

Research on the Exploration of the Big Data Technology Application in Athletic Training

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Abstract: With the passage of time and the gradual refinement of big data technology, the ubiquitous utilization of big data has permeated industries such as finance, education, and industry alike. The exponential pace of the development of big data technology has consequently exerted an unprecedented impact on the realm of athletic training, thus making the marriage of big data technology and athletic training an inexorable trend. This study, employing research methodologies encompassing literature review, logical analysis, as well as on-site observation, aims to ponder the implications of the application of big data technology in athletic training, commencing from the distinctive characteristics of the era of big data. The investigation unfolds by delving into the assimilation of big data technology in athlete talent selection, the athlete training process, in addition to the realm of athletic competitions.

1. Introduction

In the current era, the rapid advancement of information technology has made data an indispensable resource across various industries. The rapid rise of the Internet and the continual maturation of network technology have resulted in an exponential growth of data, giving rise to the notion of “big data”. As time goes by and big data technology gradually matures, the utilization of big data has found widespread application in industries such as finance, education, and industry itself. The advent of advanced big data technology has brought about a transformative impact on the realm of sports, wherein the surge of sports data has presented new opportunities and challenges[1]. In the domain of athletic training, integral to it are various big data services, including mining, statistical analysis, and exploration of athletic training data, analysis of athletic training posture and data capture, as well as intelligent athletic training wearable equipment based on big data platforms. By combining fundamental techniques of data mining, data processing, and data prediction through big data analysis, a multitude of sports data can be transformed into valuable decision-making information, providing a more scientific and precise basis for the formulation and adjustment of athletes’ training plans and competition strategies.

2. Big Data Technology and Athletic Training

2.1. Big data Technology

Big data, characterized by its large capacity, diverse types, fast access speed, and low value density, is rapidly developing into a new generation of information technology and service format that collects, stores, and analyzes massive, dispersed, and diverse data to discover new knowledge, create new value, and enhance new capabilities, as stated in the *Action Plan for Promoting the Development of Big Data*[2]. On the foundation of acquiring a vast amount of data, the core technologies of big data include data collection, data storage, data processing, data analysis, data mining, and model prediction. Through the fusion and interdisciplinary collaboration of multiple disciplines, big data technologies collectively constitute a system of big data technology.

2.2. Athletic Training

In the realm of athletic training, as referenced in pertinent materials, it pertains to the organized and systematic practice of sports under the guidance of coaches, with the primary objectives of enhancing athletic skills and improving actual performance[3]. This encompasses training in various aspects, including physical fitness, technical proficiency, strategic tactics, psychological conditioning, intellectual development, and cultivation of a winning mindset, serving as a vital component of competitive sports activities[4].

With the increasing emphasis on sports development at the national level, athletic training in our country is showcasing a positive trend of growth. However, to achieve better outcomes in the face of emerging trends, it is imperative to judiciously employ big data technology within the framework of athletic training, optimizing the training system and propelling its scientific advancement.

3. The Significance of Applying Big Data Technology to Athletic Training

3.1. Facilitating Efficient Collection of Training Data

For athletic training, the collection of training data from athletes often needs to occur during dynamic training sessions. Factors such as high-speed movements and complex athletic motions create stringent requirements for the collection process. Even a slight deviation can potentially impact the overall accuracy of the data, thus posing challenges and a higher risk of errors. With the gradual advancements of big data technology, numerous more precise and convenient computerized automated collection and monitoring systems have emerged. By utilizing computer technology to replace human visual recognition, not only can the data from athletes' training processes be automatically collected, but also real-time dynamic monitoring of the movements can be achieved. This eliminates the difficulties associated with manual collection and recording, thereby enhancing the efficiency of data acquisition.

3.2. Enhancing the Scientific Accuracy of Training Data Calculation

Athletes and trainers need to integrate various types of collected training information for comprehensive analysis and research. Traditional analysis methods not only require a significant amount of manpower and time, but they may also introduce errors during the calculation process. Therefore, leveraging big data technology and mature mathematical algorithms to compute training data can improve the efficiency and accuracy of data analysis, providing scientifically precise results for athletic training.

3.3. Enhancing the Scientificity of Training Management Decisions

In athletic training, trainers are tasked with collecting vast amounts of complex and diverse data. Faced with such a massive volume of information, it becomes challenging to derive scientific and targeted conclusions. By harnessing big data analysis techniques and constructing databases, data can be organized according to specific classification rules. This allows for the identification of correlations among the data, resulting in a standardized and consistent dataset. Trainers can then draw scientifically validated conclusions and make informed decisions based on the organized data. Furthermore, linking data from different modules enables effective utilization and maximization of the value derived from the data.

