Application Analysis of Badminton Intelligence based on Knowledge Graphs

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Abstract

With 346 web of science core databases of "badminton", "data mining", "artificial intelligence", "motion Based on Citespace software, this paper visualizes and analyzes the application effect of national fitness intelligence, thus revealing the research trends, research focus and evolutionary paths and directions of data mining. Findings: 1) China is the 'leader' in terms of research contributions, leading the way to a certain extent in research on the wisdom of modern badminton. In terms of other contributions, the top two are Malaysia and Taiwan. However, one of the regions where research is relatively weak is Africa. Research strength in Asia is concentrated in China, Taiwan and, Malaysia, while other regions are relatively weak, and the level of research related to badminton combined with big data in China needs to be improved.2) Highly productive authors and teams of related sports AI research focus on US universities, with the main research direction being the development and improvement of intelligent sports equipment for different groups based on machine learning and deep learning techniques.3) Related Research disciplines such as sporting events, sports industry, and correlative forecasting are leading disciplines in research focused on the application of smart badminton. Researchers in physical education and teaching contribute relatively little to the role of big data in badminton.4) Hotspots in badminton smartening research fall into four clusters, namely big data and related technologies, artificial intelligence monitoring indicators, big data and data mining related applications, and smart sensing badminton teaching. Sport forms and populations, data mining techniques and methods, and research methods are the inevitable effects of digital empowerment and the wisdom of sports for all.

Keywords: artificial intelligence; badminton; machine learning

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Introduction

The current research on the application of artificial intelligence in badminton in China is still at the initial development stage, and the integration of various aspects of information technology with badminton is still very rough, and there is a lack of mutual support through the technical staff. Therefore, it is becoming increasingly important to design and implement your own set of end-to-end badminton system management by combining AI and other relevant information technology with better development of badminton. Artificial Intelligence (AI) is the application of machine learning and deep learning in practice to make machines as intelligent and thinking as people. Artificial intelligence is better understood as a national industry, referring to the software and hardware that make the production of life smarter[1]. Data mining, on the other hand, is the

non-trivial process of extracting valid, novel, potentially useful, plausible and ultimately human-understood patterns (patterns) from large amounts of data. The ability of machines to learn refers to the study of how computers can simulate or implement the behaviour of our human learning lives to acquire new knowledge or skills, and machine learning is the study of computer network algorithms that can be improved automatically through social experience.

1. Overview of relevant concepts

1.1 Big data analysis techniques

Big Data analysis is the study and analysis of data, obtained from computer information systems. People may not understand the "why" of things, but they can know the "what" of things in terms of status, trends and results[2]. However, for big data analysis companies, the key technical research issues such as analysis and arithmetic have not been the main technical bottleneck due to the huge scale of development of information data for analysis[3].

The bottleneck lies not only in the front-end access to data analysis, but also in the back-end business development of the main issues of modeling and computing under the ideological and political guidance. In the early days, various OLAP technology tools were almost sufficient, while later research technology tools, such as hedup, have completely lowered the structural cost and technical threshold for distributed statistics, pushing big data analysis into a broader field altogether[4]. At the level of technology and technology corporate culture, the main difference between the big data analysis market and the past data can analyse the Chinese market in the information network era of students is that the process of finding applications/algorithms for big data analysis in the past (e.g. big centralized resource management work projects for major commercial banks, and other related data environment analysis build-ups), and in the booming history of the big data analysis market economy One of the most important factors that characterize the technology companies in the booming history of the Big Data Analysis market is the process of finding Big Data Analysis through real applications/algorithms, and therefore the size of the market for these Big Data Analysis has become the biggest challenge to improve the technology of the companies[5].

The basic features of big data analysis are as follows: (1) Big data analysis is not the same as big statistics. The basis of our problem solving is all data information of the problem, but non-sample data information, i.e. the sample is the total number, there is no causality, only correlation. (2) There are many possibilities for the application of big data analysis technology: when text can become a data for information, human society is able to read and write through, and machine learning can improve classification; when location becomes corporate data, commercial network advertising, epidemic detection, Google search during the Ya'an earthquake, etc.; when communication becomes data, it will become a social graph. Any one of these issues can be quantified and the real world economy can be used as an ocean of data management information that Chinese companies can understand, creating a new perspective on our national development and corporate culture that has never been seen before[6]. (3) The social-economic value of data analysis innovation: the reuse of data analysis. For example, data analysis and reconstruction: thanks to big data analysis, the sum of all data analysis is more valuable than the parts, and the sum of the reconstruction results and itself is more valuable than the sum of the individuals. Expandable value of data: data information collection has been designed to be expandable to increase the potential market value of relevant data, depreciated value of data: data that is unusable and must be obsolete and updated; waste of data resources: for example, through speech

recognition, if we users believe that the speech recognition application misreads his intentions, it can be effectively improved by training management systems. In summary, the real value of big data analysis lies in the development of concepts and expressions through the classification and application of big data, rather than the use of more advanced technological tools and algorithms.

