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An Assessment Over the Impact of Artificial Intelligence on Sports Activities and the Sports Industry

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ABSTRACT

Purpose: To determine various methods of artificial intelligence (AI) that have been developed, often based on an past sporting events, to generate well-formulated training plans, game strategies automatically, and score feedbacks; To develop proposals for strategies, policies and programs applicable by Türkiye dynamics.
Method: Literature review, internet search for tools and programs available in the market and descriptive and content analysis techniques are used.
Results: 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, sport 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 endeavors. Numerous studies in the literature have described the impact of AI on players and potential future players, fans, media, player training, development, scouting, recruitment, and the entire sports community related to sports. AI methods for the strategic management of athletes and sports organizations have matured by automatically generating sports plans, results, scores, and predictions in individual sports disciplines.
Conclusion: With a view to the future of the relationship between athletes, sports economics, rules, and athletes, this research helps identify existent and prospective most effective application areas of AI with the help of main findings and recommendations in the literature. Suggestions have been developed for strategies, policies and programs that can be supported and implemented in Turkish conditions.
Keywords: Artificial neural networks, Deep strategy, Robot detection systems, Intelligent sports management information systems (S-MIS).

ÖZET

Yapay Zekanın Spor Aktiviteleri ve Spor Endüstrisi Üzerindeki Etkisi Üzerine Bir Değerlendirme

Amaç: Genellikle geçmiş spor etkinliklerine dayalı olarak geliştirilmiş çeşitli yapay zeka (YZ) yöntemlerini belirleme, iyi formüle edilmiş antrenman planları, oyun stratejileri otomatik olarak oluşturma ve geri bildirimleri puanlama kabiliyeti noktasında Türkiye dinamiklerine uygun strateji, politika ve program önerileri geliştirmek.
Yöntem: Literatür taraması, piyasada bulunan araç ve programlar için internet taraması, betimsel ve içerik analizi teknikleri kullanılmıştır.
Bulgular: YZ, bilim, spor yönebim bilgi sistemleri (S-YBS), bilgi işlem ve teknolojinin tüm alanlarına gömülü önemli bir araştırma alanı olarak sürekli gelişen kapsamlı, delici ve son teknoloji bir disiplindir. Spor, YZ'nin insan çabalarını tahmin etmede ve belirlemede yardımcı bir araç olarak kullanıldığı makine öğrenimi tasarım yaklaşımlarını uygulamak için mükemmel bir alandır. Literatürdeki çok sayıda çalışma, YZ'nin mevcut oyuncular ve gelecekteki potansiyel oyuncular, taraftarlar, medya, oyuncu eğitimi, geliştirme, izcilik, işe alma ve sporla ilgili tüm spor topluluğu üzerindeki etkisini tanımlamıştır. Sporcuların ve spor

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organizasyonlarının stratejik yönetimi için YZ yöntemleri, bireysel spor disiplinlerinde otomatik olarak spor planları, sonuçları, skorları ve tahminleri üreterek olgunlaşabilmektedir.
Sonuç: Sporcular, spor ekonomisi, kurallar ve sporcular arasındaki ilişkinin geleceğine yönelik bu araştırma, literatürdeki temel bulgular ve öneriler yardımıyla AI'nın mevcut ve gelecekteki en etkili uygulama alanlarının belirlenmesine yardımcı olmaktadır. Türkiye şartlarında desteklenebilecek ve uygulanabilecek strateji, politika ve programlar için öneriler geliştirilebilmiştir.
Anahtar Kelimeler: Yapay sinir ağları, Derin strateji, Robot tespit sistemleri, Akıllı spor yönetim bilişim sistemleri (S-YBS).,

INTRODUCTION

The proliferation of 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. Drawing from strong theoretical foundations in mathematics, computer science, linguistics, and psychology (Russell & Norvig, 2009), 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:

1. AI-enhanced training tools can potentially surpass traditional coaching methods in identifying and improving player performance.

2. Wearable AI technologies might predict and prevent sports injuries more accurately by analyzing physiological and biomechanical data in real-time (Clark, Bjerke, & Carballo, 2019).

3. 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:

1. AI will become an integral component in sports management, driving efficiency, personalization, and advanced analytics.

