



# Application of Intelligent System of Internet of Things in Management of Unmanned Gymnasium

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**Abstract.** With the rapid development of the economy and the improvement of people's quality of life, fitness has become an important part of a healthy life. As the Internet of things (IoT) technology continues to infiltrate various industries, it brings new development opportunities to the fitness industry. With the technical support of the IoT and Android apps, this study designs and implements a networked fitness management system for the gym, manages the hardware services and facilities of the gym, monitors the training items, and trains the heart rate of the exercisers, analyzes, and processes the training data, and provides a scientific and feasible training scheme to achieve a good exercise effect. The main content of the study include: 1. An unmanned intelligent gym equipment access system and cloud intelligence analysis; 2. The working principle of IoT technology system in unmanned Intelligent Gym Management system; 3. The operation flow of the key technologies of the system and the module design of big data's information collection and feedback system. The design and use of the gym management system based on the IoT technology proposed in this paper has theoretical research value for promoting fitness and has a certain practical significance.

**Keywords:** Iot Technology · Intelligent Cloud Analysis · Scientific Fitness

## 1 Introduction

In the initial stage of the IoT technology, it is mostly used in industrial automation, home office, agriculture, forestry, fishery, and animal husbandry production, etc. With the rapid development and application of IoT technology, it has gradually penetrated all aspects of our daily life. Artificial big data intelligence technology, smartphone clients, wireless sensor technology, and computer network technology provide technical support for the Internet of the things fitness industry. With the rapid development of the national economy, China has become the second-largest economic complex. After rich material life, the demand for spiritual civilization increases daily, and fitness has become an important guarantee of physical health. During the 13th five-year Plan of the National Fitness Program (2021–2025), under the strong leadership of the CPC Central Committee and the State Council, the national strategy of national fitness was deeply implemented, the

level of public services for national fitness was significantly improved, and facilities for national fitness were gradually increased. The enthusiasm of the people to promote health through fitness is growing day by day, and the proportion of people who regularly participate in physical exercise has reached 37.2%, and new steps have been made in building a healthy China and a sports power. It aims to increase the supply of national fitness venues and facilities and formulate the overall plan for the construction of the national trail system and the guidance for the construction of sports parks, supervise all localities to formulate a five-year action plan for the construction of fitness facilities, and implement the project of replenishing the shortcomings of national fitness facilities. Invigorate urban idle land, make good use of public welfare construction land, support land supply by leasing, advocate land compound use, fully tap the potential of existing construction land, and plan and build sites and facilities that are close to communities and are easily accessible. It aims to build or expand more than 2000 sports parks, national fitness centers, public stadiums and other fitness venues and facilities which make up more than 5000 township (street) national fitness venues and equipment. What's more, it also aims to build a number of mass skating rinks, and digitally upgrade more than 1000 public stadiums. Promote the high-quality development of the sports industry. Optimize the industrial structure and speed up the formation of a modern sports industry system with the integration of high-end manufacturing and modern service industry. We will promote the digital transformation of the sports industry, encourage sports enterprises to "endow intelligence with numbers in the cloud", and promote the coordinated transformation of the whole industry chain of data empowerment. We will promote the concentration of sports resources to high-quality enterprises, cultivate a number of "specialized and new" small and medium-sized enterprises, "gazelle" enterprises and "invisible champion" enterprises in the areas of the supply of fitness facilities, the organization of events, and the research and manufacture of fitness equipment, and encourage qualified enterprises to become stronger, better and bigger with the goal of individual champion enterprises. We will vigorously develop the sports industry, actively cultivate outdoor sports, intelligent sports and other sports industries, and give birth to more new products, new business type and new models. People's demand for fitness is also increasing, and the breakthrough point of the development of gymnasium is the integration of networking and the creation of intelligent gyms [2].

## 2 The Purpose and Significance of Research

### 2.1 The Purpose of the Research

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- 1) To provide a new management system for the traditional gymnasium.
- 2) To establish the relationship between IoT technology and gym management.
- 3) To move closer to the information age and realize the "unmanned" management of fitness life.
- 4) To collect the data of fitness members and conduct intelligent analysis to guide fitness.