1.2 Analysis of sports intelligence data applications and their concepts

There is considerable complexity in the development of big data analysis and it is only through the use of the latest technological innovations in artificial intelligence data information analysis that data analysis can be effectively and efficiently managed[7]. There are already experts in the field of big data analysis to give the latest intelligent data analysis technology methods, such as HAVEN, TERA data Aster data analysis network platform, and some of the research has been carried out to find that the proposed big data analysis methods, but also basically can not be separated from the Hadoop big data analysis network platform. In general, HDFS uses a master/slave architecture[8].

The master architecture is called the name node and is mainly used to manage metadata, while the slave architecture is called the data node[9]. The main function is to store and manage application data related to the application. The richness of the data types supported by an HDFS system, often in excess of ten petabytes, makes it possible to use HDFS systems for a wide range of applications in big data analysis. In order to support Big Data analysis, the HDFS system can be supplemented by the HBase operating system, which has a Pig interface language role, and the HIVI management control system, which is generally used as an information technology repository for event prediction and analysis data processing. In addition, a machine learning software package called Mahout has been developed to provide effective modelling and data analysis for big data analysis of sporting events. The data analysis of this new intelligent system also integrates a number of sports cultural heritage technologies, allowing for a more comprehensive and efficient analysis of big data information[10].

2. Implications for badminton big data research

2.1 The significance of using big data in sport

2.1.1 Helpful in improving performance

Big data is used to analyse the athletic characteristics of athletes and opponents. There are a number of ways in which big data can be analyzed, one of which is by providing data through the player's relevant technology, such as wearing shoes, vests and bracelets with sensor devices to monitor the athlete's physical condition in real time and using the data to develop more targeted training methods. In addition to analysis athletes, consider data loggers, video replay analysis, and software information interpretation can all help athletes understand themselves and their competitors better, thus further improving their performance on the field of play. Coaches can also use big data analysis to make a more objective assessment of their own tactical performance and that of their opponents[11].

2.1.2 Able to prove its worth to sponsors

According to the sponsorship marketing research and consulting agency IEG statistics, in 2015 the global sports sponsorship will reach $ 40 billion scale. More and more stars and teams are taking social media seriously. c Luo's fan base on social media Facebook has long since grown to

over 100 million; Messi on Facebook at the same time, with 74 million followers[12]. On Twitter, Cairo has over 30 million followers, making him the number one icon in sport.

In the Forbes football player income list released in 2015, c Luo with 79.6 million U.S. dollars in total income ranked first, of which 52.6 million U.S. dollars in wages, advertising for 27 million U.S. dollars; ranked in the second Messi total income of 73.8 million U.S. dollars, 51.8 million U.S. dollars in wages, of which 22 million U.S. dollars in advertising income[13]. Luo and Messi between the first star of the battle. I'm afraid that until they both retire, there will be no definitive answer. However, in terms of sponsorship, Carlo has established a lead over Messi, which is inextricably linked to his social media dominance[14].

2.1.3 The combination with the Internet of Things explodes into life

The concept of "Internet of Things" is a network concept based on the "Internet concept", which extends and extends its user side to any object and object to exchange and communicate information. As Yang Jianbo said in his speech, "Wearable devices, such as the Xiaomi bracelet, Apple watch, and some products including sports combined with the Internet of Things are particularly numerous[15]. Why the sports industry uses big data, it is not only combined with the Internet, but also with the Internet of Things, so that the sports industry is a great direction."

2.2 Where badminton meets big data

2.2.1 Can be fully integrated with health data

"Many badminton rackets now come with Bluetooth and various transmission functions, so data like weight, heart, blood pressure, blood sugar, blood, urine, etc. can be displayed and transmitted to a mobile app[16].

When all this data is collected, it can be divided into several dimensions, of which sport is one dimension, health is one dimension, and some personal habits (sleep, for example) and so on[17]. Because in addition to running, the most people play badminton indoors, so the data from playing can be presented to accurately analyse the level of badminton of each person, so that it is easier to organize matches, invite more accurate, to make a national sports ranking (amateur, not professional), these may be interesting, just like WeChat sports, this piece I think is a great combination of points[18].

2.2.2 Precision in badminton training

"Create labels for all users through data mining, for example, if this user's level is beginner, the training institution will assign him a beginner coach, if his level is intermediate, assign an intermediate badminton coach, don't train beginner trainees every time the national team coaches, which is also a great waste of coaching resources[19]. If done better, the sports services are accurately recommended according to the ability of the trainees in each tier. So this is through the badminton racket can and mobile phones, and again directly (if there is Bluetooth, router in the venue) to transfer data to the cloud[20]."