2. The integration of AI in sports will lead to a significant improvement in player performance, injury prevention, and audience engagement.

3. AI's role in virtual reality, match predictions, game simulations, player recruitment, and internal monitoring systems will redefine the modern landscape of sports.

To validate these hypotheses and delve deeper into the nuanced applications of AI in the sports domain, this research will navigate through existing literature and empirical findings. Areas of exploration will include coaching and refereeing using artificial intelligence, player performance metrics, sports journalism dynamics, broadcasting paradigms, virtual reality intersections, match predictive models, comprehensive sports analysis, AI's applicability across different sports, internal monitoring system enhancements, strategic analysis support, simulation gaming, player scouting mechanisms, and the broader canvas of sports corporations employing AI.

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:

1. 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, 2011).

2. 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, 1968).

3. 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, 2008).

4. 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).

5. 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).

According to the results of a query by the Scholar database, there are many publications in the literature on sports and artificial intelligence. The expression *"*AI *in sports"* is used in the query, and it was reported that there were 254,000 publications in the expression in the text. However, 335 studies were found according to the search text in the article's title.

Chess, and especially the first computer victory over a world champion in 1997, is an example of the high potential of AI (Newborn, 1997; Campbell, 2002). However, it should be noted that such advances are closely related to the continuous increase in computing power, which is an important feature and advantage of the modern information technology environment (Novachkov and Baka, 2013). It can seriously impact sports gaming and horse race betting. Getting the correct information and information by processing big data as quickly and accurately as storing it becomes one of the biggest challenges. It also causes significant funds and economic activity. It is seen that serious research and investments in this area are insufficient (Baca and Kornfeind, 2012). 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 et al., 1998). 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 et al., 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, it cannot be said that serious research has been carried out or awareness has been raised on this subject. We can say that it is far behind the level of Turkey. 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. A report titled "Application of AI in Sports Industry" was published by PWC in February 2019. The report emphasizes that 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 AI IN THE SPORTS

While it has the potential to revolutionize the way sports are played and analyzed, there are also several risks associated with the use of AI in sports. In this response, I will discuss some of the key risks identified in the literature. 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. A third risk associated with AI in sports is the potential for unintended consequences. As AI algorithms are complex and difficult to fully understand, they may produce unexpected results or consequences that were not intended by the creators. This could lead to unintended outcomes that could negatively impact the sport, athletes, or fans. For example, a well-intentioned AI algorithm designed to improve player safety could inadvertently lead to changes in the rules of the sport that negatively impact its integrity or excitement (Wilson et al., 2020).

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

1. 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.

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

3. 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).

4. 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).

In conclusion, the use of AI in the sports sector requires careful consideration of the potential risks and benefits, with a focus on data privacy and security, the avoidance of bias and discrimination, data accuracy, and the economic impact of AI. Therefore, the use of AI in sports presents several risks that must be addressed to ensure that its benefits are realized without negative consequences. The risks of bias, privacy breaches, and unintended consequences are just a few of the potential issues that must be considered in the development and deployment of AI in sports.

CROSS SECTIONAL USAGE OF AI IN THE 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, 2008). Currently, commercial sports coaching software development is limited by the cost of acquiring 3D 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, 2012). 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 crowdsourcing 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).

Team Predictions

Team	Metric	Prediction	Probability
49ers	Passing Touchdowns	1.5	Over: 55.22% / Under: 44.78%
49ers	Rushing Touchdowns	1.5	Over: 30.82% / Under: 69.18%
49ers	Defensive Sacks	2.5	Over: 52.15% / Under: 47.85%

Quarterback Predictions

Team	Positions	Player	Metric	Prediction	Probability
49ers	QB	Jimmy Garoppolo	Passing Yards	199.5	Over: 50.23% / Under: 49.77%
49ers	QB	Jimmy Garoppolo	Passing Attempts	31.5	Over: 50.58% / Under: 49.42%
49ers	QB	Jimmy Garoppolo	Passing Completions	21.5	Over: 50.60% / Under: 49.40%
49ers	QB	Jimmy Garoppolo	Passing Touchdowns	1.5	Over: 55.22% / Under: 44.78%
49ers	QB	Jimmy Garoppolo	Interceptions	0.5	Over: 52.86% / Under: 47.14%
49ers	QB	Jimmy Garoppolo	Rushing Attempts	1.5	Over: 36.32% / Under: 63.68%
49ers	QB	Jimmy Garoppolo	Rushing Touchdowns	0.5	Over: 3.82% / Under: 96.18%
49ers	QB	Jimmy Garoppolo	Rushing Yards	4.5	Over: 49.63% / Under: 50.37%

Source: Retrieved from Arastaeus (2021).

