



# Developing an Intelligent Monitoring System for Physical Education Classes in the Context of 5G and Big Data

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**Abstract.** The development of 5G, Internet of Things (IoT), and intelligent information technology provides strong technical support for monitoring physical education classes. The decline in the physical health of China's youth has caused widespread concern in society. The State Council of China thus initiated the Sunshine Sports Program and encouraged the youth to exercise one hour a day. Physical education, as an important part of school education, plays a decisive role in enhancing physical fitness among students. Hence, we propose to develop a real-time monitoring system for physical education classes. The system could collect and analyze the data from the classes using Markov models, which enables educational authorities to have easy access to the information related to physical education classes. In addition, for those classes with bad performance, the system will automatically send feedback to relevant educational authorities to keep information updated.

**Keywords:** 5G · big data · intelligence · IoT · informatization

## 1 Introduction

### 1.1 Background

During the 13th Five-Year Plan, the State Council of China issued a plan to implement a national fitness strategy and improve the physical health of the whole nation. Under this guide, a public service system for national fitness has become complete, the sports area has increased, and people have increasing interest in physical exercise. According to relevant statistics, the percentage of people who regularly participate in physical exercise in China have reached 37.2%. And this could help in building a leading sporting nation. However, some issues still exist during this process, such as unbalanced regional development and insufficient public services. To promote high-level national fitness, focus should be placed on students, or the youth. Research has demonstrated that adolescents who rarely exercise during their critical periods are more likely to experience a progressive degeneration of the motor neurons [1]. Statistics also indicate that students in China do not perform well on physical examination, which is why education departments

at all levels are becoming increasingly concerned about physical education in schools. Relevant departments have implemented several measures, including: (1) encouraging physical exercises in schools as well as outside schools, (2) enhancing health education in primary and secondary schools, (3) reforming the evaluation system for physical education in universities, (4) integrating the level of physical education, as well as its effectiveness, into the evaluation of higher education, and (5) incorporate them into the evaluation index system of the development of undergraduate education at colleges and universities, as well as performance evaluation system for double first-class universities. Some scholars have found that “students who often take physical exercise outside schools are old familiar faces and account for a small percentage, while those who do not account for the majority of students” [2]. Therefore, physical education is an important part in school education, and plays a decisive role in improving students’ physical fitness. Supervision in traditional physical education classes is inefficient, costly, and subjective; it is hard to ensure a high-quality class if the supervisor is absent. This would be a hinder to enhance physical education as well as student’s physical fitness. Therefore, how to monitor the quality of physical education classes has become an important issue. Technology developments such as 5G, the Internet of Things (IoT), intelligent information systems, and wearable sports devices have provided technical support for monitoring physical education classes. People can obtain real-time motion data by wearing sensory devices.

## **1.2 Purpose and Significance**

### **1.2.1 Purpose**

This paper aims to (1) analyze the deficiencies of the existing evaluation systems for physical education classes;

(2) to improve class monitoring using 5G, big data, and IoT;

(3) to provide a real-time platform for educational authorities to monitor physical education classes;

and (4) to improve the quality of physical education in schools, thereby enhancing students’ physical health.

### **1.2.2 Significance**

This paper is dedicated to build an intelligent monitoring system for a real-time, long-term evaluation of the exercise load capacity and exercise intensity in physical education classes. The system enables real-time uploading of students’ exercise data as required by the education supervisory authorities so that data can be analyzed, stored and managed. In addition, educational authorities can also periodically sample the load capacity of a class at a specific stage. The system ensures the normal amount and intensity of exercise in physical education classes and provides strong technical support to improve the physical fitness of students. Studies have shown that different exercise intensities lead to different effects on human health [3]. When people’s exercise intensity is low, the metabolism of the body is low and there is no obvious improvement in their health; when the intensity is too high, harmful metabolites may be produced, which can lead to shock or sudden death. Therefore, it is essential to maintain a reasonable intensity of exercise.

## **2 Theoretical Analysis of the Design for the Intelligent Information Monitoring System**

### **2.1 Technical Analysis**

#### **2.1.1 IoT**

In its infancy, IoT is mostly used in industrial automation, home office and agriculture, forestry, and fisheries [4]. In recent years, IoT technology has penetrated every aspect of our daily lives due to its rapid development and widespread applications. Other high-techs such as AI, big data, smart phones, wireless sensor networks, and computer network technology have provided strong technical support for IoT-based fitness industry.

IoT is a network technology in which the Internet, local area networks, conventional telecommunication networks, etc., are used as the carrier of information, so that each can function separately while being interconnected. Data from students' heart rate monitors and pedometers, as well as campus monitoring systems, can be transmitted to 5G networks and local area networks (LAN) in schools, and then uploaded to the IoT-based device of a higher educational authority for analysis. After the analysis is complete, the data will serve as feedback and is then transmitted to each physical education class to achieve interconnection.