4. Application of Big Data Technology in Athletic Training

4.1. Athletes Selection

“The success of athlete selection signifies half the success in training”. In the book *Scientific Talent Selection for Athletes*, scientific talent selection is defined as “a process that utilizes modern scientific methods and techniques to identify individuals with superior innate abilities and suitability for specific sports, based on the characteristics and requirements of different sports disciplines, which involves objective testing, comprehensive evaluation, prediction, and the systematic cultivation of selected individuals from an early age. It also entails continuous monitoring of their developmental trends” [5]. Unearthing individuals with athletic potential who are both trainable and suitable for specific sports is a key factor in promoting the long-term and thriving development of athletic training in China. The increasing competitiveness in sports and the objective reality of relatively low success rates highlight the growing significance of conducting athlete selection in a scientific and rational manner[6].

Athletes’ performance is influenced by factors such as their physical morphology, physiological abilities, and overall fitness. Traditional athlete selection and evaluation methods have predominantly relied on coaches’ personal experience and static data of athletes, often limited by information barriers. In the current era of big data, sports coaches and managers should gradually transition from traditional assessments to data-driven decision-making. By integrating sports talent selection indicators with dynamic data analysis, leveraging advancements in big data analytics technology, and utilizing extensive athlete databases, a comprehensive multidimensional analysis is conducted to extract and summarize valuable data for identifying exceptional athletes. Through scientific and rational analysis and prediction supported by powerful data analytics techniques, the effectiveness of selecting high-quality athletes is enhanced.

During the athlete selection process, it is often observed that training data can be influenced by various independent factors unrelated to athletic skills. These factors cannot be easily identified through simple experiential observations. By utilizing big data technology to repeatedly mine and explore the data information of existing athletes, the problem of accurately estimating the varying degree of correlation between different indicators of athletes, which traditional assessments cannot address, can be effectively resolved. For example, in speed play, the training data of a thirty-meter varied pace running may seemingly have no correlation with the psychological traits of the athlete [7]. However, through secondary data mining and correlation coefficient calculations, it can be discovered that there exists a certain level of correlation between the two, showcasing the comprehensiveness of big data analytics techniques.

In the paper *Construction of a Campus Football Player Selection Model under the Big Data Environment*, Yang Bin proposed a new model for selecting campus football players, centered around the “Three Blocks and Two Databases” approach[8]. This model utilizes core big data technologies

to handle the collection of player information and data, analysis of player data, and tracking of player training indicators. It also involves the establishment of two information databases: the Campus Football Player Database and the Prominent Player Database. By integrating the “Three Blocks and Two Databases” framework with more in-depth data analysis, a comprehensive analysis and correlation calculation of the massive amount of information is conducted, enabling the information to be maximized. This model aims to construct a selection model specifically for young campus football players, effectively evaluating subsequent football players and conducting scientific analysis and prediction of their current status and potential for development. It aims to unearth the most outstanding and promising campus football players with optimal qualities in all aspects.

4.2. Training Process

With the rapid advancement of big data technology, athletic training has become more intelligent, personalized, and scientific. The application of big data technology in athletic training predominantly revolves around areas such as training monitoring and prevention of training injuries.

In the area of training monitoring, big data technology is used to track indicators such as heart rate, speed, and movement patterns during an athlete’s training process. Through analysis using big data techniques, adjustments can be made to training content and plans. In golf, for example, combining 3D technology and Doppler radar technology enables the capture of data on a golfer’s swing trajectory, ball flight trajectory, launch angle, speed, and direction[9]. This data is used to construct a model of the athlete’s performance, which is then analyzed in simulation software to assess the impact of various indicators on winning. This analysis identifies any issues in the golfer’s swing and enables targeted training. In 2014, the German national team, winners of the World Cup, utilized big data technology from SAP Match Insights during their training process[10]. By capturing precise motion and positional information of athletes during training, and combining it with existing databases and data analysis techniques, the team was able to make timely adjustments to their tactics, optimizing the training plans and methods for each player to maximize their individual strengths.