Similarly, these predictions can be made in real-time during the game. For example, in-game tennis predictions can predict who is more likely to score the next point in a draw using tracking data. In football, one can also predict who will be the next player to take the ball from a pass or where the next goal kick will be (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 Leaderboard 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:

1. **Deeper Data Collection** with Computer Vision or Wearable Devices

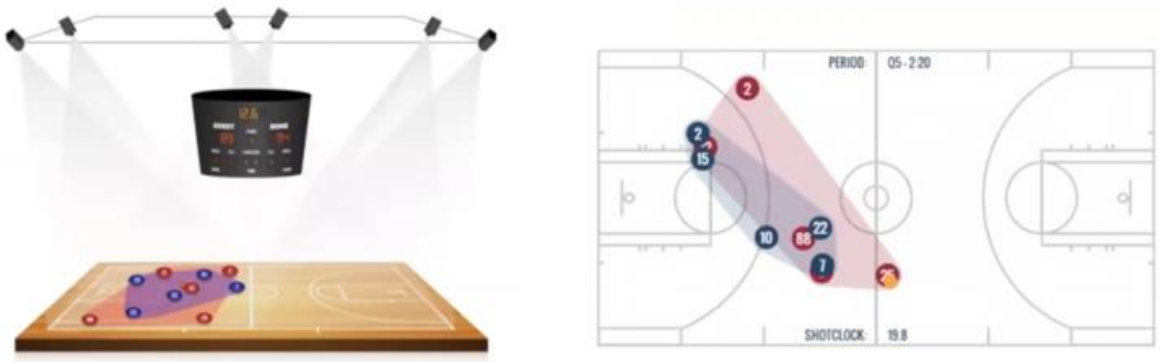
2. **Deep scene type analysis** could not do without human-AI with tracking data.

3. **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).

Support for internal monitoring systems

One way to collect monitoring data is through the use of internal systems. SportVU 2.0 uses three 4K cameras and an in-space GPU server to collect and transmit real-time monitoring data to the edge (Arastey, 2021). Stefanos (2021), in his work, provides a comprehensive assessment of the accuracy of classification models to compare different machine learning algorithms and highlight their subtle differences in this problem domain. This pipeline consists of player tracking data and event tags, rules to identify possible actions, manually reviewing game records to tag candidates, and placing player trajectories in hex into cell paths before passing the completed training set to the classification model. This resulting training set is explored using the information obtained from the extracted and designed features and the performance of various machine learning algorithms.



Stats Perform SportVU system in the stadium *(Source: Patrick Lucy of Stats Perform)*

However, data tracking has a significant limitation: scope. While data monitoring offers many opportunities for advanced sports analytics, its impact on most sports is relatively minor. It is unrealistic to install advanced equipment to monitor every sporting event on every court, court, or stadium worldwide. Most indoor solutions require a company like Stats Perform to install all monitoring equipment in the field.

To get the best coverage of the monitoring data, one should capture the data directly from the video recording. It takes advantage of the fact that at least one image must be

recorded and potentially broadcast for every sports match played (Arastey, 2019). NBA predictions derived from AutoStats data are divided into three parts. The first is to obtain raw tracking data based on player and ball coordinates and timestamps for all frames. Secondly, one can get a pass chance, impact points, per post, etc. This is data enrichment to generate meaningful features for analysis. For example, the third step is the modeling itself (Patton et al., 2021).

PSG attack converts from broadcast footage to data display *(Source: Patrick Lucy, Statistics Performance)*

This means that surveillance data is collected from in-house solutions using broadcast cameras to a more standardized approach. When collecting downstream monitoring data, one need to calibrate the camera for each frame, as playback is constantly moving during playback (Arastey, 2019). Computer vision systems that collect monitoring data directly from broadcast video recordings follow three simple steps:

1. **Points representing the player and ball trajectories**. These points can then be plotted in an area chart for visualization.

