the sports test system as shown in Figure 3 is designed.

The design goal of the data base station of this system is as follows: firstly, the base station actively sends polling signals to each data acquisition terminal, receives the data sent from the data acquisition terminal, and then transmits it to the PC host computer through the network port on the data

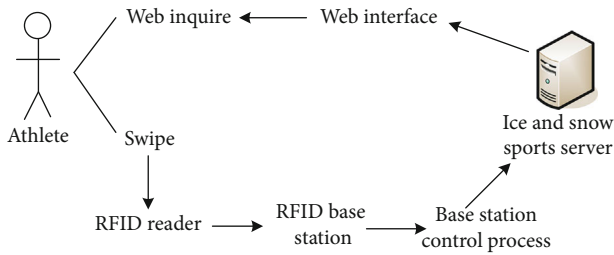


FIGURE 3: Overall system flow chart.

base station. The overall block diagram of the data base station is shown in Figure 4.

The function of the power supply module of this system is to supply power to each module, and it is required to supply enough voltage to the wireless module in this system. Therefore, the power module of this system has also been strictly designed. In this paper, the DC output of 5 V to 3 V is selected, and a linear voltage regulator is used to convert the voltage. Linear regulators have the following characteristics: (1) ultralow power consumption to extend battery life, (2) ultralow voltage to improve LDO operating efficiency, (3) ultralow noise, (4) small and ultrasmall packages (SOT23-5, SC70-5, etc.), and (5) overheating and current limiting protection [17]. The conversion circuit diagram is shown in Figure 5.

In order to facilitate the debugging of the data acquisition terminal, a serial port debugging module is added to the terminal. This article adopts the RS-232 standard, which is suitable for communication with a data transmission rate lower than 20Kb/s, and the transmission distance is limited. As shown in Table 1, the pin function table is shown.

The card reader module is the foundation of the whole system and the key module of the data acquisition terminal. Mifare1 card is an application of RFID technology. It is a noncontact IC card. Compared with the traditional magnetic card, it does not need the card reader to directly contact the card, which prolongs the life of the card. And its work is free from manual intervention and can work in harsh environments, which is very suitable for the ice and snow sports training in this paper [18]. The logic block diagram of the chip is shown in Figure 6.

The left side of the figure is the radiofrequency interface circuit, including waveform conversion, modulation and demodulation, rectification, voltage regulation, and power-on reset circuit. Its function is to provide power for the digital circuit part and receive the waveform on the antenna, the demodulated data is sent to the digital circuit, and then the data sent by the digital circuit is modulated and transmitted. The circuit on the right is the digital part of the chip.

The function of the analog interface is to receive the external analog signal, perform modulation and demodulation, determine the communication protocol between the signal and the host, and then communicate with the host through the buffer. Figure 7 shows the interface diagram of this paper.

To test the stability and packet loss rate of the auxiliary training system, a variety of conditions are used to test: one is the worst environment test; the other is the normal test. The final test results are shown in Figure 8.

Agility is one of the most important basic abilities for ice and snow athletes. It can enable athletes to have the qualities of fast movements, agile transitions, balance, and coordination during exercise and make the texture of sports lighter and neater. The training of agility ability is reflected in the traditional sports classroom through specific movements and combination arrangements, and there is no agility ability training in the strict sense.

There are many ways to assist training of agility abilities, which are mainly divided into the following:

- (1) Reaction ability training, such as reaction-decision-making ability training, including the search ability of sensory organs such as vision and hearing and the ability to respond quickly. Through the training of reaction-decision-making ability, the flexibility of the nervous system of ice and snow athletes can be improved, so that athletes can make correct responses and decisions quickly and flexibly in the changing sports modes, for example, judging various directions and positions in ice and snow sports, quickly grasping different speeds and rhythms, and judging the force method of different actions
- (2) Coordination and flexibility training of the limbs, such as training of the ability to quickly change movements, including the connection training of compound movements
- (3) Agility training of the lower limbs, such as the training of fast switching and reverse direction, mainly including running in different directions and jumping in different directions
- (4) Balance ability training, including dynamic balance and nondynamic balance

Agility is a complex composition, which is generally divided into rapid reaction ability, rapid movement ability, and rapid action ability, as shown in Figure 9.

