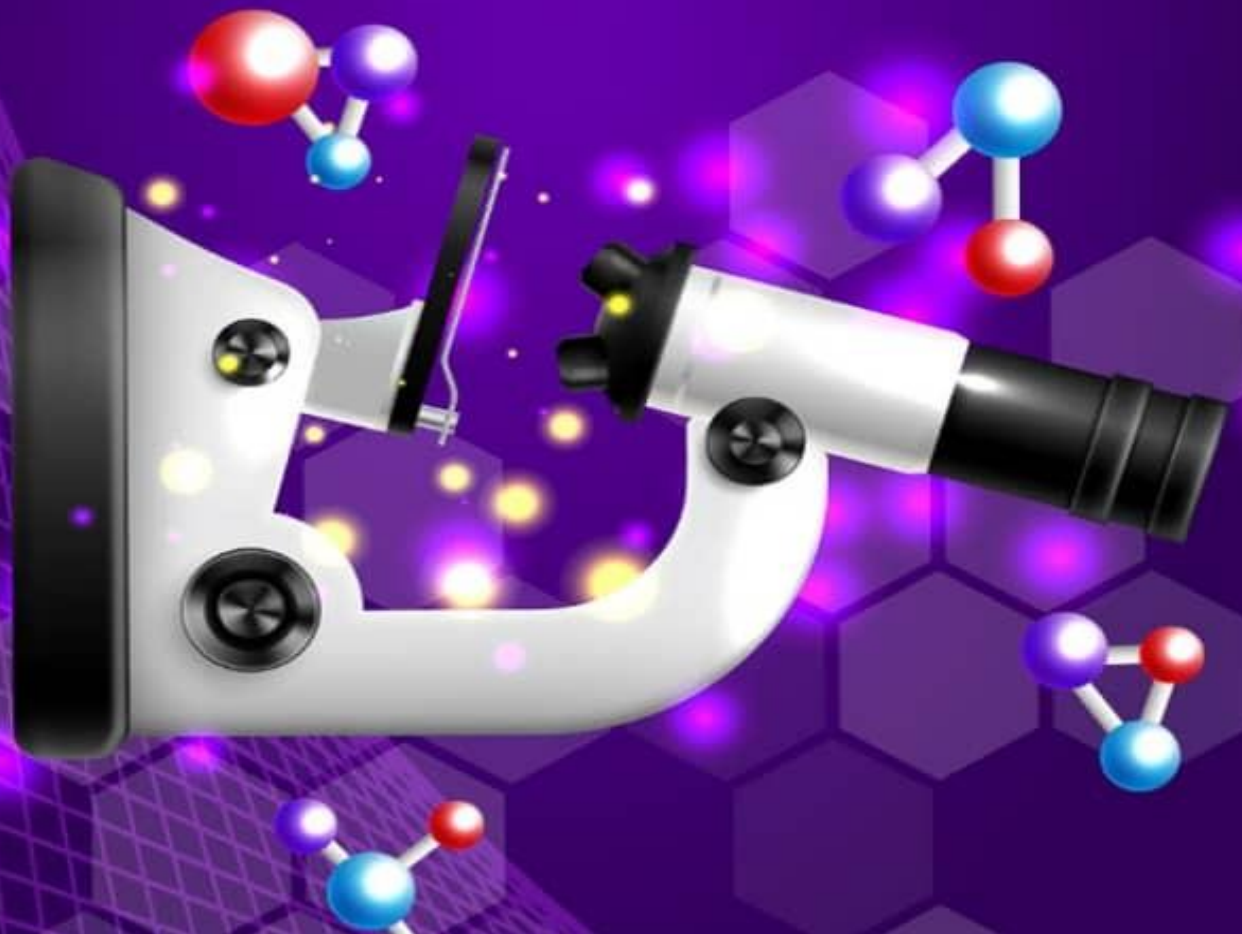# FOS

MULTI-DISCIPLINARY

JOURNAL

(Alvan Ikoku Federal University of Education)

THE INFLUENCE OF ARTIFICIAL INTELLIGENCE ON SPORTS ACTIVITIES AND THE SPORTS INDUSTRY

Oyigbo, Melitus A., Dr. Okafor, Nonye , Ugwuezuonu, Linus O. & Oseni, Jubril
07037828011
E-mail: oyigbomelitus@gmail.com
Department of Human Kinetics and Sports Studies
Alvan Ikoku Federal University of Education, P.M.B. 1033 Owerri