2.2.3 Enhancing the spectacle of the event

As technology improves, the normal broadcast footage of events no longer meets the needs of viewers, and more perspective images and digital resolution become a more advanced enjoyment, the simplest example of which is the use of Hawk-Eye technology. So in the near future, "intelligent ball nets, ball position tracking and other such tracking technologies and IOT

technologies will be greatly developed". At that time, I believe it can bring an even more exciting experience to the audience.

2.2.4 Improved technical movements and targeted tactical setup

The intelligence of the court, the racket and even badminton allows coaches to identify players' problems in time for some targeted training. "For example, if you want to look at all of Lin Dan's match data and look at the data from when he played against Li Zongwei, this involves the analysis of the entire data. Just like the analysis of football data in the football World Cup in Germany, there is a lot of extensive analysis that will be used for the tournament."

"Then badminton statistics of various data functions can be more powerful, such as rest 5 minutes can analyze a data, who is your strongest opponent, who likes to change the pass, like to play left or like to play right and so on, this piece will actually have a lot of use out, especially in some professional games to help the coaching team, each coaching team may need this match function."

3. Data sources and research methods

3.1 Data sources

The three databases, CNKI, Web of Science and IEEE Top Conferences, are highly representative of the badminton literature in China and Malaysia. The IEEE Top Conference on Badminton by Malaysian athletes and scientific experts is currently the most authoritative international database on badminton sports science, including international badminton sports data mining, badminton vision-related literature, conferences, research reports, etc., covering badminton track sports, badminton event result prediction, badminton robotics research:Web Web of Science is the world's leading interdisciplinary citation database containing the world's most authoritative SCI, SSCI, AHCI 3 major citation index database contains a variety of world authoritative, high-impact academic journals and tens of thousands of international academic conference proceedings.

It covers natural sciences, engineering and technology, biomedical sciences, social sciences, arts and humanities, etc., while CNKI is the largest database of academic papers operated in China, which includes academic papers from various disciplines in China University Research Chronicle journals from major libraries in China.

3.2 Research Methodology

Based on the volume of literature in the three major databases of badminton big data related papers and included papers, and the scope of applicability of scientometrics, the analysis of 46 papers in the direction of badminton big data used a combination of scientometrics and literature analysis, and the analysis of 10 papers in the direction of badminton data mining mainly used literature analysis. Specifically. For the econometric analysis of the papers related to badminton big data applications, econometric methods such as posting trends and keyword co-word analysis were used and scientific knowledge maps were drawn with the help of Cite Space, a visualization software developed by Dr Chaomei Chen, an information visualization expert from Drexel University in the USA, which is the most distinctive and influential visualization software in the world of information analysis in recent years. As the Cite Space software can only directly import the format data of Web of Science using self-programmed format data of CNKI and IEEE conference in accordance with Web of Science to unify the formatting process. And draw the

keyword co-word network knowledge map of badminton big data in recent years. In the analysis of badminton big data papers. The 46 papers were firstly read carefully and categorized according to the badminton vision application direction, and the important directions of badminton in the computer vision application range were extracted.

4.Badminton sports training data application clustering and its keyword analysis

4.1 Data analysis process

The management of the data analysis process can be very simple in terms of how to make predictions about what indicators are reflected in the simulation of events in sports training. For example, the most critical indicators in competitive sports teaching are the intensity of training, the increase in experience, the increase in performance, the increase in excellence and so on[21]. There are different types of data that can be used to track the development of physical culture and sport, so there are different types of key KPIS that can be used to understand the specifics of student sports training. However, as long as you have been in an industry long enough to understand the routines of the sport, you will almost always do it the same way. As far as data analysis is concerned, if the organizational divisions of a sporting event are more finely divided (for example, there may be modelling groups), then the indicators for sport analysis will probably always be doing data processing[22].

Regarding the analysis of badminton for psychological modelling, you are required to have a further understanding of the research issues related to badminton projects to the point where we can model several aspects of the problem through the enterprise (e.g. structural models of badminton technical management systems) and so on.

4.2 Motion data analysis techniques

Sports data analysis techniques include: (1) technical skills in sports database systems. The more comprehensive the better, as long as the non-technical, at least to be able to SELECT some simple search language. (2) Technical skills in EXCEL, PPT, SPSS, etc. Event coding table representation is usually in the form of Excel and PPT, preferably in the form of SPSS, so that you can set a lot of manual work to automatic work ability, thus greatly improving the efficiency of badminton sports technology and training, sports coaches impressed by you, but also have more free time to do other work. (3) Badminton tournament analysis skills. Learn to see trends in badminton events, pay more attention to event specifics such as training metrics and intensity, and now that everyone is so keen on Bayesian algorithms for feature vectors, you'll need to master the appropriate image analysis methods and visual processing methods. No one will tell you everything. You should also be able to improve their own theoretical knowledge of the relevant technology expertise in big data management through self-learning. (4) Have some basic knowledge of computers. Because we can analyse data from the above badminton or sporting events, i.e. some elements of sports project information management, and finally the issue of sports teamwork skills. Familiar with the basic computer theory knowledge, to do big data for analysis students is very practical to say. In a nutshell, we can say that data analysis = technology + sports market + trends + analysis strategies.

