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An exploratory study of artificial intelligence applications in sports medicine

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Abstract

In recent years, the field of artificial intelligence has garnered significant global attention, with AI technologies permeating various industries. Particularly, the deep integration of AI with medical and sports has made significant advancements, enhancing the quality of people's lives by providing more high-quality, customized, and personalized sports and health management services. In this context, this paper employs methods such as literature review and logical analysis to analyze the current status of AI in sports medicine in China. It introduces the applications of AI in the fields of sports and medical and identifies the key factors that drive the development of sports medicine through artificial intelligence. Furthermore, it reveals the trends of deep integration, rapid integration, multidimensional integration, precision integration, and continuous integration in sports and medical under the influence of artificial intelligence. In the future, it is imperative to fully leverage AI to integrate new technologies and promote the fusion of sports and medical.

Introduction

Artificial intelligence (AI) is the study of brain-like intelligence through the utilization of technologies such as big data, deep learning algorithms, and cloud computing [1]. It involves the use of machines to address problems that can be solved by the human brain. The development of AI has gone through phases, including its birth, a period of stagnation, and subsequent resurgence. The three key drivers of AI application development, namely, data, algorithms, and computing power, have facilitated its rapid growth. The rapid expansion and widespread use of the internet of things, social media, and mobile devices have led to a sharp increase in the volume of data generated and stored worldwide, providing a constant stream of material for deep learning training and computer vision algorithm models. Neural network models and optimization algorithms like LeNet, followed by subsequent advancements like AlexNet, ResNet, GAN, etc., have continuously pushed the boundaries of algorithm accuracy [2,3]. Data processing speed is no longer a bottleneck in AI development, serving as a powerful driving force for further advancements. With the gradual evolution of neural network

technology, AI has entered a phase of significant growth, reaching its pinnacle with the emergence of ChatGPT in 2022.

The development of AI holds extensive prospects in various fields [4], particularly in sports and medical. Moreover, AI applications have a wide range of use cases, including smart home services, mobile devices with AI capabilities, and autonomous driving, among others. Currently, numerous enterprises have produced a variety of intelligent products based on AI technology, including wearable smart sports devices, online health management services, and real-time health data monitoring. Residents can utilize these intelligent products to monitor and gain insights into their health status in real time, assisting them in self-health information queries, exercise monitoring, assessment, and promotion, ultimately providing personalized health management services. In light of these developments, this paper examines the current state of AI in sports medicine and provides an overview of AI applications in the fields of sports and medical. The aim is to offer valuable recommendations for the development of AI in the sports medicine field.

Artificial intelligence in medicine

In the present day, AI technologies are finding increasingly widespread applications within the medical sector. These applications include assisting medical professionals in diagnosis, providing personalized medical treatments for patients, and facilitating medical research [5]. The application of AI in the medical field has been a process of continuous accumulation and evolution. Among the various areas of application, medical imaging, particularly in pathology literature analysis, has reached a high level of maturity. The scope of AI in medical is steadily expanding, offering rich prospects for the industry. Its primary roles are in assisting medical imaging, pathology diagnostics, early disease screening, enhancing drug development, and providing virtual assistant follow-up services, among others. Virtual assistants, in particular, serve as information systems that guide patients and assist medical professionals. They leverage technologies such as natural language processing to compare users' descriptions of their medical conditions with medical guidelines [6,7]. In the medical sector, AI is primarily applied in various scenarios, including medical imaging for diagnostic support, clinical decision-making support, case analysis, speech recognition, drug discovery, health management, disease risk prediction, and more. Among these, medical imaging assistance based on deep learning is currently the most mature and widely applied scenario. AI in Medical Imaging: From image reconstruction to plain film reading, ocular monitoring to brain disease diagnosis, breast disease detection to organ segmentation and target delineation in radiotherapy, bone injury identification to bone age analysis, pathological analysis to ultrasound-assisted diagnostics a multifaceted landscape of research and commercial applications [8]. AI, simulating the information processing mode of the human brain, enhancing medical efficiency, alleviating scarce medical resources, elevating medical quality and research standards, and facilitating real-world research. The progression of AI from weak to strong AI is an incremental process, and its current applications in medical primarily address mundane, highly repetitive medical tasks, gradually evolving into comprehensive, multi-lesion, end-to-end AI solutions. Medical IoT and wearable devices, enabled by 5G and the internet of things, have given rise to health big data, ushering in an era of real-time and ubiquitous smart medical and health services. Ultimately, this paves the way for a comprehensive era of intelligent medical services, characterized by personalized, precise, evidence-based, and lifelong medical.

While AI provides valuable assistance to medical professionals, it is imperative for doctors to maintain an open and receptive mindset, embracing AI as a product of the modern era. They should actively explore and harness the potential of artificial intelligence to ensure its genuine contribution to clinical practice and research. By doing so, AI can become a true asset in aiding medical professionals, ultimately leading to the delivery of higher quality, safer, and more efficient medical services for patients.

