Research Article

Construction and Development Strategy of an Application System of Intelligent Sports in China’s Sports Industry

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Methods of literature review and model construction were used to study the construction and development strategy of an intelligent sports application system in the sports industry. After the literature review of the sports industry and the application of artificial intelligence in this industry, we analyzed the significance of the intelligent sports application system for the development of the Chinese sports industry from the perspective of elements, data, and policies in the sports industry. The research followed four principles of system construction, which are scientificity, practicalness, efficiency, and coordination. First, we built a framework for the intelligent sports application system and designed its function from governmental, industrial, political, and individual perspectives. Second, the content of the application system was analyzed in detail in five layers including technology, industry, application, challenge, and security. Finally, we structured the operation model according to four units: the database, intermediary platform, social subjects, and industrial subjects. This study put forward the following policy implication: it is required to (1) improve the top-level design of intelligent sports, (2) optimize the intelligent sports market environment, (3) innovate and upgrade the intelligent sports industry, and (4) build an intelligent sports talent system.

1. Introduction

Intelligent sports take AI (artificial intelligence), big data, and other high-tech technologies as production factors, the sports industry as the carrier, and Internet as the primary means to develop the sports industry into a high-end, sophisticated, and cutting-edge industry. In 2019, The General Office of the State Council issued a number of national policies, such as the Outline of Building a Strong Country in Sports and Opinions on Promoting National Fitness and Sports Consumption to Accelerate the High-quality Development of the Sports Industry. They highlighted that China should accelerate the deep integration of AI and the sports industry and enhance the application of intelligent technologies such as big data, the Internet, artificial intelligence, and IoT (Internet of Things) in the sports industry. Additionally, in 2020, the number of Internet users in China exceeded one billion, the Internet penetration rate reached 71.6%, and the total size of the digital economy reached 39.2 trillion yuan, accounting for 38.6% of the per capita GDP. Based on the aforementioned political and social status quo, we can conclude that the development conditions of artificial intelligence in the sports industry in China are complete and it is appropriate to enter a more deeply integrated development. However, the field of intelligent sports in China is still in its infancy. The development mode, implementation path, and development strategy of intelligent sports are in their exploration stages without a detailed application system and development strategies. Therefore, this study needs to make an in-depth analysis of the application system of intelligent sports in the Chinese sports industry. It can help cultivate new business forms and models for the intelligent sports industry, provide new momentum and opportunities for the sports industry development, and give theoretical support to the deep integration of the “AI + the sports industry” in China [1]. This study first reviewed the previous
research on intelligent sports in the sports industry and explored the application orientation and development significance of China’s intelligent sports in the sports industry from three aspects: industrial factors, industrial data, and industrial policies. Then, the intelligent sports industry application system was built from four angles: frame design, function design, content construction, and application analysis. Finally, the study proposed reliable and effective development strategies, revealed the huge development potential of intelligent sports, achieved the best practice of “sports + artificial intelligence” coupling, and provided new methods for the high-quality development of the Chinese sports industry.

2. Literature Review

2.1. The Sports Industry. The Chinese sports industry is broader in scope. The relevant research can be roughly divided into four perspectives: theoretical logic, implementation path, industrial integration, and domestic and international comparative study.

(1) Theoretical Logic. Some scholars have researched the kinetic theory of the sports industry development in the new development pattern and constructed a new set of development logic ideas. [2]. Wang and Liu [3] put forward a theoretical and logical framework for low-carbon development of the sports industry and proposed to achieve green development of the sports industry by improving the resource utilization rate of the sports industry and reducing carbon emission intensity. Yao and Liu [4] researched the coupling theory of the relationship between the sports industry cluster and economy in different fields based on theoretical thinking of the sports industry cluster. In addition, the theory of high-quality development of the sports industry has become the focus of current scholars [5–7]. Theories of industrial structure and industrial transformation are also the current research hotspots of the sports industry theories, which have both good theoretical significance and practical value for the optimization of sports industrial structure and industrial upgrading and transformation [8, 9].

(2) Implementation Paths. The development path of the sports industry should be designed from multilateral and multilevel, to realize its high-quality development. From a capitalist market perspective, the optimized path schemes for market supply, channel, and reform should be provided [10]. From an industrial chain perspective, it is necessary to develop industrial clusters, optimize spatial layout, and innovate supply-side reform of the industrial chain [11]. From a network perspective, it is required to improve dual network capability, innovate industrial performance, and construct the mechanism of interaction between introverted and extroverted networks [12].

(3) Industry Integration. The multiformat integration of the sports industry is a current hot topic for scholars. The research on the integration of the sports industry and the tourism industry can be studied from industrial performance mode, development dilemma, and strategic thinking realization mechanism, to improve sports tourism and promote the high-quality development of the sports industry [13–16]. The combination of the sports industry and medical treatment can be studied from different aspects, including the detection of physical health in different ages, the scientific fitness plan formulation of different social subjects, the prevention and treatment of elderly chronic diseases such as hypertension, osteoporosis, and diabetes, which can help better deal with an aging society, and raise the level of people’s health [17–19]. The integration of sports and AI is the future development direction of the sports industry. The intelligent sports industry has great development potential and prospects. At present, Chinese scholars have analyzed the advantages of intelligent sports from the perspectives of the value impact of the digital economy, the upgrading and transformation of the intelligent manufacturing industry, and the application and practice of intelligent communication media [20–22].

