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Exploring the Application of Artificial Intelligence in the Olympic Movement

Runzhi Liu[1,2], Hua Cui[2,*]

[1]Sport Philosophy and Social Science Key Research Base of General Administration of Sports of China, Beijing Sport University, Beijing, China
[2]Library, Beijing Sport University, Beijing, China
**Corresponding author*

Abstract: *Artificial Intelligence (AI) has been changing the society since the middle twentieth century, including the Olympic fields. This study analyzes the challenges and strategies for AI development in Olympic Movement. The findings show that AI has brought both opportunities and challenges to the Olympic movement. As for opportunities, AI can enhance the level of athletes' competition, boost the operational efficiency of management, enrich the audience experience, create an environmentally friendly society, and drive the Esports boom. As for challenges, AI can bring risks in many aspects, such as algorithmic bias and errors, lack of safe and secure, loss of morals and ethics, invading athletes' privacy, technological miscarriage of justice and technology dependence, and destruction of athlete subjectivity. To promote the sustainability of the Olympic Movement, measures such as optimizing the algorithmic process of AI, enhancing the technology of Big Model, creating an environment of ethical and trustworthy, respect for privacy, and constructing fair AI penalty system should be adopted.*

Keywords: *Artificial Intelligence, Sport Events, Olympic Movement*

1. Introduction

Digital technology has had a profound impact on sport[1]. Artificial Intelligence (AI) are increasingly offering us the possibility to reshape every facet of our lives in recent years. That includes sport. Olympic Agenda 2020+5, the strategic road map of the International Olympic Committee (IOC) and the wider Olympic Movement, highlights digitization as one of the key trends influencing modern society. Bach, the president of the IOC, mentioned in his speech at the opening ceremony of the 141st IOC Session that our continued success depended on how we embraced the ever accelerating development of digital technology and in particular AI. This made our Olympic Agenda 2020 imperative "change or be changed" even more urgent. On April 19, 2024, the IOC released the Olympic AI Agenda in London, England. The Agenda describes the impact that AI could have for the Olympic Movement, as well as the IOC's ambition, guiding principles, and regulatory responsibilities in leading the process of integrating AI with sport. AI likes a double-edged sword, which brings opportunities as well as challenges in the application in the Olympic Movement. By analyzing the deployment of AI for the Olympic Movement, this paper explores the challenges and strategies for AI development in Olympic Movement so as to promote the sustainable development of the Olympic Movement.

2. Methods

Literature review and expect review were conducted in this study to analyse the opportunities as well as the challenges in the application of AI in the Olympic Movement.

3. Results

3.1 Status and future application of AI in the sustainability of the Olympic Movement

3.1.1 Enhancing the level of athletes' competition

AI is revolutionizing the sports industry by enhancing the level of athletes' competition through

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various applications. In terms of performance analysis and prediction, AI-driven analytics platforms can process amounts of data, including player statistics and game footage, in real-time. Machine learning algorithms digest and interpret vast datasets, providing coaches and athletes with actionable insights into performance metrics, health indicators, and even opponent analysis, enabling optimization of training regimes[2]. In terms of injury prevention, AI systems analyze an athlete's biomechanics and movement patterns to identify potential injury risks. This information helps in developing personalized injury prevention programs, extending athletes' careers, and maintaining top performance[3]. In terms of virtual coaching and training, AI enables real-time, remote coaching sessions, providing personalized training insights based on performance data[4]. For example, Petar Veličković at Google DeepMind and his colleagues developed the tool, called TacticAI which was trained on data from 7176 corner kicks in the 2020 to 2021 Premier League season, including player positions over time and their height and weight[5]. It learned to predict who would be the first to touch the ball after a kick was taken. Thus, athlete's progress can be tracked by coaches to adapt training regimens accordingly and to ensure optimal performance enhancement and skill growth of athletes. In terms of injury recovery optimization, AI revolutionizes the way athletes approach recovery processes after injuries by analyzing performance data and identifying injury patterns, which will speed up recovery progression of athletes with the help of tailored rehabilitation programs to ensure athletes return safely to their sport[6]. In terms of real-time health monitoring, AI-powered devices monitor vital signs, sleep patterns, and other health metrics, enabling real-time assessment and management of an athlete's health[7]. In terms of talent spotting, AI technology is now playing a pivotal role in identifying future Olympians, revolutionizing talent identification and athlete development in ways that were previously unimaginable. AI systems are being tested to identify future Olympians by analyzing participants' athletic potential through various physical assessments[8].