In the realm of injury prevention in training, big data technology is employed to analyze and predict based on information regarding athletes’ training load intensity, muscle fatigue, and other physical qualities. By establishing models for injury assessment and evaluating the severity of damage, real-time monitoring and precautionary warnings are prioritized during the training process. Scientific control of training difficulty and intensity is implemented to minimize unnecessary harm resulting from overtraining. In the sphere of rugby, characterized by intense physical confrontations, the sport carries a higher risk of injuries. Effective control of rugby-related injuries becomes a crucial approach to ensure a stable and progressive level of competitiveness in rugby teams[11]. Tee and other researchers, using big data technology, collected data on player injuries from a professional rugby team over five consecutive seasons. By analyzing the data model, a series of preventive and intervention measures were derived, leading to an 8% reduction in the overall injury rate for the entire team. Yeomans and others developed the IRISweb[11], a detection system for rugby players’ sports injuries, which has been widely adopted by numerous rugby clubs in Ireland.

4.3. Athletic Competition

Athletic competition, under the supervision of referees and in accordance with the rules of the sport, involves organizing and implementing contests between individual athletes or teams[12]. It is an integral part of athletic training, serving as a means to assess the effectiveness of training plans at different stages and evaluate an athlete’s performance. The advancement of big data technology has greatly contributed to enhancing athletes’ competitive level as well.

In the initial stages of athletic competition, traditional means of data transmission and management

limited athletes' timely access to sports-related information. However, the development of big data technology has changed this situation. Data mining techniques allow for automated collection and statistical analysis of information from massive datasets, as well as classification and prediction of future outcomes. Moreover, it enables the processing of necessary data in a timely, fast, and accurate manner, providing decision-makers with the feedback they require. Athletes and coaches utilize data mining technology to collect and analyze relevant information, facilitating corresponding plan adjustments and contingency strategies. For example, they can analyze statistical data from previous matches of opponents to understand their competitive abilities and tactical characteristics, and make targeted adjustments accordingly. By analyzing significant weather and climate factors, they can predict potential influencing factors during competitions and proactively prepare tactical countermeasures. Additionally, by establishing injury assessment models based on athletes' physical information and injury evaluation criteria, continuous monitoring can be conducted to prevent excessive harm during competitions, thus impacting their training progress. All these factors greatly contribute to athletes achieving outstanding results in athletic competition.

The application of big data technology in athletic competitions has been extensive, allowing for real-time monitoring of athletes' information during the course of the game. In the Major League Soccer, Adidas' Micoach Elite System technology has played a significant role. By collecting and calculating various indicators such as heart rate, speed, acceleration, on-field positioning, ball control ability, running distance, and intensity, this system provides real-time feedback to coaches[9], enabling them to assess the match situation and make strategic decisions based on the data. IBM, a leader in the computing industry, has been monitoring over 9,000 tennis matches since 2005. Leveraging data collection and sensor technology, they have gathered a staggering 41 million data points and employed 5,500 analytical models. Within 43 potential dynamic indicators, they have identified the three most crucial indicators for competing players [13]. This breakthrough has revealed essential patterns and characteristics for success in tennis, providing valuable insights for professional tennis training.

5. Conclusions

The emergence of the era of big data has profoundly influenced the advancement of athletic training. In today's omnipresent realm of internet technology, the incorporation of big data into athletic training has become an irresistible trend. Whether it is in the realm of talent identification, athlete development, or competitive performances, the utilization of big data technology by athletes and trainers has become increasingly sophisticated. However, alongside the opportunities presented by the growth of big data in athletic training, there also arise new challenges that necessitate attention and enhancement. Primarily, there exists the matter of data quality. Given the extensive volume of data in athletic training and the relatively fragile techniques for data collection and management, it becomes intricate to exercise control and supervision over the data, thereby leading to inadvertent errors and escalated error rates within the existing data pool. Secondly, the issue of data comprehensiveness comes into play. The complexity and expansive nature of athletic training data, coupled with the fact that certain sports organizations are yet to establish comprehensive big data platforms, inevitably result in incomplete data. This fragmentation within the data processing process and the failure to effectively utilize the data that has been collected and stored, give rise to phenomena such as data islands and data wastage. Thirdly, the challenge of data security looms large. Data privacy has always been a thorny concern in the realm of big data technology. Researchers, at times, overlook personal privacy concerns when designing models for athletic training data, leading to complications such as data leakage. It is of utmost importance for sports management departments to fortify their digital infrastructure, leverage diverse digital and informational tools, overcome the obstacles

associated with massive data loss and feeble data processing capabilities in traditional models, and maximize the value of data. Furthermore, researchers within the domain of big data should remain attuned to the trends and characteristics of athletic training, augment their innovative research and development endeavors in big data technology for athletic training, and, if able to seize opportunities and confront challenges, fully harness the constructive impact of big data technology. Undoubtedly, this will foster the vigorous advancement of athletic training.

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