(4) Domestic and International Comparative Study. Compared with developed countries, China’s sports industry has problems such as a relatively late start, weak industrial foundation, poor public cognition, and unbalanced industrial structures. In recent years, with the rapid growth of China’s national economy, the government and people pay more and more attention to sports, and China’s sports industry has made a great breakthrough. Compared with the sports industry in China and the UK, the total scale, growth rate, and economic pull rate of China’s sports industry are higher than that of the UK, but the labor productivity, industrial structure, consumption structure, and GDP share are significantly lagging behind the UK [23]. Compared with the United States, the European Union, the United Kingdom, and Australia, China’s sports industry is incomplete in industrial statistics and problematic in industrial structure [24]. It is necessary to build a maturer industrial system. Both Chinese and Canadian sports industries are in a period of growth, while the latter has a more reasonable industrial structure, and the former has greater development potential. Nevertheless, the industrial systems of both need to be further optimized [25]. Through comparison, it can be found that there is still a gap in the development of the Chinese sports industry and other countries. China should learn from the development experience of developed countries such as the United Kingdom, the United States, and Germany, constantly optimize industrial structures, improve industrial systems, enhance industrial integration, and promote the high-quality development of the sports industry.
2.2. Application of Artificial Intelligence in the Sports Industry.
Artificial intelligence is a newly applied discipline that continuously innovates and expands the theory and practice of human intelligence through development and research. Intelligent sports is a new way to integrate the AI technologies such as the Internet, big data, and 5G with the field of sports [26]. Under the influence of AI, the development of the sports industry in China has ushered in new development opportunities and rapid transformation, in order to solve the problems of structural imbalance, insufficient industrial supporting facilities, and talents shortage in the early development of the sports industry, and build a matured development mode, application system, and industrial system [27]. The research of Chinese domestic and foreign scholars on intelligent sports can be classified into two aspects of artificial intelligence: the sports manufacturing industry and the sports service industry:

1. AI Application in the Sports Manufacturing Industry. The intelligent transformation of the sports manufacturing industry is inseparable from sensors. At present, sensors at home and abroad are constantly upgrading and innovating. For example, Luo et al. developed a triboelectric nanogenerator (TENG) sensing system, which plays an important role in the field of sports manufacturing such as wearable devices and sports equipment [28]. Panda et al. studied new materials such as calcium titanate (CTO) and polyvinylidene fluoride (PVDF), which provide energy for metallograph nanogenerator (PENG). Sensors collect information to monitor people’s physical health and prevent chronic diseases and sports injuries [29]. Sahu et al. used waste textiles for reprocessing to generate new energy and then used sensors for application in sports facilities [30]. Hajra et al. developed covalent organic frameworks (COFs) for power output, which can better achieve motion detection [31]. Luo et al. transformed wood into high-performance triboelectric materials for power supply sensing, assisted referees in sports events to make decisions, and promoted the digital development of the sports industry [32]. Cao, and Dong et al. studied the application of intelligent lighting systems in different sports events in the stadium [33, 34]. Umek et al. [35] used sensors to conduct experiments on golf club swing accuracy and real-time feedback. Xiao et al. [36] designed an exercise bracelet that can monitor heart rate at any time through communication devices such as the Internet of things and sensors. Zhang et al. [37] used wearable image processing technology to conduct real-time monitoring of basketball shooting posture and designed an intelligent wearable product that can monitor shooting movements and dribbling. Coyle et al. [38] added sensors into textiles and designed BIOTEX, a wearable textile fluid processing system, to monitor human physiological data and sweat composition, and monitor body composition changes during human movement, providing new research ideas for the medical and sports fields.

2. AI Application in the Sports Service Industry. Lu [39] conducted an analytical experiment based on human body fatigue and constructed a set of intelligent exercise physical control systems based on independent component analysis to solve the problem of physical fitness monitoring during exercise and prevent excessive fatigue or sports injury. Ren YH et al. developed a quantitative intelligent system of motion based on a comparison of various theoretical methods. Men [40] used statistical methods to establish a sports prediction standard database and build a sports prediction model for sports events and sports training. Gong et al. [41] and Wang and Park [42] explored the IoT and Internet to build a long-distance multimedia PE teaching system, improve the efficiency of PE teaching, optimize the school PE curriculum, and enhance the diversification of PE teaching. Yue and Yang [43] used an intelligent mobile terminal to monitor the state of sports. Leser and Baca [44] studied the motion position positioning and explained the application of positioning sensor systems in sports. Wu et al. [45] used advanced technologies such as mobile applications, websites, cloud servers, and smart wearable devices to generate personalized prescriptions for users through learning data.

3. The Significance of Intelligent Sports in the Sports Industry
Artificial intelligence and the sports industry are regarded as “sunrise industries,” with great industrial potential and developmental vitality. With COVID-19 sweeping the world in 2020, all industries around the world are facing certain difficulties. With the pandemic becoming normal, the development of the sports industry needs new opportunities to raise the “driving force” of the industry.

3.1. Analysis of the Sports Industry Elements. Intelligent sports can exert a certain promotion impact on all elements of the sports industry, especially the three core elements, namely, sports manufacturing, national fitness, and competitive sports. First of all, intelligent sports are of great value to the upgrading of sporting goods manufacturing enterprises, manufacturing technology, production efficiency, product sales channels, etc. In addition, intelligent sports can largely promote the implementation of the national strategy of National Fitness, in that it can diversify fitness approaches into fitness apps, smart equipment, live streaming, and so on. It can also apply digital platforms such as national fitness data platforms and national fitness monitoring systems, thus meeting the needs of citizens for fitness and improving the scientifcity and safety of national fitness. Last but not least, intelligent sports change the development mode of competitive sports [46]. Thanks to virtual training systems, cloud sports events, and training guidance platforms, the training efficiency of athletes can be greatly improved, and the traditional training mode of competitive sports can be
innovated, making sports training more reasonable and wise.

3.2. Data Elements of the Sports Industry. It can be analyzed from the statistical table of the Chinese sports industry data in 2016 and 2020 (Table 1) that the total size of China’s sports industry witnessed a rapid rise during this period, but after the outbreak of COVID-19 in 2020, it decreased by 211.14 billion yuan compared with 2019, and the added value of the industry decreased by 51.31 billion yuan, indicating the growth rate of −4.6%. Among the sports industry, the manufacturing industry of sports goods and related products was the most affected, with the total output falling by 132.71 billion yuan, with a drop rate of 8.1%. Next, the total output of sports services decreased by 79.35 billion yuan, with a drop rate of 3.2% [47]. It was only the construction of sports venues and facilities that increased slightly. From the data, it is clearly seen that the pandemic had a great impact on the sports industry, and the industrial structure has been destroyed and cannot be well adjusted. The impact of COVID-19 on the intelligence industry is relatively mild, and the industrial momentous continues to emerge. The integration of the sports industry with intelligent sports has thus become a development trend. During the pandemic, home fitness has become a vogue, and sports activities such as smart home fitness equipment, online live sports, and cloud sports events have become popular fitness modes among the public, which is also one of the main means for the sports industry to rejuvenate in the postpandemic era. In addition, intelligent sports have its unique advantages in the sports industry, which can help improve the independent innovation ability of the sports industry, give full play to the knowledge-driven sports industry, enhance the efficiency of industrial operation and management, and derive new formats and models with strong scientific and technological barriers.