2. **Standard metrics can be** derived (e.g., expected targets).

3. 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.

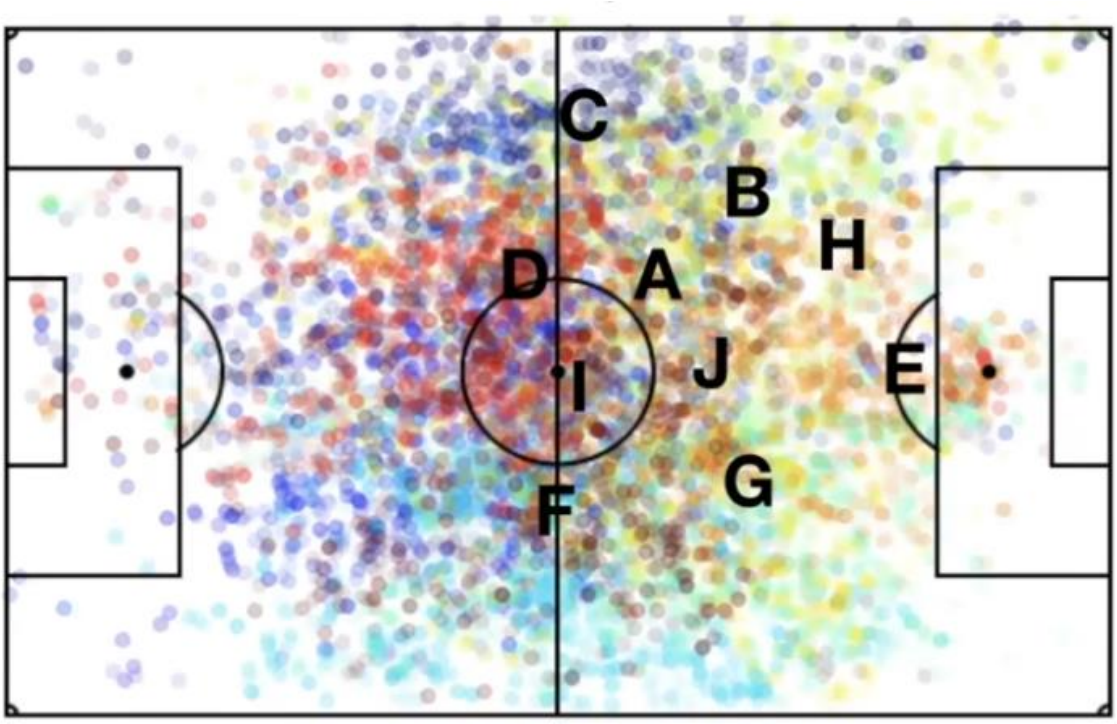
Convert video pixels to graphic points *(Source: Patrick Lucy, Statistics Performance)*

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

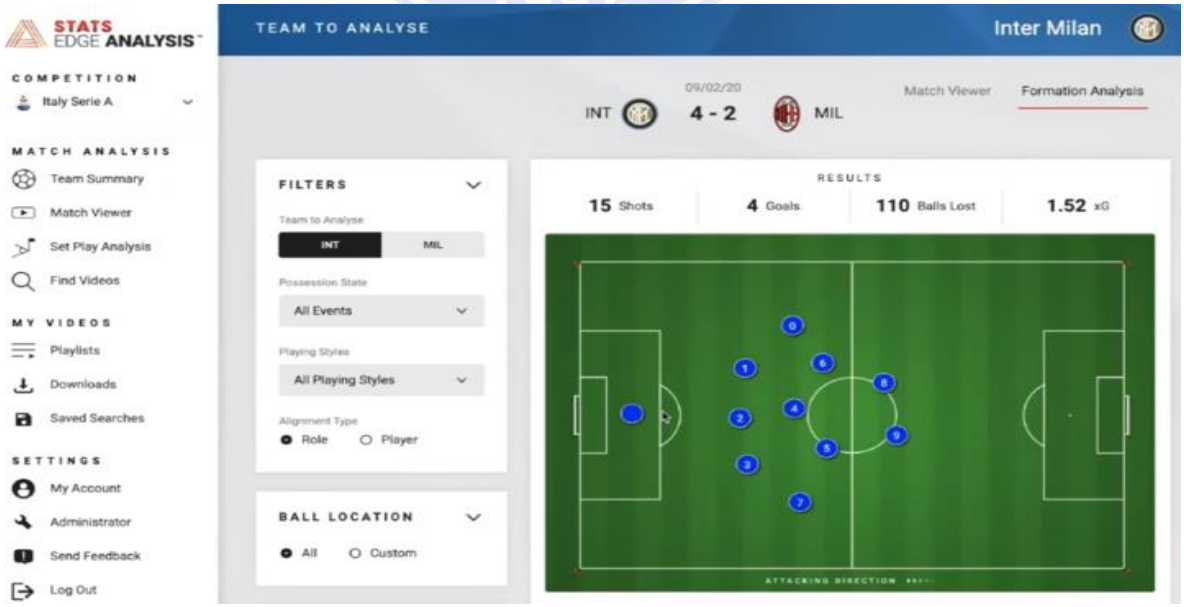
AI has revolutionized athletics and taken it to a whole new level. While it has long been clear that analytical and predictive research plays a vital role in sports, AI significantly impacts how games are played, structured, and influenced by audiences. Additionally, AI helps analyze the mental stability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