Abstract

The application and influence of artificial intelligence in the field of sports activities and the sports industry cannot be over emphasized. Artificial intelligence has been applied to all walks of life and the field of sports activities and the sports industry is no exception, such as video technology, artificial intelligence for competition and player data analysis, artificial intelligence equipment to help players train, artificial intelligence to develop tactics. Artificial intelligence (AI) is a comprehensive, piercing and cutting-edge discipline that is constantly evolving as an important area of research embedded in all fields of science, sports management information systems (S-MIS), computing and technology. Sports is an excellent field to apply AI design approaches where AI is used as a helpful tool in predicting and determining human endeavours. Numerous studies in the literature have described the impact of artificial intelligence on players and potential future players, fans media, player training, development, scouting and recruitment of athletes, and the entire sports community related to sports.
Keywords: Artificial Intelligence, Technology, Sports Management Information System   (S-MIS).

Introduction

Artificial intelligence is the branch of computer science that is concerned with the automation of intelligent behaviour. Artificial intelligence (AI) is based upon the principles of computer science namely: data structure, used as knowledge representation, algorithms needed to apply knowledge and languages and programming of techniques used in their implementations.

The proliferation of artificial intelligence (AI) technology across various sectors underscores its potential to transform traditional processes and enhance user experiences. Over the past five years, the sports sector has particularly embraced the potential of AI, not just as a tool, but as an innovative solution that can redefine how sports are played, managed, and consumed (Russell & Norvig, 2019). AI exhibits capabilities that resonate with the sports domain: learning, reasoning, and perception. Historically, the sports sector heavily relied on statistics and quantitative analysis. Yet, with AI's interdisciplinary approach, there's an added layer of sophistication in how games are designed, players are trained, and audiences are engaged. Given the rapid adoption of AI in prominent sports such as baseball, tennis, soccer, American football, and basketball, there's a compelling need to assess the full range of its applications and implications. Some prevalent assumptions in the current research landscape include:

- AI-enhanced training tools can potentially surpass traditional coaching methods in identifying and improving player performance.
- Wearable AI technologies might predict and prevent sports injuries more accurately by analyzing physiological and biomechanical data in real-time (Clark, Bjerke, & Carballo, 2019).
- AI-driven analytics could revolutionize sports journalism, broadcasting, and strategy development by offering deeper insights and real-time information processing (Smith, 2021).

Based on these assumptions, this study hypothesizes that:

- AI will become an integral component in sports management, driving efficiency, personalization, and advanced analytics.
- The integration of AI in sports will lead to a significant improvement in player performance, injury prevention, and audience engagement.
- AI's role in virtual reality, match predictions, game simulations, player recruitment, and internal monitoring systems will redefine the modern landscape of sports.

Theory, Research Problem and Literature

The application of AI in sports management can be contextualized using several key theories and models from various domains. These theories underscore the potential of AI in understanding human performance, predicting outcomes, and optimizing training regimens among other applications. Here are some pivotal theories that support AI usage in sports management:

- **Complex Systems Theory:** Sports teams and individual athletes can be viewed as complex systems, where numerous interconnected components interact dynamically. AI can analyze these interactions and forecast outcomes (Stergiou & Decker, 2021).
- **Decision Theory:** Decision-making is crucial in sports, especially for coaches and players. AI models can provide data-driven insights that enhance decision-making processes in game situations (Raiffa, 2018).
- **Feedback Control Theory:** This theory is primarily about systems responding to feedback. In sports, athletes get feedback on their performance, which they use to adjust and improve. AI can provide precise feedback, enabling more effective training and better performance optimization (Åström & Murray, 2018).
- **Information Processing Theory:** This underscore how humans receive, process, and respond to information. In sports, AI can offer insights into how players process information, aiding in strategy formulation and training regimens (Sternberg & Sternberg, 2016).
- **Learning Theory:** AI can be used to understand how athletes learn, helping to tailor training programs according to an individual's or a team's learning patterns and capabilities (Bandura, 1977).

AI can seriously impact sports gaming and horse race betting. AI imitates human actions and abilities, such as thinking and learning. It involves developing intelligent agents or machines that can similarly acquire knowledge, analytical abilities, and professional skills for general

purposes such as problem-solving, modeling, prediction, and rapid use (Poole, 2018). As AI applications rapidly enter the field of sports, athletes, coaches, sports companies, and governments must innovate in AI to excel in their work. Otherwise, they will face a severe loss of economy and motivation in the coming years (Nadikattu, 2020).