Data source: Announcement on Total Scale and Value-Added Data of National Sports Industry in 2016, Announcement on Total Scale and Value-Added Data of National Sports Industry in 2017, Announcement on Total Scale and Value-Added Data of National Sports Industry in 2018, Announcement on Total Scale and Value-Added Data of National Sports Industry in 2019, and Announcement on Total Scale and Value-Added Data of National Sports Industry in 2020 released by PRC and the National Bureau of Statistics, PRC.

3.3. Policy Elements of the Sports Industry. The top-level contributing factors to the rapid development of the sports industry should be policy support and guarantee. In 2016, China launched a number of national policies to promote industrial development, including the National Fitness Program (2016–2020), the 13th Five-Year Plan for the Development of Sports, the 13th Five-year Plan for the Development of the sports industry, and the Outline of the Healthy China 2030 Program. All of them mentioned several implementation strategies and development directions for the integration between the sports industry and artificial intelligence. As mentioned in these policies, in order to launch the integration, advanced technologies such as the Internet, cloud computing, big data, IoT, and 5G should be applied to establish a “sports industry + intelligent sports” integration system, which involves national fitness database, sports life cloud platform, sports e-commerce trading platform, sports intelligent equipment R&D system, health and medical data application system, and sports intelligent equipment manufacturing. In 2019, the Chinese State Council issued the Outline of Building a Powerful Country in Sports, which proposed to comprehensively promote the construction of intelligent fitness paths, smart fitness parks, and other intelligent fitness infrastructure, so that intelligent sports can be applied and put into practice in National Fitness level. In 2021, the proposal of the 14th Five-Year Plan for Sports Development has pushed thoroughly intelligent sports and the sports industry integration to a climax, in which China highlighted the importance to construct a National Fitness competitive sports service platform, as well as a three-level interconnection system at the national, provincial and municipal levels, accelerate the upgrading of traditional sports, and create virtual sports games and other emerging sports activities, so as to achieve the comprehensive promotion of intelligent sports and meet the needs of different social groups (Table 2).

Data source: National Fitness Program (2016–2020); “Healthy China 2030” Program released by State Council, PRC; Guidance on Accelerating the Development of Fitness and Leisure Industry; Outline of Building a Strong Country in Sports released by General Office of the State Council, PRC; The 13th Five-Year Plan for Sports Development; The 13th Five-Year Plan for the Development of the sports industry; Action Plan to Further Promote Sports Consumption (2019–2020); The 14th Five-year Plan for Sports Development released by General Administration of Sport, PRC.

4. Construction of Intelligent Sports Application System in the Sports Industry

4.1. Construction Principles

4.1.1. Scientificity. Intelligent sports are a new form of business generated by the integration of artificial intelligence and sports. It should not only follow the scientific nature of data and technology of AI but also ensure the authenticity, fairness, and rationality of sports [47]. The application system of intelligent sports in the sports industry should follow the basis of scientific development, accord with the ethics of human development, and not violate the legal norms and facts.

4.1.2. Practicalness. Practice is the fundamental meaning of the existence of intelligent sports. The application of intelligent sports in the sports industry must be based on meeting the needs of the general public and providing a more convenient and scientific and practical basis. The development of intelligent sports should combine theory with practice, strengthen practical verification in product R&D, design, engineering, and other processes, pay attention to
the practical role of products, and give full play to the huge energy contained in intelligent sports.

4.1.3. Efficiency. The essence of intelligent sports is to improve industrial efficiency and industrial initiative. With the help of advanced science and technology of intelligent sports, the automation level of sports manufacturing enterprises can be improved, the national monitoring and management efficiency of national fitness optimized, the sports service system furthered, and continuous and orderly implementation of the national strategy of “building a strong country in sports” promoted.

4.1.4. Coordination. Intelligent sports are produced by the fusion of the sports industry and artificial intelligence and other fields. The development mode of win-win cooperation should be maintained among all industries. In addition, intelligent sports involve various fields of the sports industry, and the coordination among these fields is particularly important. Government departments, as the link between various fields, guarantee the development of intelligent sports in a reasonable and orderly way and give play to the powerful synergy of the intelligent sports industry.

4.2. Framework of the Intelligent Sports Application System in the Sports Industry. The integration of intelligent sports into the sports industry can improve the development efficiency of the sports industry, promote industrial upgrading and transformation, improve citizens’ fitness environment, and open up new ideas for industrial development. The application of intelligent sports in the sports industry consists of many elements, and each of them is mutually connected and interacted. The framework of the intelligent sports application system in the sports industry (Figure 1) is composed of four interconnected closed-loop layers and four objects, which continuously extend from inside to outside and eventually generate a clear industrial application framework, as follows:

(1) The core layer is the industrial platform, intelligent system, fitness mode, and communication media. As the medium of industrial development and communication, the industrial platform has greatly promoted industrial progress and improved the driving force of industrial innovation. The intelligent system is one of the most widely used technologies in intelligent sports. It is particularly important for the sports manufacturing and sports service industry to improve the level of industrial intelligence. The fitness system is one of the fundamental ways to achieve national fitness strategies due to the fact that it covers an extensive range and relates to the scientific fitness of hundreds of millions of citizens [45]. Media is the most intuitive technology display of intelligent sports, in which advanced technologies such as 5G, VR, and 4K are used to improve the experience of watching matches, and live streaming platforms are used for shopping and fitness, which explains how it can improve industrial efficiency, expand sports consumption, and meet people’s pursuit of a better life.