The ability of reaction speed refers to the excitement caused by a signal stimulus transmitted to the reflex arc of the human body. The length of time is required for the whole process; the shorter the time, the faster the reaction speed, and vice versa. The visual conduction pathway is composed of bipolar cells in the retina, ganglion cells in the retina, and neurons with cell bodies in the lateral geniculate body. By performing repetitive ice and snow sports technical exercises on the subjects, such as lower limb strikes, their neural response ability can be improved [19].

There are four common training methods for improving fast-moving ability:

- (1) For effective training of physical activity rate, it is more common to use random signals to make the

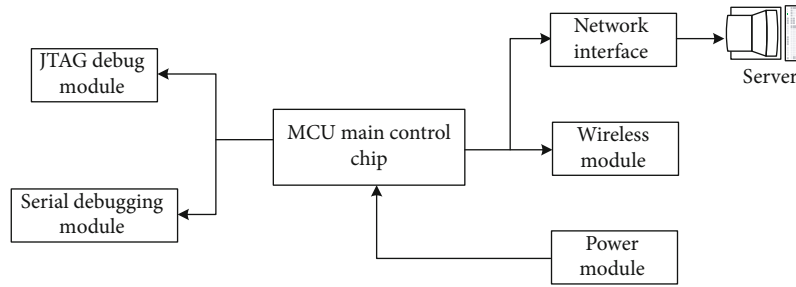


FIGURE 4: Overall block diagram of data base station.

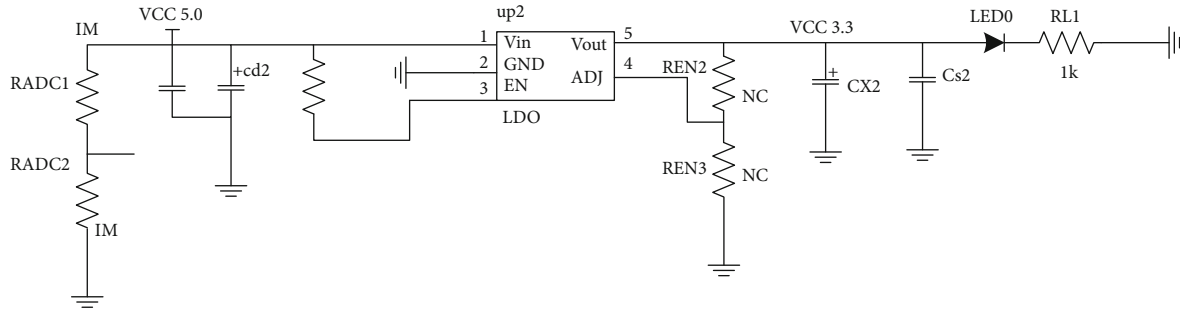


FIGURE 5: Conversion circuit diagram.

TABLE 1: Pin function table.

| Pin | Signal | Definition                | Effect  |
|-----|--------|---------------------------|---|
| 1   | DCD    | Carrier signal            | Informs the DTE that it is ready to receive   |
| 2   | RXD    | Receive data              | Receive serial data                           |
| 3   | TTXD   | Send data                 | Send serial data                              |
| 4   | DTR    | Data terminal preparation | Indicates that the data terminal is available |
| 5   | SGD    | Signal ground             | For grounding                                 |
| 6   | DSR    | Data preparation          | Indicates that MODEM is available             |
| 7   | RTS    | Request to send           | Control send state                            |
| 8   | CTS    | Clear to send             | Indicates DEC status                          |
| 9   | RT     | Bell alert                | Notification terminal                         |

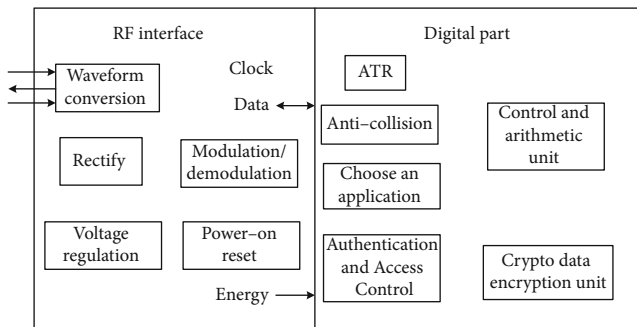


FIGURE 6: Chip logic diagram.

