Clustering and Evolution of International Sports Field Based on Multi-sensor Fusion Technology

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Abstract. Based on 549 literatures with the theme of "sports artificial intelligence" and other keywords in web of science database since 1995, this paper uses CiteSpace V software for visualization processing and analysis, and combs the country, discipline distribution, research hotspots and evolution trend of sports artificial intelligence research in recent 25 years by means of visual knowledge mapping, and discusses its research progress and development direction. 1) The research area of sports artificial intelligence is widely distributed, among which the United States, China and Germany are in the leading position. 2) Sports artificial intelligence research involves many disciplines, mainly using and learning from the research methods and theoretical perspectives of computer science, engineering, sports science and other disciplines. 3) The frequency and centrality of keywords confirm that machine learning is the main direction in the field of sports artificial intelligence, artificial neural network is the main algorithm, and data mining is the basis of practice and research. 4) Research hotspots include simple activity recognition and energy consumption research based on wearable accelerometer technology; action analysis and damage prevention and control research based on wearable sensor; computer vision scene classification research based on convolution neural network algorithm; analysis and prediction of physical fitness and technology and tactics based on computer vision; human posture recognition technology based on computer Deep learning.

Keywords: Artificial intelligence · Sports · Knowledge map · Machine learning · Computer vision · Neural network

1 Introduction

Artificial intelligence is based on computer science, physics, information theory, system science, philosophy and other disciplines to continuously improve human living standards and development level. The ability of human beings to use knowledge to discover, define and solve problems. Artificial intelligence is often used to solve problems that cannot be solved by computers. This is the peak of human understanding and ability transformation of the objective world in the era of information industry revolution. Through the analysis of the development of artificial intelligence technology in China in recent 40 years, some scholars believe that the main short-term goal of artificial intelligence is to use machines to simulate and perform some intelligent functions of the human

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brain. The long-term goal is to simulate human psychological activities and intelligent functions through machines. Yes, yes. With the development of science and technology, artificial intelligence is more and more used in the field of international sports training. This paper will use citespave software to sort out and analyze the relevant literature in wos database. Through the analysis of the research and application of artificial intelligence in the field of international sports, we can improve the relevant research structure, learn from each other and make up for the shortcomings of domestic research. Seize the opportunity of the times, promote the research of artificial intelligence in China's sports field, and make China realize the goal of becoming a sports power as soon as possible. This paper consists of the following parts. The first part introduces the relevant background and significance of this paper, the second part is the related work of this paper, and the third part is data analysis. The fourth part is clustering and evolution of sports artificial intelligence research. The fifth part is conclusion.

2 Related Work

Since it is difficult for traditional theoretical and practical paradigms to solve a series of new formats, mechanisms and logic brought about by new technologies, the development and operation have become the top priority for the development of media and a problem that Ref [1] need to think deeply at present. Based on this analyze the important role that artificial intelligence technology can play from the perspective of serving sports training activities and improving the effect of sports training [2]. Zhang et.al. [3] use the recognition algorithm based on the multilayer decision tree recognizer to identify the joint movement; the experiment shows that the method used accurately identified joint movement for football players in sports training. In the algorithm, the grey relational analysis method is introduced [4]. By expanding the standard action data, the standard database of score comparison is established, and the system architecture and the key acquisition module design based on 3D data are given [5]. Liang et.al. conduct a questionnaire analysis on the application of artificial intelligence technology in leisure sports courses [6]. Research and analyze the characteristics and functions of new intelligent information service tools, and explore the effects of artificial intelligence in optimizing university sports information services from the three aspects of intelligent evolution information service, intelligent push information, and intelligent retrieval information, and the connotation of intelligent environment Analyze characteristics and technical support to promote the optimization and upgrading of university sports information services, research on the transformation of evaluation methods from manual evaluation to intelligent evaluation, and from standardized evaluation to differential evaluation, and specifically analyze the connotation of intelligent evaluation and differential evaluation, Features and key technologies, analyze the general process of intelligent evaluation, and summarize the implementation suggestions for intelligent evaluation [7]. Wu et.al. [8] show that the node prediction model is established by using the method described. Other influential work includes [9, 10].