4.3 Analysis of the design of big data systems in the badminton training process

The sport of badminton is characterized by its skillful and tactical nature, and the Big Data system designed on this basis includes a mobile module and a server module. The latter can be subdivided into a permission management module, a training database module, a training

monitoring database module, an auxiliary information management module and an extraction and integration module for skills and tactics[23]. Each module has a personalized data collection object and processing method, such as the clinical monitoring and statistics module is mainly for the systematic collection of badminton players at all stages of training, and finally in the form of data, graphs and tables to display the number of rounds, the total number of shots, the average number of shots, the average time and the average score of the training, etc., while the tactics demonstration module is based on the opponent's personal sports characteristics and the selected tactical characteristics.

The Tactical Demonstration module is used to determine the best attacking and defending tactics based on the opponent's individual sporting characteristics and the chosen tactical characteristics, combined with the athletic characteristics of the player[24]. The mobile and server modules are at the heart of the badminton training big data analysis system, forming a complete process of data input, processing, storage and output. Specifically, data is entered into the mobile module and after a simple presentation of the statistical results, the training data is transferred to the server function and stored in the module. When the user enters an information request, the server function module completes the integration of the information in accordance with the instructions and presents it in the form of intuitive data, graphs and tables on the interface.

4.4 Analysis of the collection of big data during badminton training

Big data systems are based on the collection and analysis of large amounts of data and information, so the collection of data and information about the badminton training process is an integral part of the construction of a big data system[25]. Combined with the actual situation of badminton training, for each badminton coach, data statistician design an account and password, can be completed individually for the entire training process of badminton players or a single technical data collection, but also by several people at the same time to complete the data collection, and finally after the system of "compromise calculation" or "conflict confirmation" to complete the collection and storage of data information, can fully ensure The standardization of badminton training data collection.

The system automatically imports information about the player's name, selected area, score type and technique type, and automatically updates data about the player's options in direct score, active errors, pressing errors, non-pressing errors and total score. This maximizes the systematic, accurate and efficient data collection.

5.Badminton smart teaching clustering and its keyword analysis

5.1 Analysis of the badminton smart teaching data environment

Although the traditional sports intelligence approach to data analysis and research cannot be used to meet the needs of enterprises in the current era of big data information, there are still some similarities and relevant big data theories and techniques that can still be chosen to use several common methods of teaching data environment analysis:

The first is the decision tree approach. This approach to data analysis techniques needs to be based on the foundations of sports information theory and the output that can be achieved by this teaching method is easy to grasp and more accurate and effective, but it cannot be used for the many efficient processing techniques and processing of sports data and data analysis in badminton[26].

The second approach is the Chinese sports event correlation rule. This problematic approach

can be used primarily to analyse databases for predicting badminton events, as they often involve big data, and is currently used by companies to reduce the redundancy of tournament predictions[27].

The third approach is the rough set and clustering algorithm. This approach to situation analysis research allows for a subjective assessment of the feature vector output of the movement performance information system, which can effectively eliminate redundant data beyond other movement techniques simply by looking at information about the badminton movement control technology enterprise.

The fourth method of technical analysis is the mathematical ability analysis of technical ambiguity in badminton. This method of statistical technical analysis and research allows for a more ambiguous classification of practical developmental problems in badminton matches and daily training, and allows for more objective results than other methods of technical analysis and teaching in sport.

The fifth approach is an artificial intelligence neural system network. This type of big data analysis requires unsupervised student learning and education functions, in addition to memory association and storage of badminton movements.

The sixth approach is a chaotic fractal theory. Both of these doctrines can be used essentially for students to understand the phenomena that arise in competitive sports. It is commonly used in the study of intelligent perception and can also be used in many areas such as automatic control.

The seventh approach, for the natural computational ability analysis research approach. This method of teaching classification of information data is aimed at modelling and simulating information on different technical aspects of sport in competitive badminton, and generally we can divide it into these three different categories of analytical solutions: one is clustering intelligence two is exercise physiology immunology calculation, and three is Bayesian feature algorithm. Clustering algorithms generally study group action characteristics, sport physiology immunology calculations generally have athlete biodiversity, and classical algorithms generally have reverse, clonal selection, etc., while the common Bayesian algorithm is generally a random feature search method, but also can be a good effect of the sport global feature search method, in practice are generally able to get the optimal search space, and in In practice, the optimal search space can be obtained, and the search direction can be adjusted on the basis of this, and the whole process does not require specific rules. Currently, Bayesian algorithms have been used in many industries and have achieved good results.