(2) The intermediary layer is an important intermediate link in the application of intelligent sports in the sports industry, where, the four elements such as digital economy, artificial intelligence, intelligent fitness system, and new media communication channels represent respectively the intelligent sports application in industry, technology, fitness, and society. The digital economy can improve the industrial scale, break the traditional economic development mode, and open up a new economic growth point for the sports industry. Artificial intelligence is the main content of intelligent sports, which is the basis of the development of intelligent sports technology. It changes the traditional production mode, improves industrial efficiency, and makes artificial intelligence the main field for the future development of enterprises. The construction of an intelligent fitness system is an important part of the implementation of national fitness, involving the establishment of a national fitness network, the construction of a national fitness database, and the stimulation of citizens’ enthusiasm for fitness. New media is essential for social development. It can make artificial intelligence the name card of social progress, facilitate people’s life, innovate their lifestyles, and better meet their social needs.
## Table 2: Summary of important policies for the development of the intelligent sports industry.

| Time     | Policy                                                                 | Department                                  | Content                                                                                                                                                                                                                                                                                                                                 |
|----------|------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| June 2016| National fitness program (2016–2020)                                    | State council, PRC                          | Promote the integration of modern information technology such as mobile Internet, cloud computing, big data, and Internet of things with national fitness, and build national fitness management resource databases, service resource databases, and public service information platforms. Use big data technology to analyze the situation of national fitness and improve the level of national fitness guidance and supervision efficiency of national fitness facilities [48] |
| May 2016 | The 13th five-year plan for sports development                          | General administration of sport, PRC       | Encourage the development of mobile Internet-based sports life cloud platforms and sports e-commerce trading platforms. Promote the integration of sports enterprises and mobile Internet, and actively expand customers by using big data, cloud computing, intelligent hardware, and various theme apps [49]                                                                                     |
| July 2016| The 13th five-year plan for the development of the sports industry      | General administration of sport, PRC       | Enterprises will be supported to use Internet acquisition technologies to meet personalized needs of sports and fitness, and research and development of new sports equipment, wearable sports equipment, and virtual reality sports equipment will be encouraged [49]                                                                                                                           |
| October 2016| “Healthy china 2030” program                                            | State council, PRC                          | Develop and apply big data for national physical health monitoring, strengthen the construction of the application system of big data in health care, promote the open sharing, in-depth mining, and wide application of big data in health care, and fully build a population health information platform [50]                                                                 |
| October 2016| Guidance on accelerating the development of the fitness and leisure industry | General office of the state council, PRC   | Encourage the development of fitness and leisure services supported by mobile Internet, big data, and cloud computing technologies, and encourage the development of new forms of sports media such as multimedia radio and television, Internet radio and television, and mobile apps [51]                                                                                     |
| August 2019| Outline of building a strong country in sports                          | General office of the state council, PRC   | New information technologies such as the Internet of things and cloud computing will be used to promote the integrated application of venue booking, event information release and operation, and service statistics, and promote the construction of smart fitness paths, smart fitness trails, and smart sports parks [52] |
| September 2019| Action plan to further promote sports consumption (2019–2020)           | General administration of sport, national development and reform commission, PRC | Further promote the integration of sports consumption and information consumption, accelerate the digitalization and networking process of production, dissemination, and consumption of sports products and services, expand new media sports consumption, actively promote the construction of smart community fitness centers, and apply information technology to the construction and management of sports facilities [53] |
| October 2021| The 14th five-year plan for sports development                          | General administration of sport, PRC       | Promote “Internet + fitness” and “Internet of things + fitness,” promote the establishment of national-provincial-municipal interconnectivity of the national fitness information service platform, information service platform construction as a whole country national fitness service platform, information platform of competitive sports and the sports industry, form digital sports “the kernel,” application of new technology to promote transformation and upgrading of the traditional sports facilities, promote cloud events, virtual sports, and other emerging sports and events [49] |
(3) The application layer is the application field of intelligent sports in the sports industry, which mainly includes digital consumption, intelligent technology, intelligent manufacturing industry, national fitness data platform, intelligent fitness places, sports event services, and digital services. The sports industry applications in different fields, environments, and objects are constantly upgraded and transformed to form intelligent sports application circles.

(4) The four objects are industry, society, government, and citizens. They are the application objects of intelligent sports in the sports industry, the main purpose and target of the development of the sports industry, and the source power of the rapid development of intelligent sports in the sports industry.

4.3. Function Design of Intelligent Sports Application System in the Sports Industry. The function of the intelligent sports application system in the sports industry is the “brain” of the whole system, which controls the operation of the whole system by giving operation instructions and finally achieves the expected goals. The functional design of the intelligent sports application system in the sports industry (Figures 2 and 3) is mainly divided into four functional areas as follows:

4.3.1. Top-Level Design, Guarantee, and Feedback. Intelligent sports are of great value to industrial policies, systems, and plannings in the sports industry. (1) Policy Planning. Intelligent sports obtain relevant data of the sports industry through big data platforms such as the basic data platform of the sports industry and the national fitness monitoring system. The government adjusts and improves industrial policies and plans according to the data to ensure the high-quality development of the sports industry. (2) Government Coordination. Sports government departments at all levels are to form a cooperative management platform with other government departments, which greatly improves the synergy between government departments and speeds up the decision-making efficiency of administrative departments. (3) Feedback Mechanism. The management and supervision integrated network system of the sports industry can establish communication channels for the government, enterprises, and other social subjects, and speed up the exchange of information between subjects. Thanks to the feedback mechanism, governments can timely implement policy documents and strengthen management efficiency. For enterprises and other social subjects, it will help them timely feedback to the superior department, maximizing the efficiency of each subject.

4.3.2. Fitness Service and Accurate Monitoring. One of the important contents of intelligent sports in the sports industry is to serve the national strategy of national fitness, that is, meet the citizens’ ever-changing fitness needs, as follows [45]:

(1) Fitness Instruction. The use of an intelligent system is to assess the exercise intensity according to different groups, physical fitness, and needs, and then develop personalized fitness programs based on fitness places, facilities, and other environmental factors to achieve scientific fitness for all.

(2) Fitness Monitoring. From a national perspective, data systems such as big data and Internet can be used to monitor fitness groups, so as to comprehensively understand the fitness level of citizens, the satisfaction of facilities, and other conditions, and to provide a reference for management and policy implementation. From an individual perspective, wearable devices can be used to monitor their heart rate, calorie expenditure, and other fitness data during the exercise process, and timely adjust their exercise intensity and mode to ensure safety.

