Big Data in Volleyball-Present and Future

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Abstract: With the development of volleyball, a variety of volleyball big data systems are gradually integrated into the game, from the initial volleyball information system (VIS), to the electronic record system, and then to the hawk-eye system, which has experienced about 25 years of development. At present, in the volleyball event, the use of volleyball electronic big data system can make the volleyball game more efficient, standardized, can reduce the probability of misjudgment in the game, can make the audience better understand the game. However, some problems are also found in the use, such as the training of operators is not systematic, the evaluation standards are inconsistent, and there are problems in the communication and interaction between referees and coaches. This paper analyzes the volleyball big data system, finds out the factors that affect the game, and finds the problems in use. It provides some suggestions for the development of volleyball.

Keywords: Volleyball, big data system, influence thinking

As a global competitive sport, volleyball has attracted wide attention and participation. The beautiful saves of the defenders on the court, the precise passes of the setters and the powerful slashes of the attackers have attracted thousands of spectators to watch the match. But in the volleyball match, due to the increase of the players' strength and the improvement of technology, the volleyball ball speed is getting faster and faster, and the competition over the net is becoming more and more fierce, which leads to the referee's misjudgment and missing judgment in the process of making a penalty. In order to reduce the misjudgment of the referee, ensure the justice and fairness of the referee's punishment. The FIVB has been working hard in recent years to introduce modern electronic technology into competitions to improve the accuracy of referees' decisions. [1] With the advancement of technology and the development of data collection methods, more and more volleyball data is being collected and recorded. These data include players' technical indicators, match results, physical fitness and other dimensions of information. The accumulation of such data provides valuable resources and opportunities for the big data system of volleyball.

Over the past few years, volleyball has shown a trend of significant growth in popularity around the world. Factors such as the International Volleyball Federation's (FIVB) promotion campaigns and the broadcasting and webcasting of volleyball matches have all supported the popularity and attention of the sport. At the same time, the application of various sensors and equipment also makes a large number of volleyball sports data can be real-time and accurate acquisition. The data not only helps teams and coaches better understand players' performance and abilities, but also provides a valuable resource for researchers and data scientists to study volleyball. [2]

Big data systems have great potential for application in volleyball. Through the collection, sorting and analysis of large-scale volleyball data, we can reveal the patterns and laws hidden behind the data and gain an in-depth understanding of players' and teams' performance, tactics and strategies. [3] This in-depth insight will help improve the team's competitiveness, optimize training plans, and provide support for coaches to make more scientific tactical decisions. At the same time, the big data system will also be able to provide a richer and more interactive experience for fans and spectators, deepening their understanding and engagement in volleyball.

The purpose of this paper is to explore the application potential and research direction of big data system in volleyball, and analyze and discuss the influence of modern electronic technology on the development of volleyball. We will review the relevant research results and methods, and discuss the practical application cases of big data system in volleyball. At the same time, we will explore the challenges and problems faced, and propose suggestions and prospects for future research. Through this

research, we hope to further promote the development of big data systems in the field of volleyball and bring more benefits and value to players, coaches and fans.

1. Big data systems are mainly used in volleyball events

Big data systems in volleyball events require data collection from multiple sources, including sensors and devices, video and image data, and social media and Internet data. These data sources provide a wealth of information that can be used in aspects such as technical analysis, tactical decisions and evaluation of player performance. At present, the main volleyball big data systems used in international volleyball competitions include: Volleyball Information System (VIS), electronic record system, volleyball Hawk-eye Challenge system.

1.1 Sensors and Equipment

The increasing use of sensors and devices in volleyball provides an accurate and real-time means of data collection. Here are some common sensor and device applications:

1.1.1 Motion tracking

Through the use of inertial measurement units (IMU) and Global positioning systems (GPS), motion tracking technology can record motion parameters such as a player's position, speed, and acceleration. This data can be used to analyze the player's movement trajectory, distance run and speed changes, among other things.

1.1.2 Passing analysis

The player's passing technique is an important link in volleyball game. Sensors can be embedded in the ball and the player's hand to capture parameters such as speed, spin and accuracy of the pass. This data can help assess the quality and skill of a player's passing.

1.1.3 Blocking analysis

Sensors are installed on the blocking screen, which can measure the height of the player's jump, the time and the strength of the movement. This data can reveal a player's blocking efficiency and defensive ability.