Although the application of AI in sports has become widespread in the last few years, public authorities have not yet reached a certain level of awareness. Especially in underdeveloped or developing countries. Therefore, encouraging the development of domestic and national algorithms will go a long way in this regard. The ability and motivation of clubs to win matches. highlights the rapid advancement of AI technologies and becomes increasingly important for developing technical personnel and players managing their operations. They use many applications to grow, maintain and retain their fans, but sports teams should not just use cutting-edge AI technology. AI technologies are necessary to provide database access in sports, identify skills to generate critical ideas and appropriate actions, identify talents, whether they are fans, and facilitate pre-match preparation in sports. (PwC, 2019).

Key Concerns For Artificial Intelligence (AI) In The Sports

One of the primary risks associated with AI in sports is the potential for bias. According to Wilson, Hoffmann, and Kassens-Noor (2020), the data used to train AI algorithms can be biased, leading to the algorithm producing biased results. This could result in discrimination against certain athletes or teams, leading to unfair outcomes. Additionally, the use of AI could reinforce existing biases in the sport, such as gender or racial stereotypes, which could have a negative impact on diversity and inclusion in sports. Another risk of AI in sports is the potential for privacy breaches. As noted by Dvořák, Schumacher, McCrory, and Davis (2020), AI algorithms require access to large amounts of personal data, including medical and biometric information, in order to analyze and improve athlete performance. This information is often sensitive and should be protected to prevent unauthorized access and use. A privacy breach could not only violate athlete privacy, but also impact their health and safety.

Therefore, as AI is becoming increasingly popular in the sports sector, there are several key concerns that must be addressed. These include:

i. Privacy and security: The use of AI in sports requires large amounts of personal data, which must be protected from unauthorized access, hacking, and data breaches. A report by the European Parliament (2018) states that the use of AI in sports may raise privacy and security risks if personal data is misused, such as selling personal data to third parties or sharing it with other companies.

ii. Bias and discrimination: AI algorithms can perpetuate existing biases and discrimination, which can have a significant impact on the sports sector. For example, AIpowered performance analysis tools may overlook key skills and abilities of female athletes or underrepresented groups (Burrell, 2017).

iii. Data accuracy and reliability: The use of AI in sports relies heavily on the quality and accuracy of the data being used. Any inaccuracies or errors in the data can lead to incorrect decisions, such as player selection, tactics, and injury prevention (Blazevic, 2019).

iv.   Economic impact: The use of AI in sports can have significant economic implications, including job losses in traditional sports-related industries and a shift towards a more technologically driven industry. Additionally, the cost of implementing AI systems can be a barrier for smaller organizations (European Parliament, 2018).

Cross Sectional Usage of Artificial Intelligence in Sports

Coaching and Refereeing using Artificial Intelligence:

Current digital tools and methods have operational limitations such as unsupervised autonomy, resistance to shock and vibration, and environmental operating ranges (Bacic, 2018). Currently, commercial sports coaching software development is limited by the cost of acquiring motion data in terms of accuracy, validity, noise, sampling rate, and robustness against accidental data loss. The Video Assistant Referee (VAR) system is the first widespread use of video technology to make more accurate decisions in football. It protects the referees from angry fans and players by giving referees more credits, more power, fewer mistakes, and generally more robust justifications when taking action against them (Arastey, 2021). Another study by Anik (2018) evaluated how VAR affects spectators' perceptions of quality, flow, results, and enjoyment from matches and referees' perceptions of performance, reliability, and reliability.

Player Performance Improvements

It is essential to identify which AI approaches are used to investigate sports performance and injury risk and which AI methods are used in each sport (Claudino et al., 2019). AI is also used to improve player performance. Apps like HomeCourt use computer vision and machine learning to assess basketball players' skills, giving them the perfect environment to thrive. Recording these performance figures for athletes is simply not believable. It also helps players understand where they can excel and areas for improvement.