(3) Exercise Rehabilitation. Exercise rehabilitation is a rehabilitation treatment for the occurrence of sports injuries. The combination of AI and sports medicine is used to build an exercise rehabilitation system to meet citizens’ demand for sports prescriptions and scientifically reduce sports risks.

4.3.3. Intelligent Manufacturing and Industrial Upgrading. Given that sports goods manufacturing occupies a relatively high proportion in the sports industry, it is vital to improve intelligent manufacturing and accelerate industrial upgrading.

(1) Smart Factory. Smart factories are the key content of intelligent sports. Through automatic control and artificial intelligence robots, the input of human and material resources and costs can be reduced, and industrial energy efficiency and product quality can be greatly improved.

(2) Intelligent Technology. By improving the level of intelligence, sports manufacturing constantly develops new intelligent technology and applies it to market and product fields, so as to speed up industrial upgrading, optimize industrial structures, enrich industrial content, and raise industrial technical barriers.

(3) Innovation Platform. Talents are the basis for the development of intelligent sports. The establishment of the intelligent innovation platform will promote the exchange and sharing of high-level talents among the government, universities, research institutes, and enterprises, and improve the innovation of intelligent sports through innovation and cooperation.

4.3.4. Public Demand, Convenience, and Efficiency. One of the goals of intelligent sports is to meet the demands of the public and provide a more convenient lifestyle. (1) Intelligent Fitness Place. Smart fitness venues include services for intelligent fitness place reservation, including smart parks, smart fitness centers, smart gyms, and other smart fitness
venues, as well as fitness and health monitoring, events organization, events publicity, and other functional services.

(2) Digital Consumption. Digital consumption has become the main consumption way of sports consumption. The rapid development of the Internet conducts a series of digital consumption behaviors such as network live streaming, online shopping, and WeChat business, stimulating import and export, and driving economic growth. (3) Innovative Game Watching. As 5G, VR, AR, 4K, Internet, and other technologies continue to mature, the approaches for people
to watch the games are constantly changing, and their watching experience are getting better. (4) Virtual Training. Through AI, Internet of Things, and other technologies, the human-computer interaction system is constructed to simulate different outdoor environments for virtual sports or training, so as to improve the training effect, enhance the training atmosphere, and improve the enthusiasm for mass sports (Figure 2).
4.4. Content Construction of Intelligent Sports Application System in the Sports Industry. The application system of intelligent sports in the sports industry (3.3) is divided into five layers: technology, industry, application, challenge, and guarantee. The five layers are distinct, interrelated, and independent, jointly constituting the application system of intelligent sports in the sports industry:

1) **Technology Layer.** The technology layer is mainly about the application of artificial intelligence in the sports industry, which mainly includes data and technologies. Data here consist of data retrieval, data storage, data analysis, and data application. Technologies here consist of intelligent robots, language processing, biometrics, automatic control, and image processing. Different artificial intelligence technologies are applied to different sports industry carriers to change the development mode of traditional carriers, improve the production efficiency, and enhance the convenience of carriers.

2) **Industry Layer.** According to industry types, China’s sports industry can be divided into 11 major categories, 34 middle categories, and 71 subcategories. The intelligent sports application system divides the sports industry into 2 major categories, namely, the sports service industry and sports manufacturing industry, and then into 8 middle categories including sports event services, fitness and leisure services, athletic training services, sports media services, sports trade services, sports goods manufacturing, sports integration industry, and sports venue construction. The industry classification in the system mainly covers the important subindustries of the sports industry, as well as the application scope of intelligent sports in the sports industry.

3) **Application Layer.** The application layer is the product of the integration of the industry layer and the technology layer, including the application subjects and application contents. Government, society, industry, and citizens are the four main application subjects of intelligent sports in the sports industry, and they are connected in series to form the application network of intelligent sports in the sports industry. The application contents mainly include 9 aspects: national fitness information service platform, competitive sports service platform, automatic control intelligent enterprise, government management system platform, cloud games and virtual sports, sports think tank system, sports e-commerce platform, fitness place control system, and sports media communication system.

4) **Challenge Layer.** The challenge layer covers the problems and challenges existing in the application of AI in the sports industry. Challenges can be concluded from technological and industrial perspectives. Technical challenges mainly include the difficulties of technology development, application and integration, data risks, and long-term technical maintenance. Industrial challenges mainly include approaches to effective market supervision and traditional market transformation.

5) **Guarantee Layer.** The guarantee layer escorts the smooth operation of the whole system. The specific content of the guarantee layer is designed according to different objects of the technology layer, industry layer, challenge layer, and application layer. This layer mainly includes the intelligent government supervision system, intelligent market supervision system, intelligent enterprise supervision system, and intelligent public supervision system. Each system is interconnected and mutually supervised, forming an Internet supervision network system. First, the intelligent government supervision system controls the market system and oversees the public system at the same time. Second, the intelligent market system responds to the government system in time and manages the enterprise system. Third, the intelligent enterprise supervision system is connected with the public system and acts on the market system. Finally, the public supervision system feeds back the information to the government system to support and maintain the enterprise system.

4.5. Operation of the Intelligent Sports Application System in the Sports Industry. The operation of the intelligent sports application system in the sports industry (Figure 4) is based on four databases, one intermediary platform which serves as the link, four social subjects, and three industrial subjects. Each operational body is closely linked, mutually influenced, and constitutes together the whole big operation mechanism.

4.5.1. **Database.** Databases are the basis and guarantee of the sports industry intelligent sports application system, which is mainly composed of an industry database, technology library, talent pool, and application library, as follows:

1) **Industrial Database.** The industrial database stores and applies data through three steps: data collection, analysis, and application. The industrial database in the intelligent sports industry application system adopts NoSQL database and uses key-value storage to simplify the database structure as far as possible. Therefore, it can quickly query the required information, support cross-category multilingual storage, and meet the storage and management among multiple subsystems in the sports industry system.

2) **Technical Library.** The technology library is mainly used to store core technologies such as intelligent manufacturing technologies, intelligent intellectual property rights, and intelligent industrial information technologies. The technology library is the core database of the intelligent sports industry application system, which plays a key role in industrial innovation and development.
(3) **Talent Pool.** The talent pool mainly summarizes talents from universities, scientific research institutes, and social cutting-edge industries to form a think tank system for the formulation and evaluation of the sports industry policy planning.