5.2 Analysis of big data-assisted badminton teaching processes

The use of smart sensors to assist badminton teaching requires teachers to actively create a research-based learning model and to try to be purely guided. Students are encouraged to make full use of the real-time numerical feedback provided by the sensors during practice (e.g. stroke speed, force, curvature) and the assessment of movement standards to form a conscious self-evaluation and to explore standardized badminton technical movements, appropriate power delivery and timing... Through the effective collection of kinematic parameters during the swing, students are encouraged to discuss and communicate with each other to Deepen the understanding and grasp of the correct technical movements of badminton and return the students to the main role in the classroom[28].

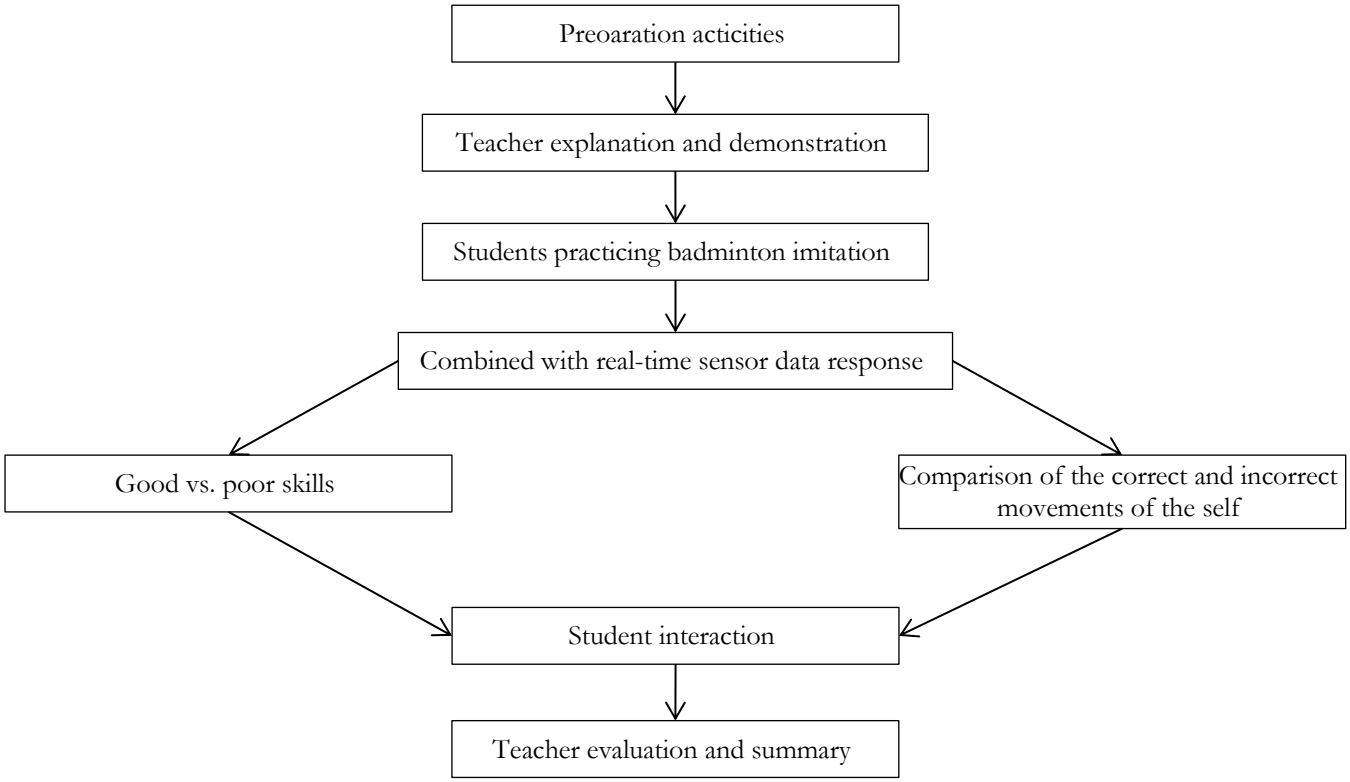

Figure 1 Flowchart of smart sensor-assisted badminton teaching

5.3 Analysis of teaching data processing for badminton big data

Big data processing in the badminton teaching process Big data processing, i.e. the calculation of big data, is the process of converting raw data information entered by coaches, players and data collectors into information that can be used and has guidance value after some processing. It is also the process of automating the processing of big data systems[29].

The processing techniques and processes depend on the pre-setting of the staff and need to be specifically planned according to the characteristics of the big data system and the characteristics of badminton. The staff should do the following in the process of designing the big data information processing system.

Firstly, systematically sort out and summarize common or needed functions, and have a clear and comprehensive pre-setting for data processing results, which will be used as an important basis for constructing the functional framework of the big data system and the functional layout of the page modules. For example, badminton players' regular activity areas, habitual sports postures, frequently used sports techniques, regular sports route trajectories, common reasons for losing and scoring points, actual sports effect information, etc. Each instruction or each function should correspond to a page button to facilitate coaches and players to enter data information, find and output the situation. In the process of daily operation, athletes and coaches can also delete or add some new function keys and function modules conveniently with the application experience, so that the system can be updated in a timely manner to better meet the needs of data processing.