## 2.2 Maintaining the Integrity of the Specifications

This study can be in line with the national “13th five-year Plan” (2021–2025) proposed in the national fitness plan to promote the high-quality development of the sports industry, optimize the industrial structure, the formation of a modern sports industry system. Promote the digital transformation of the sports industry, intelligent sports and other sports industries, give birth to more new products, new business type, and new models. This study designs a set of IoT intelligent management systems based on IoT technology. The system can manage the hardware services and facilities of the gym, monitoring the training items and training the heart rate of the exercisers, analyzing, and processing the training data so that a scientific and feasible training guidance program is available to achieve good exercise effect. Thus, a big data information collection and feedback system is established from the gym management level to the fitness individual. It obtains the necessary real-time gym environment goods information and exercise volume information of fitness participants and uploads it to the cloud in real-time, providing strong data and technical support for realizing the unmanned intelligent management of the gym and improving the fitness experience of fitness workers. In terms of the gym management, traditional gyms need a lot of human resources to manage members’ access rights, sell products, and control lighting temperature. For gym management, it is easy to waste human resources and increase the cost of gym operation. From the perspective of bodybuilders, most fitness workers do not have a good understanding and planning of the exercise load and intensity, and it is difficult to make exercise plans according to their conditions, resulting in inefficient fitness and easy strains. Nowadays, some gyms only pay attention to short-term interests, so they only attract members to apply for cards, while ignoring the follow-up services to members. Members also lose interest after coming here a few times, directly leading to the mobility of members and fewer “regular customers”. In traditional gyms, there is great sales pressure, and coaches are assigned performance requirements. Generally, only 15% of the course income is owned by coaches, so the mobility of fitness coaches is very large, thus affecting the fitness process of members and losing members. The unmanned gym under the intelligent system of the Internet of things can transfer offline sales to online for better publicity and accurate advertising. From the fitness level, natural fitness enthusiasts should exercise each muscle group twice a week. The shorter the training time, the faster you will recover, thus increasing the training frequency, triggering protein synthesis through the training frequency. The more you do, the more you will grow, but you can’t overdo it and cause damage. Muscles can’t recover in time and cortisol levels rise. Some muscles may train too much to cause strain, while others lack exercise. Long-term planned fitness is very important. This system will upload the exercise schedule through members’ APP and set reminder services to make fitness more systematic. In the long run, gyms should pay attention to cultivating members’ fitness habits, which will greatly improve the card holding rate. Relatively speaking, you can also bring in a lot of new members through these old members, so as to maintain the funding chain of the gym. Therefore, how to reduce the cost of the gym, reduce the waste of human resources, and provide fitness people with a more scientific fitness experience has become one of the urgent problems to be solved.

### **3 Theoretical Analysis of the Design of Management System of Unmanned Intelligent Gym**

#### **3.1 IoT Technology**

The IoT is an extension and expansion of the network based on the Internet, which combines a variety of information sensing devices with the Internet to form a huge network to achieve the interconnection of things at anytime, anywhere, and everything. Internet of things technology in the initial stage, it is mostly used in industrial automation, home office and agriculture, forestry, fishery and animal husbandry production and so on. With the rapid development and application of the Internet of things technology, the Internet of things technology has gradually penetrated into all aspects of our daily life. Artificial big data intelligence technology, smart phone client, wireless sensor technology and computer network technology provide technical support for the Internet of things fitness industry. It is a network technology that takes the Internet, local area network, traditional telecommunications network and so on as the carrier of information, so that all objects can perform their independent functions and interconnect with each other. The video captured by the monitoring equipment of the gym and the heart rate detector, pedometer and other sportswear of the members can be transmitted to the computer of the intelligent Internet of things center of the gym through 5G network and local area network, and the intelligent data analysis can be fed back to the APP of managers and members to complete the interconnection of information and data. In this study, combined with the networking technology, an intelligent management system of the Internet of things is designed, which is connected with each other and connected into a system by building a joint resource integration management platform of the software.