(4) **Application Library.** The application library mainly collects the applications and practices of intelligent enterprises, intelligent health applications, and human-computer interaction systems and makes statistics and analyses of the application of intelligent sports in the sports industry. The four databases constitute the database sharing mechanism through content exchange and communication.

4.5.2. **Intermediary Platform.** The intermediary platform is an important link to database information applications. The database sharing mechanism transmits data to the corresponding partitions of the intermediary platform system, such as network platform, intelligent system, data analysis, and technology application, for data processing, and then feeds the processed content back to each social subject for practice.

4.5.3. **Social Subjects.** The social subjects operation mechanism takes government departments as the core. Sports government departments and other departments not only coordinate and cooperate but also establish a system of integration and co-construction of government departments to improve the efficiency of government management. There is a two-way operation mechanism between government subjects and social subjects, integrating government departments to formulate the sports industry plans and policies for sports enterprises, community organizations, and the public; conversely, social enterprises, community organizations, and the public give feedback and suggestions on policy planning. At the same time, the government mainly establishes the sports industry think tank system to provide subject project research for the talents and expert team of the think tank, and the think tank system provides expert advice and evaluation for comprehensive fitness planning and policies. Social subjects will also collect and classify data and store them in the four databases to update data in time.

4.5.4. **Industrial Subjects.** Industrial subjects are the core subjects of the intelligent sports industrial application system. Under the Chinese domestic background of dual circulation of domestic and foreign markets, the industrial subjects of intelligent sports are to build a sports industry development environment of national fitness, sports intelligent manufacturing, and sports intelligent service. Industrial subjects and social subjects are to optimize and promote each other, jointly building the main operating system of the intelligent sports industry, and bearing the
application experience and development ideas of intelligent sports. Intelligent sports strive to promote the rapid development of the sports industry, improve the backward development mode of the traditional sports industry, and innovate new ideas for sports industry development.

5. Development Strategy of Intelligent Sports in the Sports Industry

5.1. Improve the Top-Level Design of Intelligent Sports. In the development and application of the intelligent sports industry, the policy system is not mature, the planning is not in place, and the market environment is chaotic. In view of the current development of intelligent sports, it is necessary to improve the top-level design. First of all, a more reasonable and complete sports industry policy system should be formulated to supplement the blank spots in the sports law for intelligent sports and ensure a good development environment for intelligent sports. Second, with the development of the intelligent sports industry becoming a new development trend, it is necessary to formulate regional intelligent sports industry planning, clear development direction, and goals for the intelligent sports industry. Finally, the government should strengthen the management and support for intelligent sports, set up intelligent sports industry funds, help the development of micro, small and medium-sized enterprises, establish enterprise cooperation mechanisms, give play to the “head goose effect” of large enterprises, and facilitate the high-quality development of the intelligent sports industry.

5.2. Optimize the Intelligent Sports Market Environment. There are still illegal phenomena in the intelligent sports industry, such as technology and patent stealing, product copying from competitors, and malicious competition. Optimizing the market environment is one of the important ways to improve the development of intelligent sports. First of all, the government should set up intelligent sports market management departments to conduct regular inspections and management of intelligent sports markets and enterprises at all levels, establish punishment mechanisms and intensify investigation and punishment. Second, an intellectual property protection mechanism is built, the security of privacy and interest protection is improved, security risks caused by their own loopholes are avoided, the intellectual property rights of intelligent sports subjects are protected, security publicity is strengthened, the awareness of intellectual property rights of the people is improved, and the report and prosecution of illegal behaviors are encouraged. Finally, the construction of an intelligent sports market standard system is accelerated, comprehensive pilot work of national standards is built, and promotion of the market quality standards of intelligent sports equipment and high-end equipment is continued.

5.3. Innovate and Upgrade the Intelligent Sports Industry. The intelligent sports industry is innovated and upgraded and its application value is improved in the sports industry. First of all, full play is given to the unique competitive advantages of intelligent sports, the industrial characteristics of intelligent sports “specialization, accuracy, specialty, and innovation” are fully displayed, the advanced technology of intelligent sports is used, combined with the specific content of the sports industry, the backward development mode of traditional sports manufacturing industry is innovated, and the industry is upgraded. Second, the intelligent sports industry chain is improved, the radiation range of intelligent sports is expanded, the development of key industries is focused, the building of the upstream and downstream industrial chain of intelligent sports is speeding up, the application of the intelligent sports industry is enhanced, and a vertical ecology of the intelligent sports industry chain is created. Finally, the construction of the intelligent sports application system is strengthened, the multilevel and multichain application system is improved, the AI application in the sports manufacturing industry, sports service industry, national fitness, and other key fields is strengthened, higher industrial intelligence is achieved, the digital development of the sports industry is promoted, and motivation for the transformation of the sports industry is provided.

5.4. Build Intelligent Sports Think Tanks. The construction of think tanks is an important factor in the sustainable development of intelligent sports. First of all, a talent training mechanism is established, intelligent sports talents are considered as sports + artificial intelligence complex talents, institutions are encouraged to build intelligent sports disciplines, sports science and technology innovation platform are relied, cooperation and exchanges are strengthened, and a sustainable output talent training mode is created, so as to provide high-quality talents for the government, the market, and enterprises. Second, foreign intelligent sports experts and talents are actively introduced, foreign advanced experience is learned, the knowledge barrier of intelligent sports is broken, full play is given to the value of intelligent sports, and the vitality of the industry is released. Finally, the government should vigorously develop the coordinated development of governments, industries, and universities, integrate the research into the application, build a talent pool system for governments, industries, universities, and other subjects, and facilitate the R&D, design, and application of intelligent sports, promote the transformation of intelligent sports achievements, truly put technology into practice, and give full play to the value of intelligent sports.