Secondly, coaches and athletes should further subdivide each function key and function module into many different data information indicators, select indicators according to the needs of data analysis and use, complete data processing work in the system and output core information content. For example, the sports technology module can arrange the front court, middle court and back court technical situation after entering the lower page, and then further refine the front court

technology into common skills such as rubbing, pushing and hooking, further refine the middle court technology into skills such as blocking, pumping, blocking and bouncing, further refine the back court technology into common skills such as hanging, high and killing, and match each technology with time, place, status and so on This allows badminton players and coaches to access, recognise and use the output of big data in a clearer and more understandable way.

Thirdly, in badminton, a player's scoring ability is closely linked to stroke technique, movement path, activity area and posture, so a quantitative attribute discretization algorithm with a multidimensional correlation can be used to extract, process and output the big data information results to complete the data calculation more accurately. In the first step, the quantitative attribute discretization algorithm is used to calculate. It should focus on correlation size for the planning of each type and level of data in the big data system, described by Arabic numerals, and eventually construct a set of database system from high to low, where correlation relationship exists.

In the second step, the whole database system is scanned at once, and the specific attributes and levels of the relevant information in the database system and their corresponding data processing results are finally obtained. In the third step, a minimum confidence value of 60% is set, and data greater than or equal to 60% are automatically set as correlated data according to a pre-selected data calculation formula, ultimately forming an extractable data sample system, which is automatically output to the interface after calculation, enabling coaches and athletes to visualize these data processing results[30].

6.There is a study on the application of badminton in the direction of data mining and its research

6.1 Potential links between location and points scored and lost

6.1.1 Improved AGNES hierarchical clustering algorithm

Zeng Jiajun in "Application of Improved AGNES Algorithm in Badminton Technical and Tactical Analysis" applied the AGNES algorithm to badminton, using an improved AGNES hierarchical clustering algorithm in data mining to mine the relationship between technical tactics and points scored and lost. Conclusion:Compared with traditional methods, the application of computer technology and data mining algorithms in badminton technical and tactical analysis can analyse the technical and tactical characteristics of badminton players based on a large amount of historical match information. During live matches, it can be better and more accurate[31].

This will help coaches and athletes to make technical and tactical adjustments. For pre-competition preparations, it is possible to carry out more comprehensive and specific technical training for Chinese athletes.

6.1.2 Improved APriori association law algorithm

Song Weijiao in "Data mining technology based on badminton player training pattern optimization analysis and research" designed a system to collect data, improve the Apriori correlation law algorithm and apply it to badminton data, and conduct simulation experiments[32]. The main works are: 1. A unified and comprehensive badminton database was established. Data collected by data mining techniques were used for in-depth mining. 3. Apriori association rule algorithm was improved. The problem of data for in-depth analysis was solved, and the results could be applied to badminton training to specify personalized learning training research programmes from a heavy technical and tactical perspective, solving the problem of lack of

relevant data to support the guidance of individual training methods. For the first time, the improved algorithm is applied to badminton data and simulation experiments are conducted[33].

6.2 Correlation analysis of potential links between approach, pace, score situation, etc. and points scored and lost

Bo Yao, Na Liang in 'A smart position optimization scheme for badminton doubles based on human-computer interactive training in wireless sensor Networks In "A smart position optimization scheme for badminton doubles based on human-computer interactive training in wireless sensor networks", we investigated badminton multimedia technology and tactics for statistical analysis, collected data from players playing with a Kinect sensor, and carried out sports simulation for optimization. The Kinect sensor was used to collect data from the players during play and to optimize the motion simulation[34].

A gait-touch based digital field combined with video was used to obtain relevant data and to draw statistical conclusions. An experimental study was carried out: the analysis of these data led to the following conclusions: the duo combined hitting and catching was more effective, both accounting for about 90%; the direct scoring rate was low; the main problems in the development of service work areas were concentrated in the first and fifth areas, combined with the changes in the other four areas of the enterprise, and the service information technology was mainly based on pushing; among the nine catching areas, the catching areas in the middle of the field of No. 2 and No. 5 were the most numerous[35].

6.3 Analysis of machine learning methods to predict match outcomes

Manoj Sharma, Monika et al. proposed a machine learning based method for predicting the outcome of badminton matches in "A feature weighting technique based on plain Bayesian correlation for sports match outcome prediction". In this paper, a supervised learning method with feature reduction techniques is proposed to predict the outcome of badminton matches. Fourteen salient features are selected as input predictors for a machine learning classifier to predict badminton match outcomes[36].

The performance aspects of the classifier that matched the results of the study for prediction were analyzed and evaluated, including accuracy, root mean square error, receiver operating environment characteristics and other confusion matrix parameters. The results of matching with the simplified features were analyzed and compared with the full feature dataset. It was found that the Naïve Bayes classifier based on correlated feature weighting showed significant performance in the prediction of matching results for the approximately simplified feature dataset compared to other classifiers.