According above description, we know if we use the traditional mtheds to monitor the sport, it will have many issues, but when the sensors come, this issues will be easy. At present, high-leve sports need many sensors to monitor all the characteristics of athletes is the trend of development in the future.

2.1 Research on Artificial Intelligence Technology

As early as the 1950s, the research on artificial intelligence technology began. Alan Mathison Turing, the "father of artificial intelligence", believed that it would not be difficult to manufacture intelligent machines in the future human society. He pushed down the possibility of producing intelligent machines through the development of existing technologies, and proposed Turing standard as a method to verify whether machines are intelligent, This pioneered the research of artificial intelligence technology. In 1956, the term "artificial intelligence" was formally put forward for the first time in the summer artificial intelligence seminar in Dartmouth. This is the first seminar held for the study of artificial intelligence. This seminar has become the symbol of the birth of the concept of artificial intelligence. At this seminar, artificial intelligence is considered to be an intelligent machine, The key technology is to realize intelligent computer program [11].

The research on artificial intelligence technology in China has been gradually enriched in recent years. Huang Xu and Dong Zhiqiang believe that artificial intelligence technology is an intelligent machine or intelligent system, which simulates human's ability to perceive signals and make decisions through designed programs and algorithms, so as to assist or replace human beings to complete the work that only human beings could do in the past. Further analysis of artificial intelligence technology, Tang Yonghe and Zhang Xian believe that there are two important dimensions of cognition and practice in the use of artificial intelligence technology. In the cognitive dimension, artificial intelligence technology simulates the cognitive process of human beings from signal transmission to acceptance through the designed intelligent program, giving intelligent machines a certain cognitive ability; In the practical dimension, artificial intelligence technology can transfer the information obtained through cognition to the machine, so that the intelligent machine can complete the instructions given by human beings. According to the degree of intelligence realized by artificial intelligence technology, Zhang Xian's film divides the development stage of artificial intelligence into low artificial intelligence stage, high artificial intelligence stage and super artificial intelligence stage. Point out now. The development of artificial intelligence is still in the initial stage of "weak artificial intelligence". The cognitive and practical abilities of intelligent programs and intelligent machines were further improved.

2.2 On the Connotation of Internet Plus

Corporate leaders, scholars and politicians combine their professional backgrounds to explain "Internet plus", and analyze their connotation. Internet has defined the connotation of Internet plus mainly in the following situations:

(1) "Cross border integration" theory

Mr. Ma (Tencent Holdings)'s CEO has repeatedly mentioned and discussed Internet plus. In 2015, Internet plus became the engine of China's economic and social innovation and development. "Internet plus" is based on the Internet platform and adopts ICT and industry integration. This will promote industrial upgrading, create new products, new enterprises and new models, build a new ecology, and effectively promote China's economic and social development. Internet plus is the

combination of Internet and other traditional industries. In recent years, with the increase of the number of Internet users in China, the Internet penetration rate has reached 50%. In particular, the vigorous development of mobile Internet has had a far-reaching impact on other Internet industries. Stronger and stronger. According to the founders, directors and CEO of American technology companies, Internet Plus combines Internet technology with internet thinking and the real economy to promote the transformation, value-added and efficiency of the real economy.

Deputy director of the national information center of Ying Jia County said that "Internet plus" refers to the dissemination and application of the next generation of information technology, such as the Internet, cloud, Internet of things, big data, and so on. It is a process of deep integration. In the field of economic and social life, it will have a huge, far-reaching and far-reaching impact on human economy and society. Ma Hua lanterns, Robin Li, Lei Jun and other enterprises are closely related to the Internet. Based on Internet technology, Internet managers emphasize the value of the Internet at the technical level and the integration and combination of the chemical reaction between the Internet and other industries. This is a traditional industry. It has a broad and far-reaching impact on the real economy and economic society.