1.2 Video and image data

1.2.1 Technical analysis

By analyzing game footage, it is possible to evaluate a player's technical actions such as serving, spiking, and receiving. [4] The use of computer vision technology and image processing algorithms can automatically detect and measure the player's action parameters, such as hitting point, bounce height and hitting speed.

1.2.2 Motion recognition

Through the use of deep learning and machine learning algorithms, volleyball players' movements can be identified and classified, such as spiking, passing, blocking, etc. This helps to study the players' technical characteristics and tactical choices.

1.2.3 Tactical strategy

Analyzing game film can reveal a team's tactical choices and reaction patterns. By tracking the position and behavior of players, it is possible to analyze the team's organizational structure, tactical fit, and offensive strategy, among other things.

1.3 Social media and Internet data

Social media and Internet data provide volleyball with an additional source of information that can be used for things like player performance evaluation and opinion analysis.

1.3.1 Player performance evaluation

User comments and fan interactions on social media platforms can provide perspective and evaluation on player performance. [5] By analyzing social media data, it is possible to understand the

image and reputation of players in the eyes of the public.

1.3.2 Analysis of public opinion

Topics related to volleyball matches and players are widely discussed on the Internet. The analysis of relevant data can understand the public opinion and the tendency of public opinion on the result of the match, the performance of the team and the performance of the players

1.3.3 Media evaluation

The electronic record system can better communicate the data in real time and temporarily in the public media, use a large number of existing database data, simplify the record sheet and improve the accuracy of the record sheet input. In the process of use, the coach can use the tablet computer to control the suspension of the game, substitutions, hawk-eye challenge and other requests, so as to shorten the request time and improve the enjoyment of the volleyball match. [6]

2. The necessity of introducing big data system into volleyball events

2.1 The standardization of the competition needs the volleyball big data auxiliary system

2.1.1 The standardization of the VIS

The volleyball events of FIVB need to be arranged reasonably and orderly by computer from the beginning of the schedule arrangement, and the VIS system is required to edit an event. FIVB has implemented the VIS system since 1992 to manage high-level events and select the best athletes for each event. [7] The athlete technical statistics system has been added. It's formed a complete VIS system. In this system, all FIVB competition data can be retrieved through the database, including competition information, athlete information and so on. This provides a strong support for the use of electronic records in the later stage.

2.1.2 The standardization of the Electronic records

Electronic records on the basis of VIS, read the game information, athlete information, and in the game instead of manual records, to achieve the standardization of records.

2.1.3 The standardization of the hawk-eye

The use of the volleyball hawk-eye challenge system makes the scale of the judgment of the referee in the volleyball game more unified, the accuracy of the judgment has been greatly improved, making the game easier to be understood by the audience, and improving the enjoyment of the game. [8]

2.2 The change of the rules of the game requires the volleyball big data system

2.2.1 Electronic records and competition rules

The electronic record table is linked with the rules of volleyball, and its data has the characteristics of one-to-one correspondence. The data of suspension, substitution and free person up and down in the game can be recorded accurately and standardized, which avoids the possible negligence of the recorder in the recording process and improves the accuracy and standardization of the recorder operation. Reduce the athletes, coaches, spectators and other questions about the referee's work.

2.2.2 Hawk-eye and competition rules

Every time the rules of the International Volleyball Federation change, is to allow the audience to better understand the game, watch the game, the most difficult violation in the volleyball game is to touch the net and the ball touches the athlete's blocker, because the ball speed can reach 130 km/h or more, the referee's naked eye can hardly determine, so the introduction of hawk-eye challenge system is very necessary. Within a few seconds of the players completing the hitting action, it is very difficult for the referee to see whether the hands and bodies of both players touch the net. [9] If the penalty is not accurate, it will cause dissatisfaction among the players. The Hawk-eye challenge system can take 180-226 high-definition photos per second, so the use of hawk-eye to assist the referee's decisions can effectively prevent athletes from producing conflicts, making the game smooth.

In the volleyball game, spike and blocking process, the ball will sometimes touch the blocker's hand, most of the ball referee can be judged by observation, but some of the slight tentacles require the referee in 0.4-0.8 seconds to judge, then it will be very difficult to judge, most of the referee will make a penalty

according to experience, but often lead to misjudgment. The introduction of the hawk-eye system is a good way to put an end to this kind of situation. Through the shooting Angle of 7 high-speed cameras, no dead corners are left on the whole net, which clearly shows the movement of the athletes in spiking and blocking, thus avoiding misjudgment of the referee. Make the game fair and accurate.