7. Applications relating to the field of computer vision for badminton

7.1 Analysis of the video stream and its application to the tee

Liao Tingbo in "Application Research on Badminton Detection Tracking and Trajectory Prediction Algorithm Based on Video Streaming" used 1. Badminton recognition by combining three frame difference and machine learning AdaBoost algorithm 2. Improving deep learning one stage detection Tiny YOLOv2 from both loss function and network structure to obtain badminton detection network M-YOLOv2 and YOLOBR 3. According to badminton coordinates obtained by FTOC algorithm, combined with least squares and Kalman filter to predict the trajectory of badminton in the video stream, solving the problem that badminton serve players can

only train athletes to hit various serves repeatedly. Lack of an effective visual feedback system and low intelligence[37].

7.2 Analysis of machine vision and its badminton robot application for detecting serve overhand infringements

In "Design and implementation of machine vision based badminton serve violation detection system", He Huang designed and implemented an overhand serve violation detection system using 1. adaptive enhancement variant algorithm to train data classification management model 2. state discrimination model using image angle representation method[38].

Jie Yang, Xianglong Ji et al. "Stochastic energy saving strategies using machine learning for badminton robots" presents two control methods to improve energy efficiency for robots that need to perform point-to-point movements within a given cycle. The first method is based on adaptive approximation. The first approach is based on the Adaptive Approximate Energy Optimized Servo Algorithm (APEOSA), which optimizes energy efficiency parameters. The second strategy is the use of a model predictive control strategy (MPCS) for energy management. This technique was invented for badminton robots. The robot can still intercept multiple competing transport cells in time and in both cases there is a significant reduction in energy consumption, which has been minimized in the experimental analysis. Compared to APTOS, EOMPCS and APEOSA achieve the same positioning error as EOMPCS and APTOS, allowing for a huge energy saving of about 40%[39].

The results of this study by N A Rahmad1, M A As'ari et al. in Automated badminton smash recognition using convolutional neural network on the vision based data 》 suggest that GoogleNet pre-trained CNN models are the most suitable models for automatically recognizing smash movements and providing information to the coach for further symbolic analysis. The results of this study show that it is possible to develop an automated action recognition information system by using a deep learning approach. With a limited amount of data, the pre-trained GoogleNet model can be used to automatically recognize smash moves from broadcast videos obtained online[40].

7.3 Analysis of visual response systems and their validation of athlete detectability

Kuei-Pin Kuo1 , Hsun-Heng T sai et al. in Verification and Evaluation of a Visual Reaction System for Badminton Training, the two aims of the study were to (1) design and develop an affordable badminton training visual reaction system that monitors and provides immediate feedback on agility[41]; and (2) to measure and improve badminton players' footwork and movements, outputting useful reference data. This study involved 10 badminton student-athletes. They participated in a three-week (nine session) training programme. The training was mainly through fixed or randomized footwork exercises. A timed systematic test was administered before and after each study training student to measure the agility of Chinese athletes when performing 6- and 4-point footwork exercises. The results were compared to training results calculated using sample-dependent tests. In addition, the long-term durability and functional aspects of the training management system were also analysed and tested. The training management system was designed to be able to maintain stable and reliable training and evaluation operations through the long term. The results showed significant improvements in visual reaction time ($p=0.003$) and agility ($p=0.001$) for the athletes[42]. The proposed training system is an affordable option for training

and for monitoring, evaluating and recording training. It allows for accurate recording of movement and response times and simulates a corporate competitive market environment.

Hawk-eye technology in badminton refereeing, the official name of the "Hawk-eye" is "instant review system", the system consists of 8 or 10 high-speed cameras, four computers and a large screen. The computer calculates the three-dimensional development of the field of play into millimetre units of measurement, captures the basic realization of the tennis ball's flight path from different angles at the same time using the information high-speed cameras, and then plays the three-dimensional target image on a large screen. The teaching process takes less than 10 seconds for the entire operation and playback[43].

The development of Hawk-Eye technology has to a certain extent reduced the probability of miscarriages of justice and made the game more impartial, but the impact it has had is also evident to all. With the development of science and technology, the progress of society and the improvement of people's appreciation, the use of high-tech means to assist the referee's decision will become the development trend of badminton[44]. At the theoretical level, the Hawk-Eye system is a comprehensive application of relevant expertise in disciplines such as air dynamics, imaging, graphics, information and communication, 3D model reconstruction, etc. The core teaching challenge is how to simulate the spatial trajectory of a ball, determine the development of a ball's running path, achieve precise positioning and tracking of the ball, and then calculate the ball along this trajectory and where it will land. Although Hawkeye technology is currently a high monopoly, it is believed that if the commercialization of the competition can be combined with the integration of research forces and investment in R&D funding, China will be able to develop a Hawkeye system with perfect performance and independent intellectual property rights in the near future[45].