(2) "Technology upgrading" theory

Professor Huang of Peking University said that the Internet includes not only manufacturing, but also e-commerce. Industrial Internet, network finance and Internet plus innovation are two upgraded versions of technology integration. Not only industrialization, but also the Internet, as an important feature of information development, is closely related to industry, commerce and finance. Internet plus Internet plus is Internet plus, Internet plus, Internet professor Fu Zhilong, Tsinghua University professor.

3 Data analysis

3.1 Data Sources and Research Methods

This paper studies the development and application of artificial intelligence in sports in a broad sense, and selects "Sports" as the explanation of "Sports". Artificial intelligence is widely used in the field of sports. The keyword "artificial intelligence movement" alone can not fully reflect the research status in this field. Through literature retrieval and expert consultation, the current research fields in the field of artificial intelligence include mechanical learning, deep learning, natural language processing, knowledge representation, machine reasoning and so on. Computer vision and robotics. Among them, mechanical learning, deep learning, natural language processing and computer vision have become research hotspots, and have penetrated into the field of sports.

$$P_{n-1}(k, L) = t_{n-1}(k, L) + qC_{n-1}(L) \tag{1}$$

$$P_{n-1}\left(k, m^{*}\right) = \min\{P_{n-1}(k, L)\} \tag{2}$$

According to the analysis of the city space V software, because the related literature first appeared in 1995, the time slicing is selected from 1995 to 2020, the time slice is

1 year, the node type is "account", the threshold item is "topn = 50", and the others are the default values to get the co-occurrence network map (Fig. 1). The size of circle radius and the thickness of node connecting lines are directly proportional to the number of papers and the degree of connection.

Fig. 1. Distribution of sports AI research countries (regions) from 1995 to 2020

3.2 Subject Distribution of Sports Artificial Intelligence Research

Artificial intelligence involves a wide range of disciplines, such as philosophy, cognitive science, mathematics, neuroscience, physiology, psychology, computer science, information theory, cybernetics, etc. When setting the analysis parameters of city space V, the time is divided into 1995–2020, sliced every year, the node type is "category", and the threshold item is "topn50". The results are shown in Fig. 2. The top five papers were Computer Science (219), engineering (15), Computer Science (Artificial Intelligence) (107), engineering (electronic and electrical) (104) and Sports Science (100). In terms of centrality, engineering (0.66) was significantly higher than other disciplines, followed by Computer Science (0.34), sociology (0.18), Sports Science (0.16), Economics (0.13) and Mathematics (0.13).

$$(E(t) - M_2C)\Delta\dot{x}_{k+1}(t) = f(t, x_d(t)) - f(t, x_{k+1}(t)) + B\Delta u_k(t) - \left(\Gamma_{p1}C + M_1C + M_2C\right)\dot{x}_d(t) + \Gamma_{p1}C\dot{x}_{k-1}(t) \tag{3}$$

According to this analysis, computer science and engineering firmly occupy the top two of the number and centrality of published articles, and sports science is also in the top five, which further, and based on engineering, develops artificial intelligence equipment and applies it to the field of sports science. Generally speaking, sports AI technology "comes" from computer science, "transforms" in engineering "and" goes "in sports

science. In addition, it is worth mentioning that sociology, economics and mathematics, with only about 10 papers published in history, have attracted great attention in 2020. Among them, there was a sudden increase in the centrality of articles in Sociology in 2016. For example, alphago defeated Li Shishi, a professional nine stage chess player in 2016, and what role human beings will play in the field of sports in the future has aroused sociological thinking on the development of sports in the world. Mathematics and economics have attracted much attention in the field of sports artificial intelligence since 2017. Advanced mathematical algorithms provide the theoretical basis and guarantee for the development of sports artificial intelligence technology, while economics widens the capital channel for the future development of sports artificial intelligence.