3.1.2 Boosting the operational efficiency of management

AI plays a significant role in boosting the operational efficiency of management across various sectors. As for decision-making, by equipping staff with AI tools, AI can provide race staff with accurate race information by collecting and analyzing data in real time, which will help the staff make better decision-making. With AI, organizations can monitor processes continuously, detect inefficiencies, and make adjustments on-the-fly, ensuring smooth and efficient workflows. As for automation of routine tasks, AI can automate repetitive tasks such as data entry, scheduling, and invoice processing, reducing the need for manual intervention, decreasing error rates, and speeding up operations. This allows employees to focus on higher-value tasks, leading to increased productivity and innovation[9]. As for customer service automation, AI-powered chatbots and virtual assistants can streamline operational efficiency by dealing routine customer inquiries and support requests, which can accelerate response times and reduces the workload on human agents, enabling them to address more complex issues[10]. As for financial management, AI automates financial processes like expense tracking, budgeting, and fraud detection, which boosts operational efficiency by streamlining financial workflows. This automation reduces manual oversight, minimizes errors, and accelerates financial reporting[11]. As for refereeing, AI-enhanced refereeing improves the accuracy of refereeing decisions by providing real-time data analysis, and AI-enhanced video review systems help minimize human errors and offer objective insights, ensuring fair play and maintaining the integrity of the game. Besides, by transcribing meeting notes, facilitating multilingual translation, organizing contracts and archives, and so on. This boosts collaboration, participation and efficiency within the IOC and among organizations across the Olympic Movement. Whatsmore, AI can reduce the broadcast footprint through lower power consumption and physical space. AI technology is used to automatically generate tournament highlights, assist video editing work, and improve the efficiency of production and editing. AI live production technology is being used in ice hockey, which is still in the development stage, but shows great potential[12].

3.1.3 Enriching the audience experience

In the aspects of enriching the audience experience, AI can create interactive experiences, such as virtual concerts and hybrid events, offering global audiences an immersive digital experience that traditional broadcasting cannot match[13]. Using an intelligent analytics system, AI offers audience the opportunity to engage more closely before, during and after the competition, including through athlete-centric storytelling, personalized schedules, venue navigation and augmented reality features, whether at the competition venues or elsewhere, which makes the audience experience more personalized and immersive. The audience can also leverage AI technologies to share their own Olympic moments. Furthermore, AI can analyze audience reactions and behaviors in real-time, providing valuable feedback to content creators. This data-driven insight helps refine future content and

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events, ensuring that audience engagement remains high. AI-powered real-time translation and dubbing make content accessible to global audiences, regardless of language barriers. This is particularly important for international events and helps broaden the reach of the content.

3.1.4 Creating an environmentally friendly society

IOC has a strong and positive attitude towards sustainability. The IOC sees itself as a leader in sustainability within the Olympic Movement. AI-enhanced demonstrating a commitment to sustainability enhances public trust and credibility, fostering stronger support for research initiatives and cross-sector collaborations[14]. AI promotes social well-being through sport, supporting athletes, safe sport and fair play. Through the intelligent energy management system, AI can help the efficient use and energy saving by participating the construction of competition venues and monitor and regulate the real energy use of the venues in time, such as the intelligent building management system of the National Aquatics Center- the first renovated venues for the Beijing 2022 Winter Olympics, effectively controls and monitors the indoor temperature, humidity, lighting, acoustics and other variables. The monitoring platform for total energy consumption and carbon emission effectively controls carbon emission and turn the venue into a green and low-carbon one. Moreover, AI can optimize transportation routes and vehicle scheduling to reduce traffic congestion and emissions, and reduce the impact on the environment.