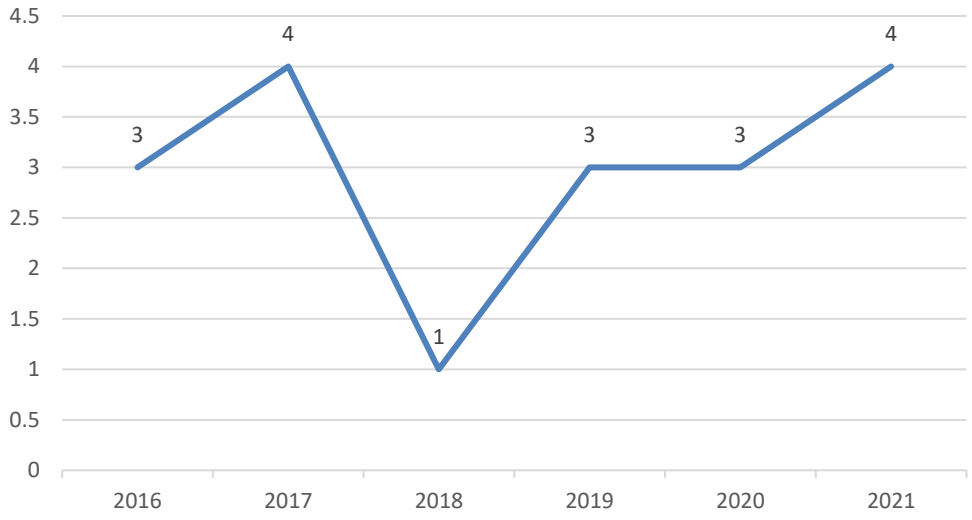

Figure 2 Trends in badminton postings in big data-related applications in 2016-2022

8. Badminton research trends in the direction of big data

Liao Tingbo in "Application Research on Badminton Detection Tracking and Trajectory Prediction Algorithm Based on Video Streaming" used 1. Badminton recognition by combining three frame difference and machine learning AdaBoost algorithm 2. Improving deep learning one stage detection Tiny YOLOv2

As shown in the figure, from 2016-2022, the number of articles published in China Knowledge Network in 2016-2018, gradually declining trend, 2018-2020 article trend to see the research on badminton big data straight up, a gradual rise and continue to maintain the stage; 2020 began to date, still steadily rising. It can be seen that the overall research trend of badminton-related big data direction is.

1. badminton tracking detection has started to move from two to three dimensions.
2. algorithms studied for badminton robots.
3. the object of identification is no longer just badminton, but begins to identify the specific action of playing the ball.
4. Tactics in badminton are no longer analyzed only through data, but the flight path of badminton and the stance of the players have also become important references.

9. Conclusions and recommendations

9.1 Conclusion

Badminton as well as social sports intelligent big data analysis technology includes a huge amount of information data within and outside the structure. With the cloud computing platform for massive collection and data processing, big data distribution is achieved through the construction of databases, and data mining techniques are used to manage and classify the results of data analysis and represent the state in a more unified manner. The purpose of physical education data can be mined is to make analytical decisions on badminton data technology in the context of the development of a new era, through illustrating the intricate social information network economic relationships that exist in the real world of business, material and visual sensory enjoyment.

There are two main problems following the application of data mining in the badminton sector. Firstly, data collection is still limited to manual statistics and does not allow for end-to-end system design.

Currently, there is a relatively single algorithm for optimizing correlation analysis from a technical and tactical perspective. The future direction of research is to use data mining algorithms to develop more scientific training programmes by combining aspects such as physical fitness, mental indicators and physiological indicators.

After the development of applications in the field of badminton for vision system analysis, the main research issues are: first badminton in each individual scene recognition accuracy rate is low, the need for algorithms can be further improved to improve. Secondly, the current badminton sparring robot can not fully meet the needs of enterprises, the relevant data algorithm performance needs to be continuously improved.

9.2 Recommendations

In order to implement an end-to-end correlation analysis system for badminton matches, the ultimate problem becomes how to recognize the various technical movements in the video. Some awareness has now been recognized by some and the recognition of specific movements has become an important direction for badminton.

In correlation analysis, analysis is also carried out mainly in terms of both technical and tactical aspects. There is a trend to combine physiological, psychological and physical indicators for analysis, but correlation analysis of multiple attributes may lead to a decrease in performance and needs further thought.

Although badminton sparring robotics can achieve some relatively simple sparring action in enterprises, but there is a greater impact distance from normal sparring, how to make badminton machine learning can own a better and faster response, more efficient movement, more fit position to hit the ball to become the problem to be solved.

The Hawk-Eye system is not perfect, even in individual matches the Hawk-Eye system is subject to large errors and the coordination between its internal algorithms and hardware needs further improvement.

Disclosure statement

The authors declare no conflicts of interest.

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