6. Conclusion

China’s sports industry, known as the “sunrise industry of the 21st century,” constantly increases and matures. Nowadays, it has become a key component of Chinese economic and social development. With the continuous development of the economy and society, people’s demand for intelligent sports is constantly evolving. The development and application of intelligent sports in the sports industry are necessary content for the development at this new era. With the
continuous integration of artificial intelligence and the sports industry, the development mode of intelligent sports gradually turns standardized, scientific, and intelligent. In the process of applying intelligent sports to the sports industry, it is necessary to clearly understand the opportunities and challenges brought by intelligent sports to the sports industry. Intelligent sports take data, algorithms, and hash rate as the core; the sports industry content as the carrier; government, market, industry, and public as service objects; AI, big data, Internet, cloud computing, IoT, 5G, and VR as technological means; industrial platforms, databases, intelligent manufacturing technologies, and intelligent service as the application means. This shows its great development potential to achieve the high-quality development of the sports industry. The government needs to constantly strengthen the top-level design of intelligent sports and establish a new system and model for market development. The market needs to optimize the market environment and give full play to leading enterprises. Enterprises need to improve their innovation, reduce technological risks, protect the privacy of citizens, and facilitate the participation of AI in the development of China’s sports industry. In this way, the sports industry can achieve its innovative, scientific, standard, and systematized development.

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

Conflicts of Interest
The authors declare that they have no conflicts of interest.

Authors’ Contributions
Yuxin Tang, Xiaowen Zhang, and Wenyan Zhu made equal contributions to the manuscript.

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References
[1] F. Zheng and W. K. Xu, “Intelligent sports in China: rise, development and countermeasures,” Journal of Sports Science, vol. 33, no. 12, pp. 6 14–24, 2019.
[2] J. W. Qian and R. R. Li, “Kinetic energy of the sports industry development under the new development pattern: theoretical logic,” Changchun University of Science and Technology, vol. 33, no. 1, pp. 54–63, 2022.
[3] M. Wang and D. F. Liu, “Theory logic realistic dilemma, and implementation path of digital technology empowering low-carbon development of the sports industry,” Journal of China Sport Science and Technology, vol. 4, no. 1, pp. 71–80, 2022.
[4] S. B. Yao and B. Liu, “Relationship between the sports industry agglomeration and regional economic growth: theoretical logic, and trend review,” Guangzhou Sports College Journal, vol. 9, no. 5, pp. 1–6, 2021.
[5] K. Y. Shen, “Theoretical explanation and countermeasures of digital economy driving high quality development of sports industry,” Journal of Wuhan Sports College, no. 10, pp. 5–12, 2021.
[6] L. Liu and W. G. Lv, “Theoretical research and discussion on the high-quality development in China’s sports industry in the new era,” Journal of Beijing Sports University, vol. 44, no. 7, pp. 1–8, 2021.
[7] B. Ren and H. Y. Huang, “Theoretical Logic Practical Dilemma and Implementation Path of High Quality Development of the Sports Industry Driven by Digital Economy,” Journal of Shanghai University of Sports, no. 7, pp. 22–66, 2021.
[8] L. Lin and L. Q. Peng, “The development of the structure of the sports industry theoretical and positive analysis,” Journal of Chengdu Physical Education University, no. 4, pp. 7–11, 2004.
[9] X. L. Wang, “Transformation of growth power of the sports industry high-quality development based on system dynamics,” Journal of Shenyang Sports University, vol. 40, no. 6, pp. 111–119, 2021.
[10] Q. V. Zhu, “Capital market supporting high-quality development of the sports industry mechanism, dilemma and path choice,” Journal of Shanghai Sports Institute, no. 12, pp. 35–49, 2021.
[11] S. Q. Zhang and G. Q. Peng, “Internal logic and optimization path of sports consumption market development in China from the perspective of industrial chain,” Sports Culture Guide, no. 11, pp. 82–89, 2021.
[12] Y. L. Duan and B. Liu, “The innovation-driven path for high-quality development of the Chinese sports industry,” Journal of Xi’an Sports Institute, vol. 38, no. 6, pp. 673–680, 2021.
[13] Y. Lei and A. Q. Liu, “Performance model of tourism industry and the sports industry integration,” Social Scientist, vol. 66, no. 9, pp. 71–97, 2021.
[14] J. Q. Cui, “Dilemma and Path Exploration of High-Quality Development of China’s Ice and Snow Sports Tourism Industry under the New Development Paradigm,” Sports Culture Guide, no. 8, pp. 7–13, 2021.
[15] Z. H. Wang and L. Luo, “Thinking on facilitating quality development in the sports industry in the beijing-zhangjiakou sports culture and tourism belt,” Journal of Beijing Sport University, vol. 44, no. 4, pp. 25–38, 2021.
[16] X. X. Feng and Y. H. Lin, “Integration of the sports industry and tourism industry based on experience economy and its realization mechanism,” Sports Culture Guide, no. 9, pp. 108–112, 2017.
[17] S. L. Zhu, “Research on the path of “integration of sports and medicine” For Improving the Physical Health of the Elderly Family Dependents in Cities,” People’s BBS, the Academic Front, no. 1, pp. 106–108, 2022.
[18] S. S. Gao, “Construction of evaluation index system for scientific fitness literacy of medical and nursing groups based on sports and medicine integration,” Nursing Research, vol. 35, no. 22, pp. 3968–3972, 2021.
[19] Y. Zhang, “Research on the model of physical-medical integration for chronic diseases under the background of “Healthy China”,” Journal of Health Economic Research, vol. 38, no. 10, pp. 23–25, 2021.
[20] Y. X. Luo, “Value and strategy of the digital economy in leading high-quality development of the sports industry,”
Journal of Xi’an Sports Institute, vol. 33, no. 1, pp. 64–72, 2022.

[21] S. Z. Peng, "For the application of intelligent manufacturing technology in the sports equipment design," Journal of Mechanical Design, vol. 38, no. 10, pp. 158–159, 2021.

[22] D. L. Zhu and X. L. Zhao, "Media communication and digital aesthetic characteristics of sports culture in 5G intelligent era," Physical Education and Science, no. 1, pp. 61–66, 2021.

[23] X. L. Duan and Q. Fu, "Comprehensive comparison of the sports industry development between China and Britain and its enlightenment to China: based on British sports satellite account and China’s sports industry statistical bulletin," Journal of Tianjin Institute of Physical Education, vol. 35, no. 1, pp. 56–63, 2020.