3.1.5 Driving the Esports boom

The AI footprint of esports industry's is large. Thanks to esports, video games are not just for fun anymore, also known as live-streamed professional gaming. Esports is rather an entirely new category of digitally native competition than a virtual version of traditional sports, which utilizes smart machines to enhance the experience. AI is contributing to the growth and development of the esports industry, including enhancing game difficulty, supporting betting ecosystems, creating realistic visuals, and facilitating augmented and virtual experiences. It also touches on the potential of esports technology to foster positive behavior and collaboration among players. Every move of the expert players will be watched, scrutinized, and analyzed by millions of viewers digitally logging into live streams, attending live events, or watching match recaps[15].

3.2 Challenges of AI to the sustainability of the Olympic Movement

3.2.1 Algorithmic bias and errors

AI systems can inadvertently learn and perpetuate biases present in training data, leading to unfair outcomes. Compared with the integration of AI with other industries, there are still some technical obstacles to integration in the field of sports. Pre-processing data can be time-consuming and may not always be effective, especially if the training data is already biased[16]. Model selection methods may be limited by the lack of consensus on what constitutes fairness. As far as sports referees are concerned, "if", "and", "or" and other logical connectives are the basis on which the computer code runs, but these often do not appear directly in the sports rules. In addition to the logical relationship of sports rules, the intricate relationship within individual rules, it is never easy to restore them by machines. AI algorithms may have errors or defects that lead to incorrect game results or athlete performance assessments. AI algorithms may also make decisions based on biases in historical or training data, leading to unfair game results or athlete evaluations.

3.2.2 Risks of safe and secure

The use of AI in the Olympic Movement may raise a number of safe and secure issues, including but not limited to the restrictions on the use of technology, and regulation. Because AI needs to be trained with a large amount of data to gain capability, issues such as illegal collection and use of data, improper content in training data, and data leakage are significant concerns[17]. If it is trained with data that has been contaminated by hackers, the trained model will be vulnerable. Furthermore, AI models and algorithms may have inherent flaws that can be manipulated, leading to unreliable outputs or adversarial attacks.

3.2.3 Loss of morals and ethics

AI systems in the Olympic Movement raise several ethical concerns, including potential negative impacts on athletes' privacy, autonomy, and the exacerbation of inequalities[18]. Due to the inherent lag in regulation, information regulation lags behind the development of information technology, leaving safety regulation in place. Thus, the application of AI in competitions may raise controversies about fair

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play, cheating and ethical standards.

3.2.4 Invading athletes' privacy

The collection and misuse of personal data, unnecessary surveillance, issues of data ownership and control, cybersecurity risks, and discrimination are all significant concerns related to the invasion of athletes' privacy in the application of AI with the Olympic Movement[19]. AI systems typically rely on vast amounts of personal data such as performance metrics, biometric information, and social media activity to function effectively, which can raise significant compliance and privacy risks[20]. If proper safeguards are not in place, this data could be vulnerable to misuse, breaches, or even unintended exploitation. In order to make a profit, some people or companies do not hesitate to invade athletes' privacy and use athletes' data for commercial purposes such as user profiling or advertising and promotion.

3.2.5 Technological miscarriage of justice and technology dependence

Despite the potential of AI technology to improve refereeing accuracy, there is still a risk of miscarriage of justice, especially in complex or fast-changing sporting events. AI has the potential to introduce bias, infringe on athletes' privacy, and the issues of data ownership and control, leading to unfair outcomes or "technological miscarriage of justice". Meanwhile, over-reliance on AI technology may undermine the autonomy and creativity of athletes and the professional judgment of coaches.

3.2.6 Impact on athlete subjectivity

There is a risk that coaches and athletes may become overly reliant on AI systems, leading to a potential erosion of human decision-making and subjective input. Whether the data comes from wearables, sports doctors, or fitness tests, the question remains who ultimately owns an athlete’s data. With the development of AI technology, there may be less emphasis on individual athlete skills and decision-making, thus affecting the athlete's status as a sports subject.