IoT is one of the technical frameworks for intelligent information monitoring systems, and this study combines IoT technology to design an intelligent management system for IoT [5], which aims to enable education authorities to grasp the basic information of school physical education classes in a timely manner, and to provide timely information feedback for physical education classes with substandard sports indicators, and to build a joint resource integration management platform for the software [6] so as to achieve The purpose of the system is to provide timely information and feedback on physical education classes that do not pass the sports index.

#### **2.1.2 5G Technology**

The peak rate of 5G transmission can reach 1.25 GB/s, which is nearly 100 times that of the current 4G network, and its applications are becoming more and more widespread. In the applications of physical education technologies, the system uploads data on student information, sports information, exercise data, and exercise videos, which are eventually aggregated to a central computer calculator for intelligent analysis and storage.

#### **2.1.3 Intelligent Monitoring and Feedback**

Intelligent data analysis refers to the analytical method of discovering knowledge from data using analysis methods such as statistics, pattern recognition, machine learning, and data abstraction.

Feedback control, referred to as ex-post control or results control technology, is an ex-post management measure that is carried out after a specific date or planning has been made, and is a key application technology for management control. The main purpose of this technique is to summarize the experience of the implementation of the next investment plan and to provide a basis for its later investment decisions.

Information data collection of school physical education classes is uploaded to schools and relevant educational authorities, and the monitoring system computer performs intelligent big data processing for feedback, which will guide physical education classes for timely adjustment and long-term planning of exercise volume and exercise load. For example, when the education authorities start to randomly check the physical education teaching practice in certain areas of schools, the intelligent big data processor will take the initiative to analyze the load intensity and analyze certain teaching units that are not scientific and reasonable according to the correct model comparison, and the system will feed back information to the next level of education authorities for them to make teaching adjustments.

#### **2.1.4 Update of Sports Wearable Devices**

Wearable devices, also known as wearable computing devices, are not yet uniformly defined. The MIT Media Lab defines it as a computer technology that combines multimedia and wireless communication to connect personal local area network functions and thus become a tool for users to process information during physical activity [7]. Sports wearable devices have had rapid development in recent years, the innovative application and development of microelectronics technology will be the miniaturization of the chip, intelligent further improvement, from inaccurate to accurate, from equipment bulky function single to equipment lightweight function diverse. It provides a strong support of technical equipment for monitoring student movement. In particular, the heart rate indicator devices for evaluating the intensity of physical education class load, from sports bracelets and sports undershirts are capable of real-time monitoring and real-time uploading. It can also calculate the trajectory of the student's movement, the distance traveled, and the amount of exercise combined with the heart rate. The intensity of the heart rate load has an important value, and the intensity of the load can be evaluated as a percentage of the heart rate to the maximum heart rate. In particular, the heart rate indicator device, which is used to evaluate the intensity of students' physical education classes, can be instantly detected and uploaded in real time from the sports bracelet and running undershirt. It can also calculate students' running trajectory and distance traveled, as well as measure the amount of exercise based on heart rate. One of the systems of great practical value is the maximal heart rate load reinforcement system, which is assessed by the ratio of heart rate to maximal heart rate. The exercise load assessed by the system can be divided into five levels: the first level is the exercise recovery zone within 50% of the maximum heart rate, the second level is the fat burning zone between 50

and 65% of the maximum heart rate, the third level is the optimal strength exercise zone between 65 and 85% of the maximum heart rate, and the fourth level is the anaerobic threshold zone between 85 and 100% of the maximum heart rate.

### 2.2 Technical System Structure Diagram

See Figs. 1, 2 and 3.