#### **3.2 Application of IoT Technology in the Management System of Unmanned Intelligent Gym**

##### **3.2.1 Unmanned Intelligent Gymnasium Equipment Access System, Intelligent Cloud Analysis**

- (1) There are two ways to manage members' entry and exit. The first is face recognition. When the member gym has access to the gym, the system will scan the face and upload the image to big data storage system in the cloud for comparison. The second is the QR code entry, and members can also show the QR code in the mobile phone APP under this system to enter.
- (2) All the equipment in the unmanned intelligent gym can be connected to the IoT system. The sensor of the equipment transmits the fitness data to the intelligent cloud system, which is intelligently analyzed and fed back to the member's mobile phone APP, giving the gym-goers an intuitive understanding of their fitness, and allowing them to get the most suitable exercise amount according to their physical functions. The APP will recommend a certain amount of load standard for the gym member and adjust the fitness plan to provide better fitness services with diversified intelligent functions.
- (3) The wearable devices worn by members, such as bracelets, heart rate monitors and sphygmomanometers, can connect to the intelligent cloud system through the

fitness APP under the system, improve the members' database content and guide scientific fitness. Members of the APP will have a customer service window that can provide online advice on fitness and related issues.

- (4) The system sets the reminder function, intelligently analyzing the number and density of exercises in a certain cycle, and feedback the weak and strong reminders to the member's mobile APP. Fitness is a long-term process, and the intelligent reminder function makes fitness more in line with the law of fitness, making fitness more systematic and scientific.
- (5) The system can upload the specific data to the cloud data according to the outdoor temperature and light, and then the intelligent analysis can automatically adjust the temperature and lighting of the gym. Members can arrange an appointment on the fitness APP; the system automatically adjusts the temperature and lighting and switches to energy-saving mode when no one is exercising.
- (6) When bodybuilders want to buy goods, they can buy them through unmanned vending machines. The commodity buying and selling data are uploaded to the system to facilitate statistics, shop inspection, and replenishment.

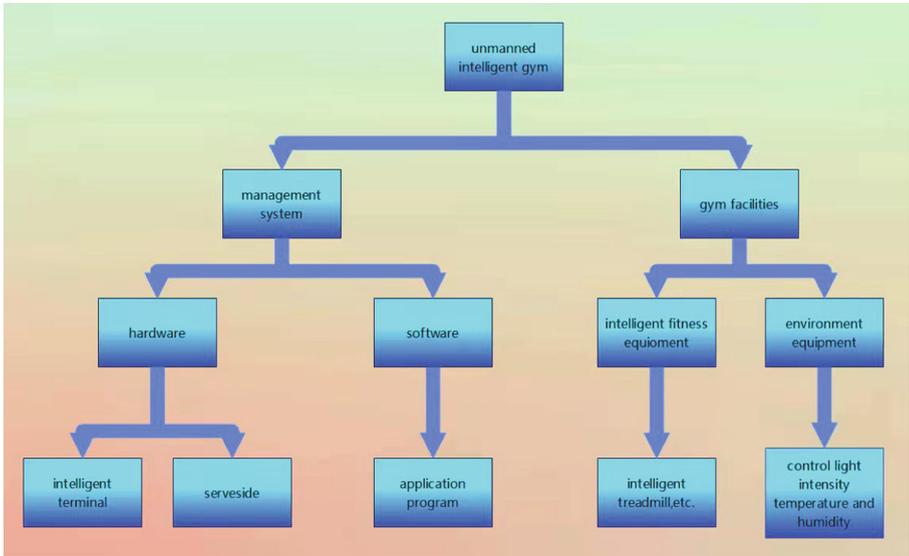
### **3.2.2 The Working Principle of the Iot Technology System in the Unmanned Intelligent Gym Management System**

The IoT-based unmanned smart gym management system mainly consists of the gym terminal device and the server-side. The gym terminal device collects various exercise and health data through APP smart fitness devices, personal wearable devices, and members' cell phones. On the server-side, server clusters form the hardware management system, which manages server resources and operating systems through a hardware virtualization system and unites software resources to build the management platform [3]. The distributed system design method allows for the management and integration of each third-party application system, such as lighting, temperature, dry and humidity controller, to provide better intelligent management services for members.