Artificial intelligence in sports

The profound fusion of AI with the field of sports has become an unmistakable trend in our technologically driven society, and its impact is continuously growing [9]. In the realm of competitive sports, the utilization of AI-driven devices, com-

ined with the tracking, collection, and extensive data analysis of athletes' physiology, training routines, and performance, has proven to be a powerful tool for coaches. This approach enables them to arrange more effective and targeted training sessions, ultimately enhancing athletes' performance. The application of technologies such as "Hawkeye" and electronic timing systems not only ensures the fairness, impartiality, and transparency of sporting events but also provides spectators with a more comfortable and immersive viewing experience [10]. In the realm of grassroots sports, the widespread adoption of smartphones and the proliferation of sports and fitness applications (Apps), as well as the use of smart wearable devices, have become indispensable tools for the general population's fitness activities [10]. The integration of AI with grassroots sports is gradually guiding individuals to develop healthy physical activities and lifestyle habits. It also aids in the creation of a comprehensive database for grassroots fitness, providing data support for evidence-based decision-making in relevant government sectors. Within the sports industry, the application of AI in conjunction with big data and other technologies has the potential to reduce labor costs, increase production efficiency, drive innovation in sports products and services, and promote the transformation and upgrading of the sports industry. With the assistance of AI and big data, a wider array of high-quality and creative sports products and services will seamlessly enter people's daily lives, continuously catering to the ever-diversifying cultural and recreational needs of individuals. In the domain of sports education, the use of smart wearable devices in teaching has multifaceted benefits. Not only does it assist educators in data organization and understanding students' physical activities, but it also stimulates students' interest in learning and cultivates healthy exercise habits [11].

The influence of artificial intelligence on sports performance

With the continuous development and widespread adoption of AI (AI) technology, its impact on the sports world has become increasingly apparent. AI is employed to enhance performance and training, potentially revolutionizing the way athletes train and compete. AI is helping athletes gain better insights into their performance during practice and competition. AI-driven analysis provides valuable insights into their performance, enabling them to make adjustments to optimize their techniques and maximize their potential. AI-based analysis also offers coaches data-driven insights into athletes' performance, enabling them to make better decisions regarding training and competition strategies. AI is also used to improve training and sports performance. For instance, AI algorithms can be employed to create personalized training programs tailored to athletes' individual needs and goals. AI can also enhance the accuracy and speed of biomechanical analysis, allowing athletes to gain a better understanding of their movement patterns and make corresponding adjustments. AI is further used to develop new technologies that enhance sports performance. AI-based algorithms are employed to create new sensors and devices that can monitor athletes' performance in real-time, providing instant feedback on their performance. This technology allows athletes to make immediate adjustments to their techniques and optimize their performance. The transformative potential of AI in the world of sports is evident. As AI technology continues to advance, its

influence on sports performance may become even more pronounced. AI-based analysis and technology have the potential to revolutionize the way athletes train and compete, enabling them to achieve new heights in their performance.

Sports big data and artificial intelligence

As teams and organizations seek to gain a competitive edge, sports analytics has emerged as a rapidly evolving field. With the rise of big data, sports teams can now analyze and leverage information in ways previously unattainable. Thanks to advancements in analytics and AI, teams can gain profound insights into players' on-field performance and a better understanding of the game itself. Sports big data is derived from various sources, including live online streaming, broadcasting, and even social media. This data can be used to delve deeper into the performance of players and teams. For instance, teams can use data to monitor player performance and health and make wiser decisions regarding strategy, personnel, and tactics. AI can also be employed to simulate scenarios and predict outcomes, allowing teams to better comprehend different playing styles and tactics' performance in the game. AI can also be utilized to analyze the game itself. For example, artificial intelligence can analyze game footage and extract information such as ball speed, player positioning, and player movements. This can assist teams in understanding the game and formulating winning strategies. AI can also be used to analyze fan behavior, enabling teams to better understand their target audience. The ability to analyze sports big data provides teams with a competitive advantage, while AI helps teams gain a better understanding of the game. With continuous technological advancements, teams will be able to gain deeper insights into the game, thus making wiser decisions and gaining an edge over their competitors.

Analysis of sports prediction and gambling artificial intelligence and machine learning

In recent years, sports betting has made significant strides. With the emergence of AI and machine learning, sports prediction and betting have become increasingly accurate and reliable. AI and machine learning are powerful technologies that are revolutionizing the sports betting industry. AI systems can analyze extensive datasets of sports statistics and trends to generate highly accurate predictions. Machine learning algorithms can use historical data to 'learn' and forecast future outcomes. One of the key advantages of AI and machine learning in sports prediction and betting is their ability to consider a broader range of variables compared to traditional statistical methods. This leads to more precise predictions and more profitable betting. AI systems can also reduce the time required for data analysis and prediction as they can automate many processes. AI and machine learning are also being used to enhance the user experience in sports betting. For instance, AI can be utilized to provide personalized recommendations to bettors, such as the best odds for specific games or the most profitable bets. Despite the profound transformation brought by AI and machine learning to sports betting, there is still a long way to go. The ability of AI systems to accurately predict future outcomes is still limited and requires human input and judgment. Nevertheless, AI and machine learning will continue to play an increasingly important role in sports prediction and betting in the coming years.