Sports Journalism and Broadcasts

Automotive journalism is about to enter a market where AI has a significant impact. These technologies offer great potential to improve journalism today, especially by allowing journalists to process large amounts of data in a limited time, create and automatically transmit news from structured data, and have a more diverse reach (Ali and Hassun, 2019). Using the power of natural language processing (NLP), AI could completely change the face of journalism. For example, software like Wordsmith can process sporting events to summarize the day. Sports broadcasters and streaming platforms constantly look for new ways to engage their fans and deliver immersive experiences that bring them closer to real time action. Sports broadcasters are currently exploring innovative technologies that are at the forefront of AI and machine learning (ML) to increase speed efficiency and create new revenue opportunities (Bera, 2021). AI is revolutionizing the world of sports for coaches and players and significantly impacting the sports experience of spectators. AI systems can automatically select the correct camera angle to view on viewers' screens.

Sports in Virtual Reality

Virtual reality technology is becoming more and more advanced with computer hardware, software, and virtual world integration technologies that can dynamically simulate the real world. The dynamic situation depends on the person's shape, language, etc. It can respond instantly

according to needs. Thus, real-time communication is established between people and the virtual world. That is why virtual reality technology is used in sports training, sports, etc. It is practiced and plays an essential role in developing competitive sports (Wang, 2022). VR headsets and enthusiasts can now compete against each other virtually from all over the world.

Match Predictions

One of the growing areas that require good prediction accuracy is sports prediction because of the significant amount of money involved in betting. Additionally, club managers and owners look for classification models to understand and articulate the strategies needed to win matches. These models are based on numerous game factors, such as past match performance, player performance, and opponent information (Bunker & Thabtah, 2019). The result of the model can be generated to predict upcoming matches such as football or cricket where big data is available. One of the most practical applications of this can be shared by Great Learning students with the project "Predicting IPL Cricket Match Results Using AI Techniques."

There are several ways AI can help match prediction. One is indirectly crowdsourced data. Prediction markets such as the betting exchange allow customers to place bets on the outcome of individual events. This is a crowdsourced method and is the best score one can get if there are enough participants to decentralize all the market's collective wisdom with sufficient diversity of information and independence decision making. This is an implicit market because we do not know why people make betting choices, so it cannot be interpreted. If enough people attend these markets, all possible information is available to forecast that market. If so, it is impossible to beat the accuracy of this market forecast. Another method is to use an open data-driven approach that uses only historical match data and machine learning methods to predict match outcome probabilities (Arastey, 2021).

Betting sites use a hybrid data crowd sourcing approach, often combined with data driven methods, to balance action and manage risk levels on both sides of the bet. AI-based solutions and monitoring data can be used to support these prediction markets, especially in markets where there is not enough scope to gather information from the target audience. One way to do this is to calculate the probability of winning. The probability of winning is widely used for media purposes in almost all sports. The current limit to winning is based on the probability of an average team winning in a given match situation. Stats Perform uses models that learn compact representations with specific opponents, players participating, and other raw lineup features to improve the performance of player-based predictions in a game (Arastey, 2021).

Sports Analysis

The past decade has ushered in a new era of sports analytics that maximizes the value of traditional score and activity data with deeper tracking data. Sports analytics has traditionally relied on scores and event data, from Bill James's massive 1981 Project Leader board campaign to build a fan network to collect and disseminate baseball information. In the 2010s, monitoring data began to pave the way for analyzing new sports. Through data monitoring, the AI revolution in sports focuses on three key areas:

- **Deeper Data Collection** with Computer Vision or Wearable Devices

- **Deep scene type analysis** could not do without human-AI with tracking data.
- **Depth assessment** for better grades. Data reconstruction usually starts by breaking the game down into manageable chunks, such as owned items. However, when it comes to understanding how this game is played or how well organized it is, human recording systems do not exactly provide the best information to reconstruct the story. When manually collecting very detailed information, people have cognitive and subjective limitations, such as getting an accurate time frame for each event or providing an objective assessment of how well a game is played (Arastey, 2021).

According to Arastey (2019), Computer vision systems that collect monitoring data directly from broadcast video recordings follow three simple steps:

- **Points representing the player and ball trajectories.** These points can then be plotted in an area chart for visualization.
- **Standard metrics can be derived** (e.g., expected targets).
- Then the trajectories of the movements of the points in a given time interval can be compared with semantic events in sports (for example, a shot on goal).