The strength of the players, the improvement of the technical level, the volleyball spike speed has reached nearly 130 kilometers per hour, the ball falls near the line, due to the ball speed is too fast, Angle, ball landing expansion and other problems, the line or the referee may misjudge. The use of hawk-eye technology effectively eliminates the occurrence of such misjudgments. [10] Hawk-eye can clearly capture the trajectory of the ball near the line and the ball shape change caused by the change of pressure, so as to accurately judge whether the ball is out of bounds. It greatly reduces the misjudgment of the ball in and out of bounds in the game, and ensures the fair conduct of the game.

2.2.3 Tactics system and competition rules

In modern volleyball game, the tactical system of the team is becoming more and more complex, and the back row attack has been more and more applied to the tactical system of the game. It is more and more difficult for the referee to judge whether the athlete steps on the line at the moment of jumping off. After the introduction of hawk-eye technology, the high-speed camera can clearly capture the moment of stepping on the line and effectively assist the referee to make a penalty.

2.3 Coaches and tactical analysis need volleyball big data system

In volleyball, big data systems provide strong support for coaches and tactical analysis, enabling them to make more informed decisions and optimize tactical strategies. Here are some examples of application areas:

By analyzing big data, coaches can identify and evaluate the effects of different tactical strategies and optimize them. Big data systems can reveal the impact of specific tactical strategies on match results and player performance, helping coaches choose the best tactical plan.

Big data systems can provide data and performance evaluations of opponents. By analyzing opponents' weaknesses and strengths, coaches can formulate countermeasures and tactical plans accordingly. Big data systems can reveal opponents' defensive patterns, offensive strategies and players' individual characteristics, thus helping coaches make informed decisions during matches.

Through big data systems, coaches can objectively evaluate and analyze players' performances. Data can be used to measure a player's performance in different aspects, such as serving, spiking, blocking, etc. This helps identify the players' strengths and areas of improvement, providing them with personalized training and development plans

2.4 Fan engagement and experience enhancement require volleyball big data systems

Big data systems in volleyball can promote fan participation and experience enhancement, providing fans with a richer, personalized and interactive experience.

Through big data systems, it is possible to provide fans with data-driven interactive experiences. For example, through real-time data analysis and visualization, fans can learn about key data indicators and statistics in matches. Data-based games and challenges can also be developed to involve fans in predicting match results, player performance, etc., increasing their engagement and interest in the game.

Big data systems can help analyze the emotions and reactions of fans, thereby enhancing their engagement and experience. By analyzing social media data, fan comments and interactions, it is possible to understand fan preferences, emotional tendencies and concerns. This helps teams and organizations understand the needs of fans and offer corresponding events, promotions and interactions that enhance fan engagement and loyalty.

Big data systems can leverage social media data to enhance interactive fan experiences. By analyzing fans' behavior and interactions on social media, it is possible to understand their interests, preferences, and levels of engagement. This can be used to launch personalized content and interactive activities such as polls, Q&A's, fan interactions, etc., thereby increasing fan engagement and loyalty.

Big data has important application potential in volleyball fan engagement and experience enhancement. Through data-driven interactive experiences, fan sentiment analysis and engagement enhancement, as well as the application of social media data, big data systems can provide fans with a

more personalized, rich and interactive experience to enhance their participation in and support for volleyball. This can help boost fans' satisfaction and loyalty, and boost the development and promotion of volleyball.

3. The impact of the introduction of big data system in volleyball on the competition

3.1 The impact of VIS on the game

VIS system is the earliest big data system implemented by FIVB. Its function is to record the effect of each touch of the athlete, which can objectively reflect the performance of the athlete in the game. This system is also the basic basis for FIVB to select the best athlete after each competition. At the same time, the network score live broadcast is also realized according to the VIS system, making the game more easily accepted by the audience, and the process is easier to understand.

3.2 The impact of electronic records on the game

The use of electronic records avoids the possibility of human errors on the recording desk. The recorder is very attentive for most of the game, but sometimes there are problems in the communication and communication with the second umpire, which can cause the record desk to make mistakes. Electronic records avoid the probability of error in this communication. Make the record desk more accurate and effective.