Artificial intelligence and sports medicine

Sports medicine, also known as 'medical sports,' is a medical approach that employs sports techniques for disease preven-

tion, recovery, or improvement of bodily functions. It is a subset of sports medicine. Typically, therapeutic methods involve medical exercises, walking, jogging, cycling, qigong, Tai Chi, as well as specialized exercise equipment like resistance bands, and automated treadmills, along with activities like sunbathing and water baths. Treatments should be tailored to individual needs, gradual, consistent, and may be combined with pharmaceutical or surgical interventions, as well as psychological support. Sports medicine in China has a long history, dating back over 2000 years when practices such as guidance, health preservation, and dance were used for disease prevention and treatment. It has since evolved and improved, becoming an integral part of traditional Chinese medicine. However, in the context of disease treatment, the role of medical intervention far outweighs that of sports medicine, resulting in a relatively weak incorporation of sports techniques. This has impeded the fusion of sports and medicine. Nevertheless, the rapid development of AI, especially its widespread application in the field of sports, is expected to bridge the communication gap between sports and medicine, facilitating a better integration of sports into the medical field. The utilization of AI, particularly data mining and processing techniques, allows individuals to objectively and accurately track various physiological parameters during sports activities. It also contributes to the creation of high-quality data resources, promoting rapid updates and upgrades in the application of AI in the field of sports [12]. Currently, the application of AI in sports medicine is gaining momentum as an increasing number of individuals recognize the potential benefits of integrating sports and medicine into their medical routines. AI is poised to provide new opportunities for this integration.

Sports monitoring and analysis

AI can utilize sensors, cameras, and other devices to monitor an athlete's real-time physiological indicators. By employing machine learning algorithms, AI can analyze data related to an athlete's technical movements, physical strength, and more, providing precise data support and guidance for coaches and medical professionals. In team sports like soccer and basketball, AI can swiftly analyze tactical formations and individual performance by identifying player positions and movements, assisting coaches in formulating more rational tactics and training plans. As AI technology continues to advance and data accumulates, personalized training is poised to become the future's mainstream approach. AI can intelligently create personalized training programs based on individual characteristics and requirements. Furthermore, when combined with big data and cloud computing, real-time monitoring and adjustment of training effectiveness become possible, ensuring that each individual receives the training method most suitable for their needs.

Prevention and rehabilitation of sports injuries

With the assistance of AI algorithms, doctors and athletes can more accurately assess an athlete's injury risk. During training, AI can monitor an athlete's physical condition, predict potential injury risks, and make timely adjustments to training plans to prevent injuries. In the rehabilitation process, AI can utilize extensive databases and algorithms to develop personalized rehabilitation protocols, enhancing the effectiveness of rehabilitation. The application of AI in sports injury treatment will continue to be strengthened. By combining virtual reality technology and AI algorithms, doctors can provide patients with immersive treatment experiences, helping patients better engage in rehabilitation training. Additionally, AI can offer more precise treatment plans and medication recommendations through the

analysis of big data and algorithms, thereby improving treatment outcomes [12].

Furthermore, another significant breakthrough of AI lies in researching the connection between sports and the brain [13]. By combining brain-machine interface technology and machine learning algorithms, scientists can gain a better understanding of the essence of human movement, further optimizing training and rehabilitation programs. In conclusion, AI has vast prospects in the field of sports medicine, and there are many promising directions for future development.

Challenges faced by artificial intelligence in sports medicine

Despite the vast prospects of AI in the field of sports medicine, it also faces several challenges. Privacy and data security issues have garnered increasing attention as AI applications expand. Protecting user privacy and data security during the process of sports monitoring and health data collection is an important concern, necessitating the establishment of corresponding laws and regulations. Technological barriers and application costs are currently limiting the application of AI in sports medicine to large organizations and professional sports teams. These barriers and costs restrict the involvement and benefits for the general population. Therefore, addressing how to reduce technological barriers and provide more inclusive AI services is a challenge that needs to be addressed in the future.

Conclusion

The prospects of AI in the field of sports medicine are exciting. In the future, through continuous research and application, AI will provide athletes and medical professionals with more precise and personalized training and rehabilitation programs, offering greater possibilities for medical. However, the development of AI also requires collaborative efforts from governments, businesses, and society to ensure the reasonable regulation and application of this technology, promoting its sustainable development in the field of sports medicine. The rapid development of AI technology provides a solid technical foundation for further integration between sports and medicine, creating ample potential for deep integration, rapid convergence, multidimensional fusion, precise fusion, and continuous fusion in the development trends. The integration and development of new technologies are essential drivers for innovation and societal progress. Leveraging AI to integrate new technologies will advance the convergence of sports and medicine.

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