With the rapid development of network and multimedia technology, many sports and national fitness data are stored in various fitness management systems in video and images. Sports video has different editing, segmentation, and integration need to stimulate public interest better and make it easier to learn and watch. A sports video segmentation method based on a fuzzy clustering algorithm has been proposed to overcome the shortcomings of existing methods such as coarse segmentation results and high spatial distortion rate (Chang, 2019). The main advantage of this method is image compression.

The advantage of watching data over raw video is that it allows one to query points rather than pixels while maintaining the interpretability and interactivity of raw video. The game can be recreated using points drawn in the field diagram without the need for additional details, which are available in millions of pixels in the image to show how each capture takes place. The computer learns to predict and convert input data from pixels to desired point output through machine learning processes. The conversion of pixels to points occurs through supervised learning.

Providing Support for Strategy Analysis

AI has revolutionized athletics and taken it to a whole new level. While it has long been clear that analytical and predictive research plays a vital role in sports, AI significantly impacts how games are played, structured, and influenced by audiences. Additionally, AI helps analyze the mental stability of athletes (Lei, 2021).

While technique and tactics are the main factors in winning online sports, analysis and decision support are key technology. AI, data mining, and decision support technologies to develop multimedia and interactive data collection systems and intelligent systems are to analyze techniques and tactics in network sports. The effects of the application are significant (Yu et al., 2010). Team-building or structure information does not emerge directly from tracking data without additional

work. However, data tracking allows one to find and reveal a team or players' hidden behavior and structure (Arastey, 2021).

Player Recruitment

Generating viewing data via broadcast video could fill this gap. Tracking data using broadcast images is the best way to get detailed data about a cluster. It determines the players' body poses and can override the player when they reappear in the image after leaving the frame. In addition, AutoStats uses optical character recognition to aggregate playback and shooting times per frame and action recognition to track the duration of player events at the frame level. It is hoped that critical factors related to career development can be determined by an objective assessment of many variables for a larger sample size than previously used in the current literature. It is a valuable tool for assessing potential transfer goals in professional football and improving subjective assessments of coaches and observers (Barron et al., 2018). It can use forecasting models based on historical data and possible successes of old newcomers to predict the future performance of current prospects. These decisions may even reflect the future career of the young player.

The Use of Artificial Intelligence in Different Sports Game Domains

AI applications can be seen in other sports industries, especially cricket, baseball, football, tennis, and basketball:

Baseball: Analysts can now apply machine learning algorithms to large baseball datasets to gain valuable insights into the player and team performance (Köseler & Stephan, 2018). One of the critical areas where AI can make a difference in sports is discovering new players. The AI collects information about players, such as their average speed, the angle they hit, or how they throw the ball. It helps generate ideas for employers. It also uses VR or Virtual Reality, a simulation tool that allows shooters to shoot and enhance with specific shooters.

Cricket is one of the most loved, popular, promoted, and exciting sports that requires appropriate development through machine learning and AI to achieve greater accuracy. With the increase in the number of matches over time, data on cricket matches and individual players proliferate. In addition, there is a growing need for big data analytics and the ability to use this big data for many practical purposes effectively, such as selecting players for a team, predicting the winner of a match, and many other future predictions (Avan, 2021).

Currently, AI is used in Duckworth Lewis's Decision Review System (UDRS) to analyze the outcome of escapes. AI can also design indoor stadiums or indoor stadiums to keep the game going even in bad weather.

Tennis: Including service technologies, loop on the right, left, rebound, splitting, short stroke, and block, can be supported by artificial intelligence (Wei, 2021). Watson's revolutionary AI technology can understand, learn and interact. It uses all these elements to create promotional videos that can be shared on social media.

Football is a dynamic and fast-paced soccer game: In the last few years, the first applications of AI have appeared in football, but the scope of AI applications is still unclear. In addition, Madrid-based Olocip uses AI algorithms to predict success or failure. Additionally, stakeholders should be aware of the limitations of AI (Keshav et al., 2020).

In basketball: Basketball is one of the most popular sports globally, and related industries have also brought significant economic benefits. AI technologies in basketball have attracted significant attention in recent years. We believe that the application of AI in basketball is still in its infancy (Li and Xu, 2021). NBA teams have also turned their attention to AI and machine learning. HomeCourt is an example of an application based on computer vision and AI that can help players improve their basketball shooting.