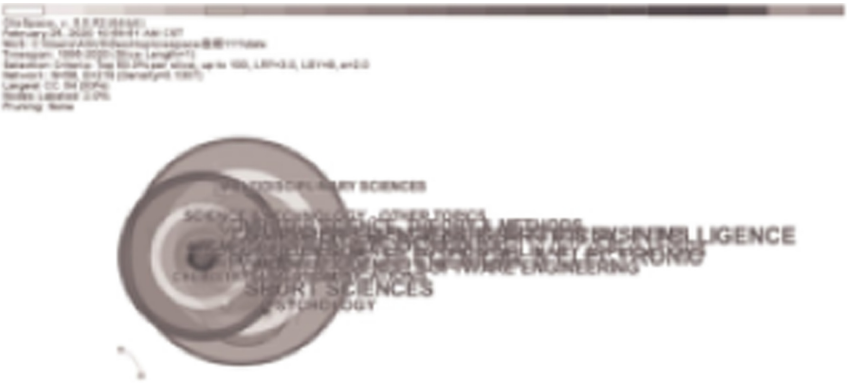

Fig. 2. Network Atlas of main disciplines of sports artificial intelligence research from 1995 to 2020

3.3 Key Words Analysis of Sports Artificial Intelligence

Based on the co-occurrence diagram of keyword research hotspots in Fig. 3, the time node surge diagram of six highly cited key words in recent years is generated by using citespvev software, as shown in Fig. 4. The six keywords with the highest burst intensity are tracking (2009–2013), physical activity (2011–2015), artificial neural network (2011–2013), valdiy (2011–2015) (human body), energy expenditure (2011–2013) and action recognition. In addition to gesture recognition, the other five words appeared intensively from 2011 to 2013. What is the relationship between these words? Analyzing the representative literature, such as staudenmayer, developing and testing two artificial neural networks and applying them to the uniaxial accelerometer to collect sports activity data, and analyzing low-intensity exercise, strenuous exercise and housework, it is considered that the application of neural network to the accelerometer in sports recorder has a wide application prospect. Based on the original data of genea (gravity estimator for normal daily activities), Zhang's team successfully developed a wrist accelerometer model suitable for walking, running, home or sedentary activities. Its performance is comparable to that of the traditional waist hip accelerometer, and finally used for physical activity evaluation.

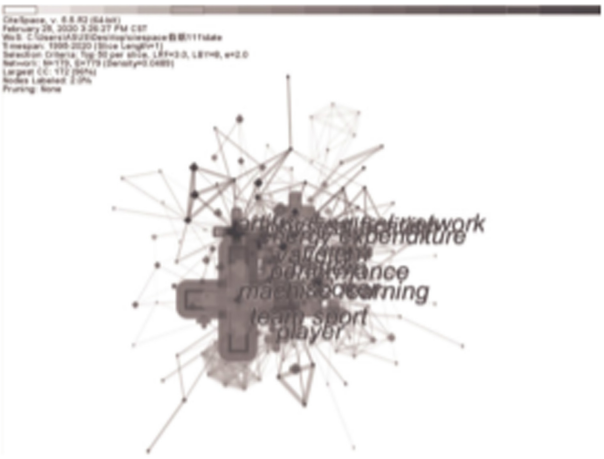

Fig. 3. Hot spots of sports artificial intelligence research keywords from 1995 to 2020

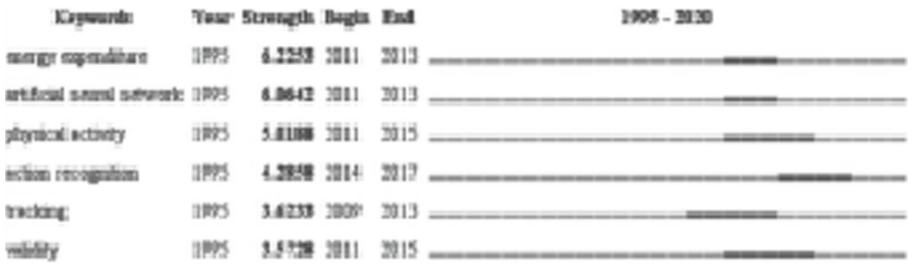

Fig. 4. Network Atlas of main disciplines of sports artificial intelligence research from 1995 to 2020