Visual representation of the football field noise monitoring dataset *(Source: Patrick Lucy, Stats Perform)*

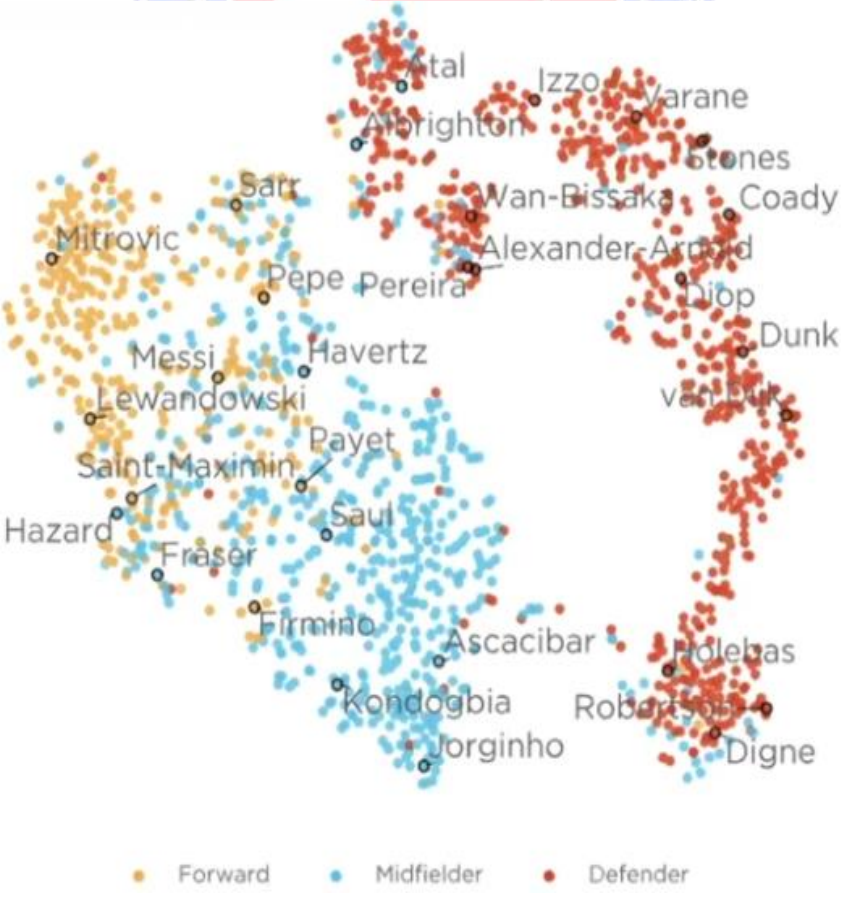
Stats Perform developed the Stats Edge Analysis software solution to query endless events based on monitoring data to visualize better and interpret monitoring data. Unique systems have been developed to process and search large data streams for both tasks. However, there is no infrastructure to integrate search and automated online analysis of data streams (Probst et al., 2018).