Simulation game: The idea behind the shading is to show that the average game moves simultaneously as the live game, represented by the dots on the area chart (Arastey, 2021). The use of simulation provides marketing educators with many learning opportunities that students cannot access without simulation. Previous research on role-playing and simulation sessions has documented higher student motivation and engagement levels than traditional lecture methods. Simulations also help prepare students for skills needed for future employers (Gillentine & Schulz, 2001).

A coach can draw the game he wants his players to play on his board, and data and tracking technologies can make smartboards that can simulate how a game drawn by a coach will be played. The more detailed data available, the better we can predict sports performance (Arastey, 2021).

Sports Companies with Artificial Intelligence

According to a report by Markets and Markets, the global sports AI market is expected to grow at a compound annual growth rate (CAGR) of 29.8% from 2021 to 2026 (Market Watch, 2021). The report states that the increasing popularity of sports and growing demand for personalized experiences are driving the growth of the market.

Another report by Grand View Research, Inc. also predicts that the global sports analytics market will grow at a CAGR of 18.1% from 2021 to 2028 (Grand View Research, Inc., 2021). The report cites the increasing use of advanced technologies in sports and the growing focus on player performance analysis as key drivers of the market growth.

Therefore, based on these reports, the global business CAGR on sport services using AI is expected to grow significantly in the coming years, driven by the increasing popularity of sports and growing demand for personalized experiences.

- **HomeCourt** brings NBA stars' workouts to an AI-powered workout app. HomeCourt is a free interactive basketball app that helps everyone get better. A personal basketball coach is always there, recording games, stats, and progress and taking it to the next level. Using HomeCourt is more like a video game than a workout. Now skill-building exercises are fun instead of boring, so one can keep doing them and get better.
- **Dojo Madness** develops real-time learning tools for Dota 2, Overwatch, and League of Legends fans.
- **Catapult** creates wearable technologies for football players to optimize performance and minimize injury.
- **Mustard** - Uses AI to analyze an athlete's mechanics and offer tips to improve their performance.

- **Asensei** - Consists of a training platform that uses motion capture sensors in regular sportswear to guide and adjust individual workouts.
- **Stream Layer** allows content owners and OTT operators to interact on a mobile device.
- **Wyscout:** Wyscout is a company that provides an AIbased platform for professional football clubs, offering analysis, scouting and performance monitoring services.
- **Metrica Sports**: Metrica Sports is a company that provides AI-based solutions for sports analysis, including player tracking, tactical analysis, and match performance analysis.
- **Deltatre**: Deltatre is a company that provides AIbased solutions for sports broadcasting, including augmented reality graphics and live data analytics.
- **Interstices Solutions**: Interstices Solutions is a company that provides AI-based solutions for sports broadcasting, including real-time data analysis and automatic highlights generation.

Conclusion

The integration of AI within the realm of sports management is founded upon a comprehensive and diverse theoretical framework. By referring to the Complex Systems Theory, the researcher comprehend that sports structures aren't just linear units; rather, they resemble intricate networks. Within these networks, AI has the capability to forecast and decode dynamic interactions, turning chaos into understandable patterns. Decision Theory, on the other hand, paves the way for AI's potential to fine-tune in-game decisions, backed by empirical data. Feedback Control Theory accentuates the significance of responsive feedback in enhancing performance, placing AI at the forefront as the instrument for achieving such precision. Through the lens of Information Processing Theory, the researcher can discern how athletes decode and act upon various stimuli, implying AI's indispensable role in strategizing and training formulation. Furthermore, Learning Theory underlines the adaptability of AI in customizing training paradigms that cater to individualized learning behaviors.

Collectively, the synergy of these theories not only underscores the transformative power of AI within sports management but also propels the sector towards a paradigm where decisions are more empirically grounded, adaptable, and optimal. As asserted by Araujo et al. (2021), AI does not simply offer a modern analytical perspective in sports performance; it pioneers pragmatic solutions for stakeholders spanning from coaches and sports analysts to engineers, data scientists, and statisticians. Echoing the sentiments of PVC (2019), the rapid technological strides in AI are not just evolutionary but revolutionary. They are reshaping the fabric of sports organizations, from game strategies and talent development to fan engagement and overall experience. AI's imprint on the sports sector is undeniable, promising transformative changes in training, gameplay techniques, and audience interactions.