3.3 The impact of hawk-eye on the game

The implementation of hawk-eye makes the players have more "right to speak". Volleyball rules stipulate that only the captain can challenge the referee's decision, but the referee must accept it unconditionally after explanation. The implementation of hawk-eye makes the referee's decision more fair, more humanized and easier to be accepted by the players.

The use of hawk-eye has put an end to the phenomenon of black leave of referees in competitions. In the competition, because the referee is endowed with the supreme right, sometimes the referee's judgment will directly lead to the difference in the result of a match, directly lead to the unfair game, and do not conform to the healthy development of the commercialization of the game. Therefore, the appearance of hawk-eye effectively put an end to such phenomena, make the game fair, just and accurate, and promote the healthy development of volleyball.

4. The limitations of the introduction of big data system in the volleyball game

4.1 Limitations of VIS

VIS system can effectively reflect the performance of the players in the game, the high level of VIS operators can effectively reflect the data of the players, but some VIS operators due to the limitations of the level, resulting in the error of the athletes' game data, or even loss, resulting in the not objectivity of the players evaluation system.

4.2 Limitations of hawk-eye

The use of the hawk-eye system makes the penalty of the game more accurate, but the hawk-eye operator in the process of operating the hawk-eye, due to the limitation of the level, will lead to a pause in the game for 1 to a few minutes, thus disrupting the rhythm of the game. A long pause will affect the enjoyment of the game.

4.3 Limitations of the quality of the data

The effectiveness and accuracy of big data systems depend on the quality of the data. There may be noise, errors, or incompleteness in the data collected in volleyball. Therefore, data cleaning, processing, and integration are required to ensure data quality. In addition, measures need to be taken to ensure data consistency and accuracy, thus improving the reliability and credibility of the analysis. At the same time, each team has two opportunities to challenge the game, and can continue to challenge after the challenge

is successful, and lose a challenge opportunity if it is not successful. This results in a match in which a best-of-five match has a minimum of 12 challenge opportunities, meaning that there will be 12 breaks in play. It disrupts the flow of play.

4.4 Limitations of sensitive data

Big data for volleyball may contain personally identifiable information and sensitive data. Legal and ethical guidelines for privacy protection must be followed when conducting data analysis. Measures such as data desensitization, anonymization and encryption are adopted to ensure that the privacy of players and fans is effectively protected. At the same time, a framework and policy for privacy protection will be established to strengthen data security awareness and protection measures.

5. Conclusion

In the process of volleyball big data system serving the competition, it is necessary to strengthen personnel training and establish a perfect personnel team; Improve VIS operators, recorder of the system familiar degree; Improve the equipment accuracy of hawk-eye, improve the level of hawk-eye operators, and shorten the time of hawk-eye operation. Only to maximize the function of the volleyball big data system, making the details of the volleyball game clear, the referee is fair and just, the game is smooth, the viewer's watching feeling is happy, in order to expand the volleyball market and improve the influence of volleyball. Through the research and discussion in this paper, we can clearly see that the big data system of volleyball has great potential in providing insight, optimizing decision making and improving sports performance. Big data systems can help coaches, players and teams make more informed decisions in training, tactics and techniques, as well as provide personalized training and rehabilitation programs. In addition, big data systems can enhance fan engagement and experience, providing fans with a more interactive and personalized experience. In recent years, FIVB has been reforming its competitions to make them more exciting, coherent and understandable to viewers.

Although the big data system for volleyball has made some important progress, there are still many future directions and research opportunities that deserve attention.

Improvements in data quality and privacy protection: Further improve data quality management and privacy protection mechanisms to ensure the accuracy, integrity and security of data. Researchers can explore new methods and techniques to address challenges such as data cleansing, desensitization and anonymization.

Model and algorithm improvement: Further development and improvement of predictive models, classification algorithms and machine learning models applicable to volleyball. Researchers can explore new algorithms and models to improve the accuracy and reliability of predictions, and delve into the impact of features and variables behind the models.

Cross-domain collaboration and data sharing: Enhance cross-domain collaboration and data sharing to facilitate communication and collaboration among researchers, coaches, players and data scientists. This helps to provide more comprehensive data sets, improve analytical methods, and accelerate the application and landing of big data systems in volleyball.

Application of emerging technologies: Focus on the application of emerging technologies such as blockchain, Internet of Things and augmented reality in the big data system of volleyball. These new technologies can provide new solutions in terms of data security, real-time data collection and interactive experience.

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