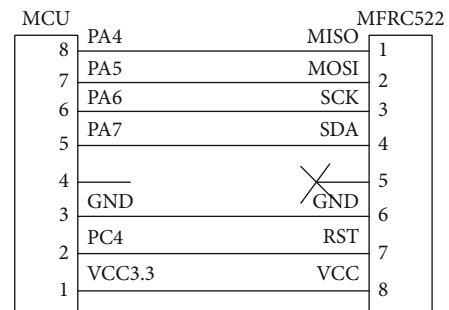


FIGURE 7: Interface diagram.

subjects respond quickly and make high-speed movements for practice

(2) To develop the ability of the phosphate system to supply energy, the more commonly used method is

to carry out repeated repetitive exercises. Because speed exercise is an anaerobic process with high intensity and short time, the energy supply of ATP-CP system plays a greater role



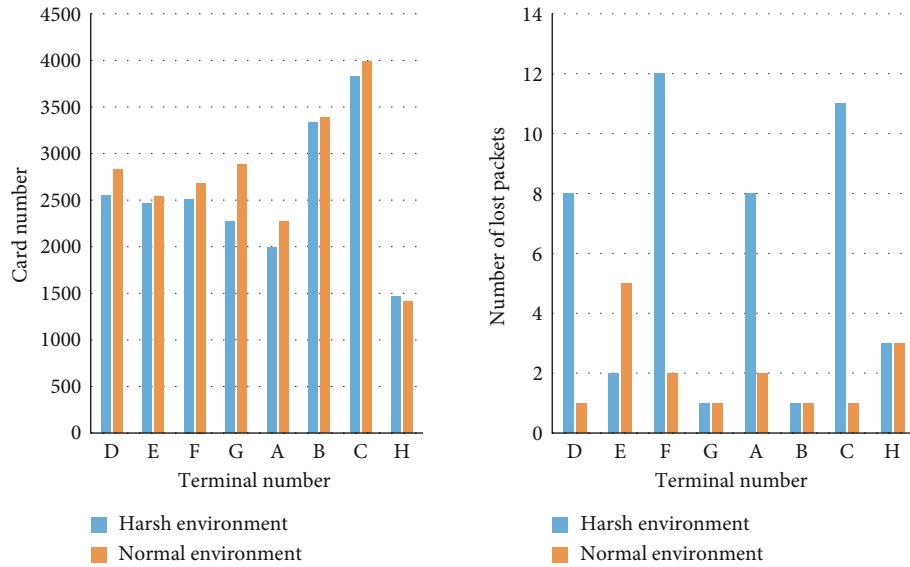


FIGURE 8: Packet loss test results.

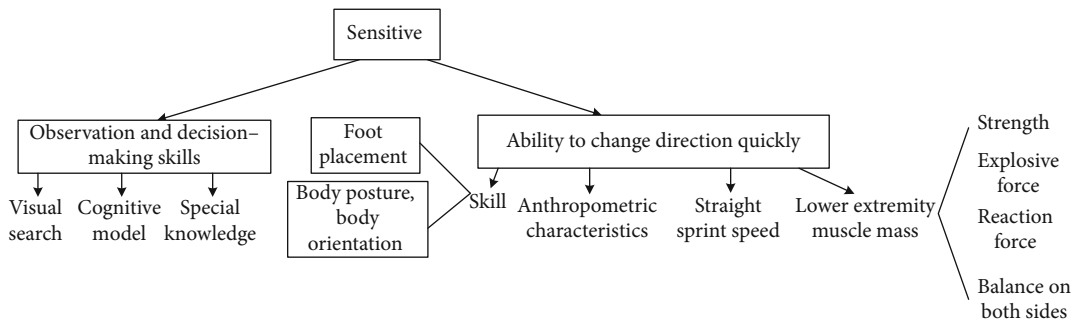


FIGURE 9: Components of sensitivity.

TABLE 2: Athletes’ views and understanding of auxiliary training.

| Survey item  | Can | Generally | Can not | Not clear |
|--|-----|-----------|---------|-----------|
| Can this auxiliary training promote the agility of the lower limbs | 67% | 15%       | 10%     | 8%        |
| Is this supplementary training valuable                            | 80% | 3%        | 10%     | 7%        |
| Can this supplementary training improve classroom performance      | 15% | 75%       | 5%      | 5%        |
| Can this auxiliary training improve the performance of the game    | 60% | 25%       | 7%      | 8%        |

- (3) Pay attention to the muscle relaxation process after training
- (4) Since the rapid movement ability is mostly exerted by the legs, it is necessary to focus on the development of the strength of the legs and the mobility of the joints

The auxiliary training system designed in this paper allows the test subjects to accept the constantly changing signals, so as to quickly make the corresponding designated actions for ice and snow sports. The sequence of instructions received by each test subject is different, and the actions and connections between actions are also different. However, it

can keep the total amount of actions performed by all subjects consistent, so it can basically guarantee the fairness of training and testing [20].