3.3 Strategies of AI to the sustainability of the Olympic Movement

3.3.1 Optimizing the algorithmic process of AI

To maximize the value of algorithmic decision-making and avoid the bias and defects of algorithmic decision-making, the algorithmic process of AI technology needs to be optimized from the source of design, such as differentiating the types of algorithmic decisions, imposing restrictions on algorithmic decisions involving value judgments, and avoiding external interference.

3.3.2 Enhancing the technology of Big Model

Data can be collected from various sensors and devices in different formats, from independent or connected applications. This data avalanche has outpaced human capability to process, analyse, store, and understand the information contained in these datasets[21].The model and underlying data must protect against inappropriate use, disclosure and cyber-security threats. Big Model technology should have the ability of combining expert knowledge with Big Models to automatically generate threat maps and threat report interpretations by analyzing historical data, so that AI will not pose safety risks to people, venues, infrastructure or organizations, helping organizations implement preventive measures before threats even materialize. This proactive approach helps identify and stop cyber-attacks before they cause significant damage.

3.3.3 Creating an environment of ethical and trustworthy

Creating an environment of ethical and trustworthy AI in the Olympic Movement involves a multifaceted approach that includes the establishment of ethical and legal frameworks, the alignment with Olympic values, the development of guidelines, the compliance with data protection regulation, collaborative efforts, sustainability and integrity.

3.3.4 Respect for privacy

In the processing of integrating with AI, data collection, storage, handling, sharing and destruction must align with public expectations for privacy, such as limiting which kinds of data are collected and considering how sensitive information is obscured. The need for careful consideration and regulation in the use of AI within the Olympic Movement should be highlighted. In this regard, relevant organizations may rely on techniques to develop AI systems in sports that process as little personal data as possible, while still remaining functional[22].

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3.3.5 Constructing fair AI penalty system

We should ensure that the data used by the AI system is of high quality and complete to avoid misjudgments due to data issues. Prior to the introduction of AI technology, clear rules and standards need to be established to clarify the scope and limitations of AI use. Those who are involved in the use of AI technology should be trained to improve their understanding of how AI works and its limitations, and to reduce blind trust in the technology. There is a need for professionals to monitor and review the results of AI judgments to ensure that misjudgments can be detected and corrected in a timely manner if they occur. Moreover, the AI penalty system is regularly monitored and evaluated to ensure its accuracy and effectiveness, and the system is updated in a timely manner to adapt to new situations.

3.3.6 Adhering to athlete-centeredness

When introducing AI technology to assist with training or game analysis, athletes should be consulted and explained to ensure they are comfortable and clear with the use of AI and understand its purpose and benefits. The design and implementation of AI technology should be athlete-centered and customized to each athlete's unique characteristics, focusing on their needs and preferences rather than imposing technology on them. Furthermore, a collaborative relationship between athletes and AI technology should be established, positioning AI as a tool to enhance athletes' performance rather than as a means of control.

4. Conclusion

AI is becoming increasingly more important and has revolutionized the field of Olympic Movement. By harnessing the power of AI, the Olympic Movement is witnessing unprecedented advancements in performance, efficiency of management, audience experience, environmentally friendly society and Esports. While reaping the technological benefits of AI, the Olympic Movement must also remain vigilant about the associated risks. It is crucial that AI is used responsibly, fostering trust within the Olympic Movement. IOC, as the leader of the Olympic Movement, should unite the stakeholders across the Olympic Movement – athletes, International Federations, National Olympic Committees, Worldwide Olympic Partners, the International Paralympic Committee and many other organizations – to explore the great potential of AI as well as to mitigate the risks, to truly become a leader in driving the disruptive transformation of AI in the field of sports. The stakeholders across the Olympic Movement should keep the Olympic values in mind, promote responsibility and sustainability, and foster fairness to support athletes and to drive the sustainable development of the Olympic Movement.

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