Through the above literature analysis, the emergence of these six keywords has a strong correlation. Since around 2011, based on the theory of artificial neural network technology and human energy consumption as the index, a series of research on efficient identification and tracking technology of physical activities have been carried out, and finally the terminal carrier of intelligent Tibet piercing equipment has been realized. Based on this, researchers have seen and learned, broadened the development direction of technology and theory, and driven the efficient combination and deepening development of sports and artificial intelligence.

4 Clustering and Evolution of Sports Artificial Intelligence Research

4.1 C1 Knowledge Group: Simple Activity Recognition and Energy Consumption Based on Accelerometer Technology

C1 knowledge group is the # 1 cluster "validity". The application of a technology, its reliability and effectiveness is the basic guarantee. In the early field of sports artificial

intelligence, the simple and effective monitoring and evaluation of human motion state is a research hotspot. From the time line chart of highly cited literature, we can see that the relevant theoretical research focused on 2004–2012, and it was during this period that five prominent keywords appeared. Since then, the related research has gradually faded out of the field of vision, instead of the in-depth application of intelligent sensors in the analysis of technical characteristics and spatiotemporal parameters of action. In the two high school mind and highly cited papers of this knowledge group, Crouter et al. 19's paper "a novel method usngaccelerator data to predict energy expenditure" established a new binary regression model of artificial neural network, It is proved that the new algorithm is more accurate than the traditional actigraph accelerometer in predicting energy consumption. Staudenmayer et al. M's paper "Journal of Applied Physics" developed and successfully tested two kinds of artificial neural network models which can be used to collect physical activity data and applied to uniaxial accelerometer, and tested the behavior of 46 subjects. Finally, the recognition accuracy of human action through the amount of metabolism reached 88%. These two papers are innovative to establish the artificial neural network model, which makes the judgment and recognition of action type and energy consumption more efficient and practical.

4.2 C2 Knowledge Group: Computer Scene Classification Based on Convolutional Neural Network Algorithm

Related scholars also put forward many other artificial neural network implementation methods. For example, the depth image segmentation method based on Kohonen neural network can be applied to the selection of swimming far mobilization, handball tactical mode selection, swimming competition performance prediction and other competitive sports fields. Girshick applies the artificial neural network grammar model to human detection, which can recognize the part of the human body that is occluded or whose posture and appearance change. It can effectively solve the problem of human detection in pascal-voc data set. The variable detection model developed by Pedro can also realize the target location in chaotic images.

On the basis of the research of C2 knowledge group, the computer vision technology based on machine learning in the field of sports sports has begun to develop rapidly. This knowledge group began to use computer vision analysis technology to try to analyze various data in sports, especially team sports, and achieved good results. Osgnach et al., the author of the first central article, creatively used video matching analysis technology to evaluate the physical performance of professional football players. Based on the video analysis of 399 Serie A players running on the field, this paper evaluates the instant metabolism ability of top football players, so as to redefine the concept of "high intensity" according to the actual metabolic ability rather than just according to the speed. He also assumed a model combining video matching analysis of official matches with GPS of training, which can conduct a more in-depth study on the differences related to match position, ranking and fatigue degree in a single match or football season. This broadens the field of vision for the further study of wearable sensors in the future. In his subsequent research, he further improved the collection technology of complex terrain "acceleration" data.

5 Conclusion

This paper studies all the current databases and resource databases. From their various characteristics, we can find that if we combine the current college students' own characteristics to select the corresponding projects, the success rate will be higher. Moreover, the current e-commerce is a project integrating multiple advantages, which can not only improve the ability of College students to start their own business, And it can make the project land faster, which is also very good. It can apply their knowledge to practice.

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