Voluntary ice and snow sports participants were selected for 6-week sensitivity training 3 times a week. Table 2 shows the athletes’ views and understanding of auxiliary training.

It can be seen from the above table that the athletes still recognize this auxiliary training and basically believe that this training can promote their lower limb agility and performance on the field. For the software output as the test standard, they can also recognize this feedback method and feel that it can truly reflect their training status every time.

A control group and an experimental group were set up. The control group received normal ice and snow sports training, while the experimental group received auxiliary training 3 times a week in addition to normal training. Table 3 shows the lower limb sensitivity data of each athlete before the experiment, and Table 4 shows the lower limb sensitivity data of each athlete after the experiment.

From the comparative analysis of the experimental data before and after the experimental group, it was found that there was a significant difference in the performance levels of the students before and after the experiment. With the aid of the auxiliary training system, the training effect of the lower limb sensitivity ability of ice and snow athletes has a significant effect.

In this paper, 6 ice and snow athletes were selected again for sensitivity auxiliary training. After the test subjects performed sensitive auxiliary training on the lower limbs, the results of each athlete were recorded in combination with the obtained data. Figure 10 is a comparison of the performance of the six athletes in the experimental group in the first and last test. From the figure, it can be clearly seen that their seconds have increased. In addition, this picture intuitively reflects their “starting point” level. In the first test, the maximum difference in seconds is 20 s, and after a period of training, their maximum time difference is 9 s. It can be seen that there is still a generality for their training growth. The experimental results are shown in Figure 10.

## 5. Discussion

Generally, smart sports are defined from the following three points: first, the development of smart sports is based on digitalization. Through the application of sensors and biological chips, theoretically anything can be converted into digital form, so that it can be more easily perceived by the computer and realize the digitization of sports. Second, the condition for the development of smart sports is networking. With the development of science and technology, emerging technologies such as the Internet of Things and cloud computerization continue to develop and mature, and everything in the world can be connected through the Internet. Third, the core of smart sports development is intelligence. With the popularity of the Internet, there is a lot of information on the Internet. Using the powerful processing power of sensors and computers to process this information, and combining the comparison between the background database and the information, the analysis results are obtained, which makes the sports information more intelligent.

The features of smart sports include the following: first, comprehensive sensing. Using the Internet of Things technology, the sports situation of the athletes is sensed through sensors, and the intelligent terminal is connected to analyze the data to fully understand the sports situation of the athletes. Second is fully integrated. The Internet is used to store and manage the data sensed by the sensors and use a large amount of data and information on the Internet to process and integrate management through the cloud platform to plan the construction of smart sports infrastructure. Third is encourage innovation. Innovation is the soul of a nation's

TABLE 3: Lower limb sensitivity data of each athlete before the experiment.

| Control group |       | Test group |       | Difference |
|---------------|-------|------------|-------|------------|
| Numbering     | Grade | Numbering  | Grade |            |
| A             | 44    | F          | 50    | -6         |
| B             | 48    | G          | 54    | -6         |
| C             | 58    | H          | 49    | 9          |
| D             | 41    | I          | 38    | 3          |
| E             | 60    | J          | 35    | 25         |

TABLE 4: The lower limb sensitivity data of each athlete after the experiment.

| Control group |       | Test group |       | Difference |
|---------------|-------|------------|-------|------------|
| Numbering     | Grade | Numbering  | Grade |            |
| A             | 40    | F          | 32    | 8          |
| B             | 52    | G          | 26    | 26         |
| C             | 36    | H          | 31    | 5          |
| D             | 44    | I          | 35    | 9          |
| E             | 52    | J          | 30    | 22         |

progress, and smart sports are no exception. Encouraging sports managers' innovative ability in sports management through incentives or rewards can effectively promote the development of sports. Fourth is collaborative operation.