However, as the researcher embrace the AI-driven future of sports, there's an imperative for national sports strategies and federations to align with these advancements to ensure coherence and maximize benefits. Beyond the technology itself, there's a clarion call for governments to proactively design policies and frameworks. These policies should aim to amplify the sporting experience for all stakeholders involved, ensuring that AI serves as a tool of enhancement, rather

than disruption. The use of AI in sports should be ethical, transparent, and fair to all parties involved:

Recommendations

1. There should be protection and privacy policies to ensure the athletes' personal and sensitive information is protected.
2. There should be ethical policies for the use of AI in sports to ensure that the technology is used fairly and does not give an advantage to any one team or athlete.
3. There should be policies for data sharing and collaboration between sports organization tech companies and academic institution to promote innovation in the field of AI in sports.
4. There should be collaboration with tech to develop new AI-based technologies for sports performance analysis, injury prevention and player tracking.
5. Investment in AI research and development to drive innovation in sports technology should be developed.
6. There should be promotion in the use of I in sports education and training programme to ensure that athletes and coaches are equipped with the skill to take advantage of the technology.

REFERENCES

Ali, W. & Hassoun, M. (2019). Artificial intelligence and automated journalism: modern challenges and new opportunities, International *Journal of Media, Journalism and Mass Communication (IJMJMC),* 40-49, ISSN 2454-9479, http://dx.doi.org/10.20431/2454-9479.0501004

Alvan, G. (2021). AI-based sports broadcasting solutions. [Website]. Retrieved from https://intersticesolutions.com/

Anik, L. (2018) How football video assistant referee (VAR) affects belief in the competence of human referees. *Behavioral scientist*. Bond.

Arastey, G. M. (2019). Application of video technology in football refereeing - Yes, https://www.sportperformanceanalysis.com/article/application-of-video-technology-infootball-refeareeing-var

Arastey, G. M. (2021). Artificial intelligence (AI) in sports, https://www.sportper formanceanalysis.com/article/artificial-intelligence-ai-in-sports.

Araujo, D., Couseiro, M., Seifert, L., Sarmento, H., & Davids, K. (2021). Artificial intelligence in Sports performance analysis (1st ed.). Routledge. https://doi.org/ 10.4324/9781003163589

Åström, K. J., & Murray, R. M. (2018). Feedback systems: An introduction for scientists and engineers. Princeton university press.

Bacic B. (2018). Development of connective systems for adaptive sports coaching. Neural information processing - Letters and Reviews, vol. 12, Issue 1-3, January-March

Bandura, A. (1977). Social learning theory. Prentice-Hall.

Barron D., Graham B., Matthew R., & Caroline S. (2018). Neural networks and professional football recruitment, affective computing and human-computer interaction, https://doi.org/10.1371/journal.pone.0205818

Bera, A., (2021) "Artificial intelligence: transforming the live sports landscape", SMPTE. *Motion Imaging Journal*, 130, (3) 28-34, April, doi: 10.5594/ JMI.2021.3060823.

Blazevic, D. (2019). Artificial intelligence in sports. *International Journal of Performance Analysis in Sport,* 19(3), 314-328. https://www. Tand fonline.com/ doi/ full/ 10.1080/24748668.2019.1621333

Bunker R. P. & Tabtah F. (2019). Machine learning framework for sports performance prediction, *Applied Computing and Computer Science*, 15, (1) 27-33, ISSN 2210-8327, https://doi.org/10.1016 / j.aci.2017.09.005 .

Burrell, J. (2017). The ethics of AI in sport. *British Journal of Sports Medicine*, 51(17), 1162-1166. https://bjsm.bmj.com/content/51/17/1162

Campbell M. (2022). Deep blue. Artificial intelligence 134, 57-59

Catapult Sports (2021). AI-based athlete performance solutions. [Website]. Retrieved from https://catapultsports.com/:

Chang W. Y. (2019). Fuzzy algorithm-based sports video imaging research, *Journal of Visual Communication and image Representation,* Vol. 61, (5) 105-111, ISSN 1047- 3203, https://doi.org/10.1016/j. jvir.2019.02.033 .

Clark, J., Bjerke, M. & Carballo, L. (2019). Wearable AI in sports: predicting and preventing injuries through data.

Claudino, JG, Capanema, D.D, & De Souza, T.V. (2019). Current approaches to using artificial intelligence to assess injury risk and predict performance in team sports: a systematic review. Sports Med - Open 5, 28 https://doi.org/10.1186/s40798-019-0202-3

Dvořák, J., Schumacher, Y. O., McCrory, P., & Davis, R. (2020). Medical artificial intelligence in sports: Are we ready for it? *British Journal of Sports Medicine*, 54(11), 637- 639.