[24] Y. Lu and D. C. Zhong, "Analysis on some developed countries’ gross domestic sports product (GDSP) and its inspiration to China," Journal of Capital Institute of Physical Education, vol. 28, no. 5, pp. 392–401, 2016.

[25] G. Li, M. Liu, Y. Fu, and B. A. Feng, "A comparative study on the system and scale of sport industry between China and Canada," Journal of Physics: Conference Series, vol. 1624, no. 4, Article ID 042070, 2020.

[26] J. Gao, "The concept and development application prospect of intelligent sports in China," Journal of Physics: Conference Series, vol. 1345, Article ID 042030, 2019.

[27] C. Deng and Z. Tang, "Historical opportunity and structural transformation of sports industry development under the background of new information technology," Journal of Physics: Conference Series, vol. 1575, no. 1, Article ID 012170, 2020.

[28] J. Luo, W. Gao, and Z. L. Wang, "The triboelectric nanogenerator as an innovative technology toward intelligent sports," Advanced Materials, vol. 33, no. 17, 2021.

[29] S. Panda, S. Hajra, H. Jeong et al., "Biocompatible CaTiO3-PVDF composite-based piezoelectric nanogenerator for exercise evaluation and energy harvesting," Nano Energy, vol. 102, Article ID 107682, 2022.

[30] M. Sahu, S. Hajra, S. Panda et al., "Waste textiles as the versatile triboelectric energy-harvesting platform for self-powered applications in sports and athletics," Nano Energy, vol. 97, Article ID 107208, 2022.

[31] S. Hajra, J. Panda, J. Swain, H. G. Kim, M. Sahu, and M. K. Rana, "Triazine skeletal covalent organic frameworks: a versatile highly positive surface potential triboelectric layer for energy harvesting and self-powered applications," Nano Energy, vol. 101, Article ID 107620, 2022.

[32] J. Luo, Z. Wang, L. Xu et al., "Flexible and durable wood-based triboelectric nanogenerators for self-powered sensing in athletic big data analytics," Nature Communications, vol. 10, no. 1, p. 5147, 2019.

[33] S. M. Cao, "Intelligent lighting control system in large-scale sports competition venues," Light and Engineering, vol. 26, no. 4, pp. 172–182, 2018.

[34] P. Dong, W. Q. Qiu, J. F. Shi et al., "[Cancer screening service utilization and willingness-to-pay of urban populations in China: a cross-sectional survey from potential service demander’s perspective]," Heath Economic Evaluation Working Group, Cancer Screening Program in Urban China CanSPUC, vol. 39, no. 2, pp. 165–172, 2018.

[35] A. Umek, Y. Zhang, S. Tomazić, and A. Kos, "Suitability of strain gage sensors for integration into smart sport equipment: a golf club example," Sensors, vol. 17, no. 4, p. 916, 2017.

[36] N. N. Xiao, W. Yu, and X. Han, "Wearable heart rate monitoring intelligent sports bracelet based on Internet of things," Measurement, vol. 164, Article ID 108102, 2020.

[37] L. Zhang, Y. Sun, M. Wang, and Y. Pu, "Wearable product design for intelligent monitoring of basketball training posture based on image processing," Journal of Sensors, vol. 2021, pp. 1–15, 2021.

[38] S. C. Coyle, K. T. Lau, N. Mynna et al., "BIOTEX-biosensing textiles for personalised healthcare management," IEEE Transactions on Information Technology in Biomedicine, vol. 14, no. 2, pp. 364–370, 2010.

[39] B. X. Lu, "Intelligent control system of physical strength in sports based on independent component analysis," Neural Computing & Applications, pp. 1–2, 2022.

[40] Y. H. Men, "Intelligent sports prediction analysis system based on improved Gaussian fuzzy algorithm," Alexandria Engineering Journal, vol. 61, no. 7, pp. 5351–5359, 2022.

[41] W. M. Gong, L. Tong, W. Huang, and S. Wang, "The optimization of intelligent long-distance multimedia sports teaching system for IoT," Cognitive Systems Research, vol. 52, pp. 678–684, 2018.

[42] T. Wang and J. Park, "Design and implementation of intelligent sports training system for college students’ mental health education," Frontiers in Psychology, vol. 12, p. 634978, 2021.

[43] Y. B. Yue and Y. Yang, "Mobile Intelligent Terminal Speaker Identification for Real-Time Monitoring System of Sports Training," Evolutionary Intelligence, Springer, Berlin, Germany, 2020.

[44] R. Leser and G. BacatoGris, "Local positioning systems in (game) sports," Sensors, vol. 11, no. 10, pp. 9778–9797, 2011.

[45] Y. C. Wu, Z. Ma, H. Zhao, Y. Li, and Y. Sun, "Achieve personalized exercise intensity through an intelligent system and cycling equipment: a machine learning approach," Applied Sciences, vol. 10, no. 21, p. 7688, 2020.

[46] Y. Tang, S. Zan, and X. Zhang, "Research on system construction and strategy of intelligent sports in the implementation of national fitness," Computational Intelligence and Neuroscience, vol. 2022, no. 1, 13 pages, 2022.

[47] J. H. Abawaize, Z. Xu, M. Atiquzzaman, and X. Zhang, "International Conference on Applications and Technology in Cyber," Applications and Techniques in Cyber Intelligence, Springer Nature, Berlin, Germany, 2021.

[48] P. R. C. State Council, National Fitness Program (2016-2020), State Council, Chennai, India, 2016.

[49] P. R. C. General Administration of Sport, The 13th Five-Year Plan for Sports Development, General Office of the State Council, Zhongnanhai, China, 2016.

[50] P. R. C. State Council, "Healthy China 2030" Program, State Council, Chennai, India, 2016.

[51] P. R. C. General Office of the State Council, Guidance on Accelerating the Development of Fitness and Leisure Industry, General Office of the State Council, Zhongnanhai, China, 2016.

[52] P. R. C. General Office of the State Council, Outline of Building a Strong Country in Sports, General Office of the State Council, Zhongnanhai, China, 2019.

[53] N. Drc, General Administration of Sport, National Development and Reform Commission, PRC. Action Plan to Further Promote Sports Consumption, NDRC, China, 2019.