The protagonists of competitive sports are athletes, and the monitoring and management of athletes have always been closely followed by the sports management department. With the smart athlete management system, managers can keep track of the athletes' routine physiological indicators and analyze the athletes' strengths and weaknesses. By proposing training plans for athletes in a targeted manner and intelligently monitoring and early-warning decision-making for the current bad environment, it ensures the athletes' sports status and thus effectively manages them. For example, in many large-scale competitions now, athletes will receive an information card before participating in the competition. The information card stores the basic information of the athlete, accommodation arrangement, competition schedule, etc. The athlete can know it at any time and can also monitor various indicators of the athlete in real time to effectively prevent doping.

There are many methods of agility auxiliary training, which are mainly divided into the following:

- (1) Reaction ability training, such as reaction-decision-making ability training, including the search ability of sensory organs such as vision and hearing and the ability to respond quickly. Through the training of reaction-decision-making ability, the flexibility of the nervous system of ice and snow athletes can be improved, so that athletes can make correct responses and decisions quickly and flexibly in the changing sports modes, for example, judging various directions and positions in ice and snow sports,

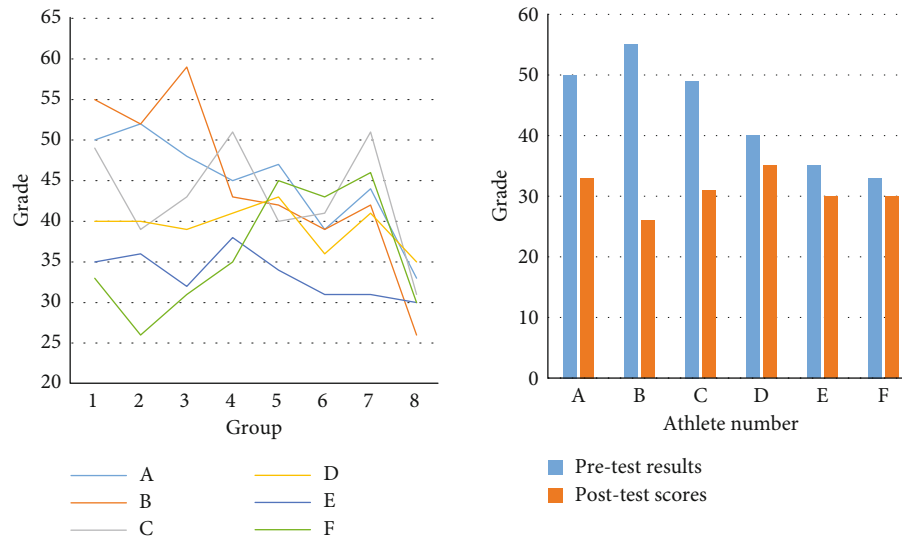


FIGURE 10: Athlete data comparison.

quickly grasping different speeds and rhythms, and judging the force method of different actions

- (2) Coordination and flexibility training of the limbs, such as training of the ability to quickly change movements, including the connection training of compound movements
- (3) Agility training of the lower limbs, such as the training of fast switching and reverse direction, mainly including running in different directions and jumping in different directions
- (4) Balance ability training, including dynamic balance and nondynamic balance

## 6. Conclusion

With the arrival of winter, ice and snow sports have become one of the sports that people pay most attention to and are deeply loved by people. The content of traditional ice and snow sports auxiliary training is boring and not very scientific. The traditional physical fitness training methods are very close to other sports. The training content does not reflect the features of snow and ice sports, and the results of training are always half-hearted. In this article, an IoT training aid was built for training and testing the lower limb sensitivity of ice and snow sports players. The article sets up a control group that only performs normal ice and snow sports training and an experimental group that performs normal training and auxiliary training. The experimental results show that the auxiliary training system can effectively improve the lower limb sensitivity of ice and snow athletes. In this paper, the preliminary prediction research is carried out. In view of the limited data sources and academic level, there are inevitably some omissions in the research. The analysis of the status quo analysis stage is not thorough enough; it only shows the changes of relevant indicators and lacks internal judgment analysis. In the stage of theoret-

ical research, this thesis does not grasp the theory deeply enough. The difference in performance presented by the system depends to a large extent on the difference in the reaction time of the athletes. In the future improvement, efforts should be made to quantify the reaction time of the athletes in detail and conduct comparative analysis.

## Data Availability

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

## Disclosure

We confirm that the content of the manuscript has not been published or submitted for publication elsewhere.

## Conflicts of Interest

There are no potential competing interests in our paper.

## Authors' Contributions

All authors have seen the manuscript and approved to submit to your journal.

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