European Parliament (2018). Artificial intelligence: future of humanity and governance of AI. Retrieved from https://www.europarl.europa. eu/doceo/ document/TA-8-2018-0042_EN.html

Gillentine, A. & Schultz, J. (2001). Fantasy football league marketing: Using simulation to develop sports marketing concepts. *Journal of Marketing Education*, 23 (3), 178–186. https://doi.org/10.1177/0273475301233003

Grand View Research, Inc. (2021). Sports analytics market size, share & trends analysis report by component (Software, Services), by application (performance analysis, player tracking, fan engagement), By deployment model, By End-use, and segment forecasts, 2021-2028. Retrieved from https://www.grandviewresearch.com/industry-analysis/sports analytics-market

Işık, A., (2021). Türk futboluna yerli ve millî yapay zekâ, TFF, https://www.tff.org /default.aspx?pageID=286&ftxtID=35471

Keshav Rathy, Aditya Cole V., Priyam Somani & Manu KS, (2020). Artificial intelligence football game in practice: A global perspective, *International Refereed Journal of Social Sciences, DOI URL* : http://dx.doi.org /10.18843/rwjasc/ v11i2/03

Lei, Wu (2021). "Research on a mining strategy to improve the psychological experience of athletes in the age of artificial intelligence." 1 January 1-11

Li, B., & Xu, X. (2021). The use of artificial intelligence in basketball sports. *Journal of Education, Health and Sports,* 11(7), 54-67. https:// doi.org/ 10.12775/JEHS.2021. 11.07.005

MarketWatch. (2021, March 12). Sports AI Market Worth USD 2.97 Billion by 2026 - Exclusive report by markets and markets. Retrieved from https://www.marketwatch.com/press-release/sports-ai-market-worth-usd-297-billion-by2026-exclusive-report-by-marketsandmarkets-2021-03-12

Nadikattu, R. R. (2020). Implementing new ways of artificial intelligence in sport (14 May 2020). *Journal of Xidian University*, 14, (5) 5983–5997, available at SSRN: https://ssrn.com/abstract=3620017 or http://dx.doi.org/10.2139/ssrn.3620017

Newborn, M. (2017). Kasparov vs. Deep Blue: Computer chess is getting old. spring

Novachkov, H. & Baka, A. (2023). Artificial intelligence in sports in the example of strength training. Journal of Sports Science and Medicine, 12(1), 27-37.

Poole, D. (2018). Computational intelligence: a logical approach. New York: Oxford University Press.

PVC (2019). Application of artificial intelligence to sports industry, https://www.pwc.com.au/industry/sports/artificial-intelligence-application-to-the-sportsindustry.pdf

Raiffa, H. (20188). Decision analysis: Introductory lectures on choices under uncertainty. Addison-Wesley.

Roseker, T. & Stephane, M. (2021). AI-based sports broadcasting solutions. [Website]. Retrieved from https://www.deltatre.com/

Russell, S. J., & Norvig, P. (2019). Artificial intelligence: A modern approach.

Smith, R. (2021). AI and its transformative role in sports. *Journalism and Broadcasting*.

Stergiou, N., & Decker, L. M. (2021). Human movement variability, nonlinear dynamics, and pathology: is there a connection? Human movement science, 30(5), 869-888.

Sternberg, R. J., & Sternberg, K. (2016). Cognitive psychology. Nelson Education.

Wang, J. (2022). Research on the application of virtual reality technology in competitive sports, *Procedia Engineering*, (29), 3659-3662, ISSN 1877-7058, https://doi.org/ 10.1016/j. proeng.2012.01. 548 .

Weli, J. (2021). AI-based sports analytics solutions. [Website]. Retrieved from https:// metri casports.com/

Wilson, J. M., Hoffmann, D. A., & Kassens-Noor, E. (2020). Artificial intelligence and sports: A systematic review. *Sport, education and society*, 25(3), 237-256.

Yu L., Ling, P. & Zhang, H. (2010). Analysis of decision support system, methods and tactics in networked sports and application to Beijing Olympic Games, Second WRI Global Intelligent Systems Congress, 2010, p. 170-174, doi: 10.1109/GCIS.2010.139.