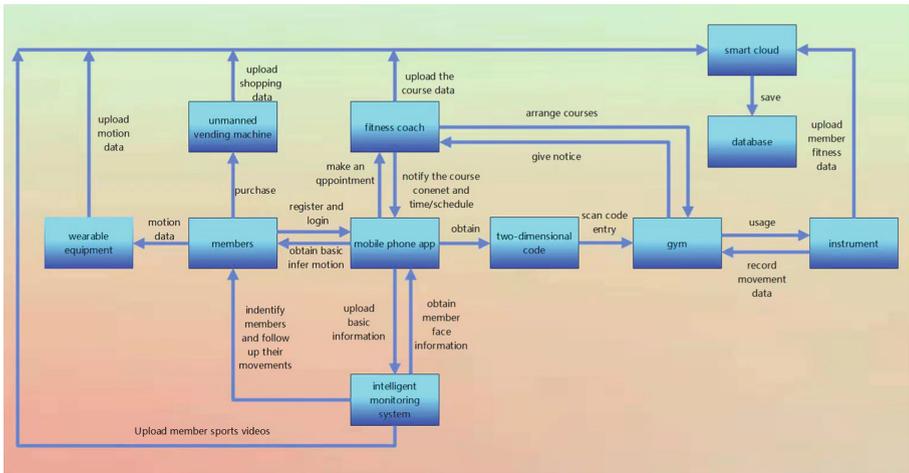
The unmanned smart fitness system works based on IoT technology, and its basic workflow is to collect and integrate the detection signals from all human body sensors through a server-side application and transmit them to the client program. After intelligent data processing by the client program, the results are sent to the member's terminal system. In this way, users can perform health and fitness activities through smart devices and have access to proper health consultation services. Intelligent devices mainly refer to fitness terminals and core components, including vital signs sensors, client applications, etc., and can get corresponding fitness advice services. These functions are mainly for collecting and transmitting data to the server terminal with the help of a wireless 5G network. The terminal will process and call the data.

### **3.2.3 Technical System Structure Diagram**

Internet of things intelligent unmanned fitness system structure diagram, mainly composed of the following three parts, unmanned gym structure chart, member fitness flow chart, system feedback flow chart (Figs. 1, 2 and 3).



**Fig. 1.** Structure diagram of unmanned intelligent gym



**Fig. 2.** Workflow diagram of fitness training

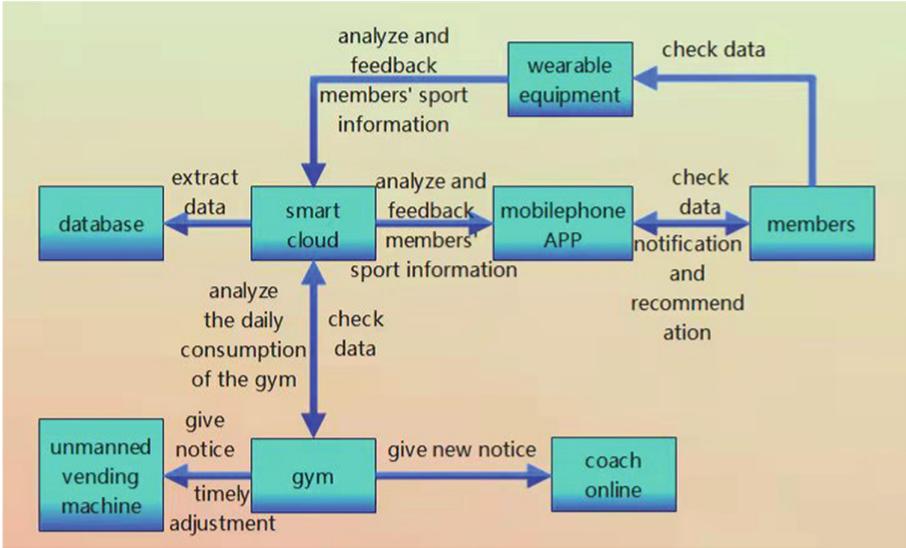


Fig. 3. Workflow diagram of feedback system

## 4 Conclusion

The unmanned intelligent gym under the IoT technology will significantly reduce the waste of human management resources and reduce the cost of the gym.

Big data analysis of intelligent systems can improve the fitness efficiency of gym-goers and improve their fitness. Keeping fitness is a long-term endeavor, and the intelligent reminder function makes exercise more in line with the fitness law.

The unmanned intelligent gym under the IoT technology can reduce the fatigue accumulation of members and reduce sports-induced injuries.

The model of the unmanned intelligent gym under the IoT technology can be replicated for building larger chain stores.

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