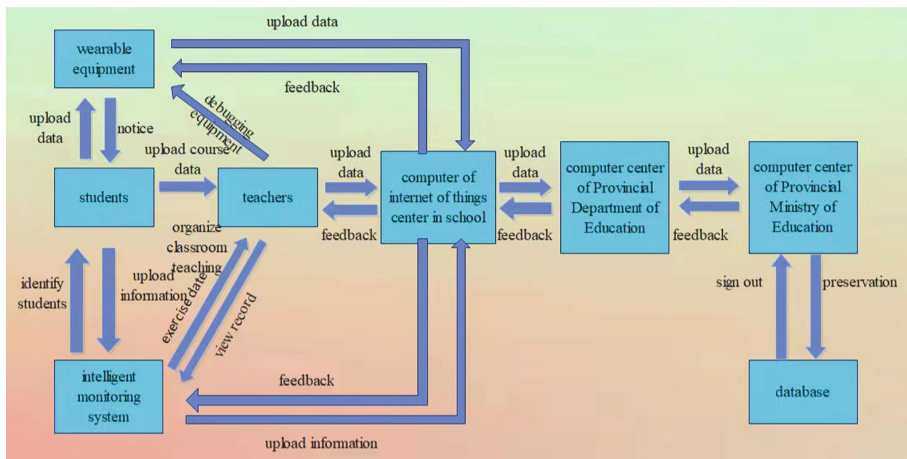


Fig. 1. Model diagram of wireless transmission technology

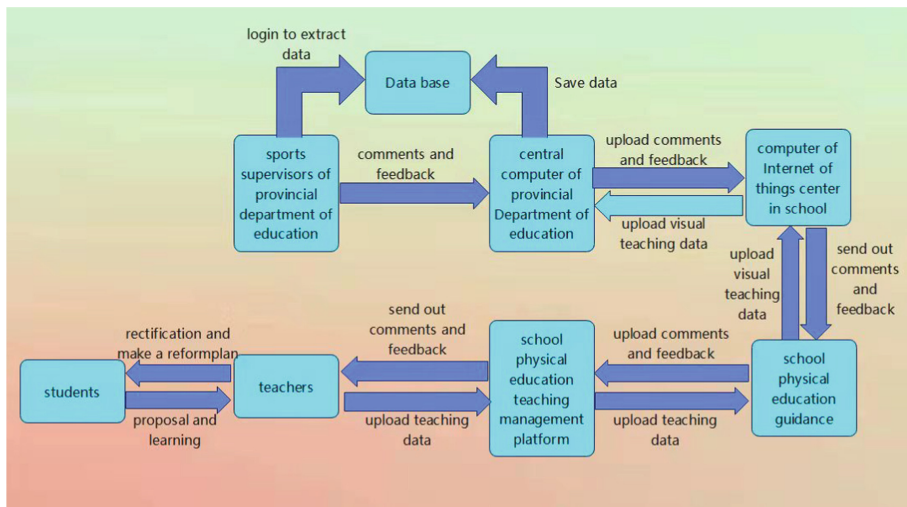


Fig. 2. Diagram of intelligent monitoring and feedback

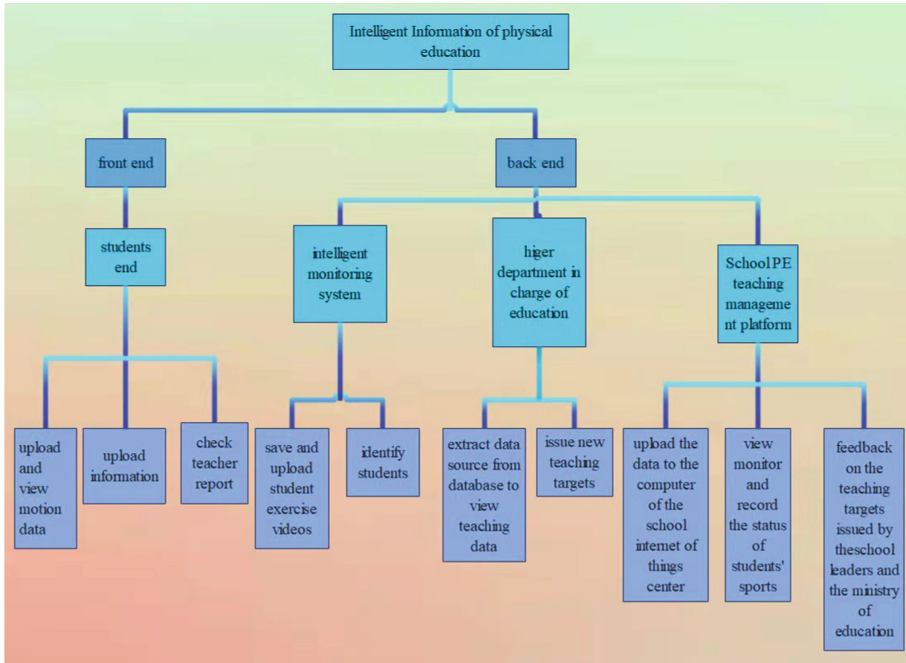


Fig. 3. Intelligent information monitoring system for physical education classes

### 3 Research Conclusions and Recommendations

#### 3.1 Conclusion

The establishment of an intelligent information monitoring system for physical education classes will improve the monitoring of the volume and load of physical education classes, greatly improving the efficiency and authenticity of the survey.

The system regularly conducts intelligent analysis of the uploaded data, which will better guide the development of physical education classes in schools.

Scientific and accurate real-time monitoring of human physiological parameters before, during and after physical exercise, prescribing exercise and scientific physical exercise guidance to prevent sudden death from exercise.

The long-term operation of the intelligent information monitoring system for physical education classes will create a physical fitness profile for students and analyze their strengths and weaknesses through big data, thus providing strong support for “Healthy China” and lifelong physical education.

#### 3.2 Recommendations

The sports monitoring service system can be operated jointly with the government, enterprises or individuals to enhance its influence, which is conducive to the further development and promotion of this system, and the number of people committed to using this service system is favorably guaranteed.

Joint training of sports monitoring service system and students of social sports guidance in sports colleges and universities. To meet the social practice ability of social sports guidance students, moreover, it can solve the problem of scarcity of professional exercise instructors in this service system.

The state should increase investment in IoT big data for physical education to create a perfect intelligent information monitoring system for physical education classes, so that it can play a positive role more widely and effectively.

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