Statistical Edge Analysis *(Source: Patrick Lucy, Statistics)*

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. Currently, no studies track objective performance data influencing players' movement between game levels and career trajectories. 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.



Source: Retrieved from Arastaeus (2021).

THE USE OF AI 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 et al., 2021). Thanks to the power of artificial intelligence, analytics has reached unprecedented levels. 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, 2017). 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).

Oversight of the average league team (whites) defending a position *(Source: Patrick Lucy, Statistics Performance)*

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 MarketsandMarkets, the global sports AI market is expected to grow at a compound annual growth rate (CAGR) of 29.8% from 2021 to 2026 (MarketWatch, 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.

1. **HomeCcourt** [1]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.

2. **Dojo Madness**[2] develops real-time learning tools for Dota 2, Overwatch, and League of Legends fans.

3. **Catapult** [3]creates wearable technologies for football players to optimize performance and minimize injury.

4. **Mustard** [4]- Uses AI to analyze an athlete's mechanics and offer tips to improve their performance.

5. **Asensei** [5]- Consists of a training platform that uses motion capture sensors in regular sportswear to guide and adjust individual workouts.

6. **StreamLayer** [6] allows content owners and OTT operators to interact on a mobile device.

[1]For a detailed overview see: https://www.homecourt.ai/
[2] For a detailed overview, see: https://www.bayesholding.com/
[3]For a detailed overview, see: https://www.catapultsports.com/
[4]For a detailed overview see: https://teammstrd.com/
[5]For a detailed overview, see: https://asensei.com/
[6]For a detailed overview see: https://www.streamlayer.io/home

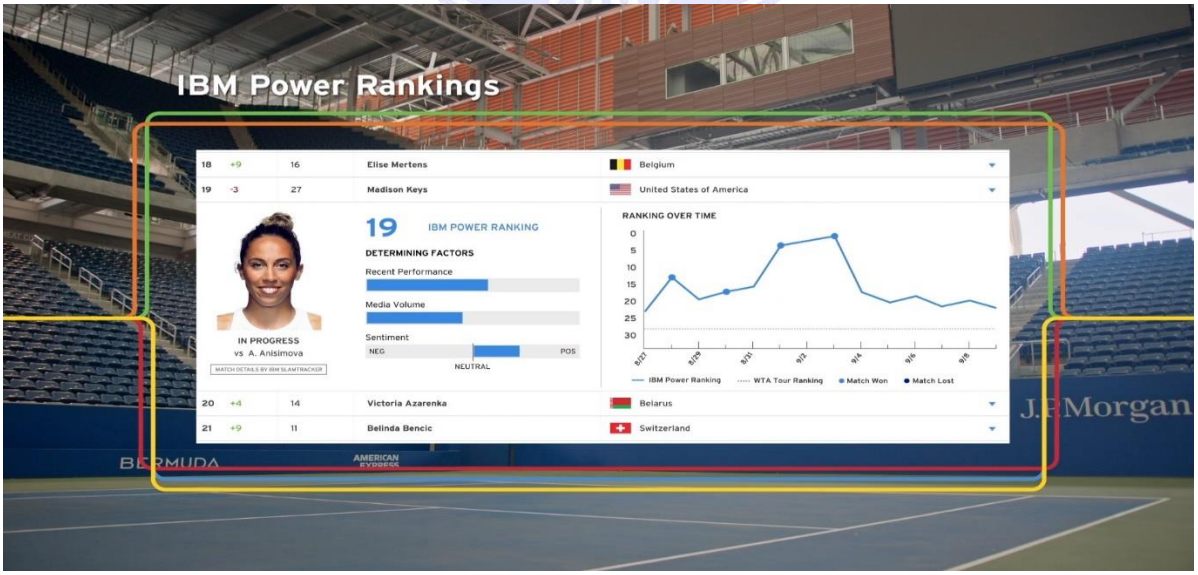
7. **IBM** - artificial intelligence. IBM is helping improve the US Open digital experience by using AI to inform fans more about players and matches, with real-time data and insights from the US Open app and USOpen.org. Watson Discovery NLP capabilities and secure and open IBM Cloud to analyze player performance data; [7]mining media reviews; measurement of the player's momentum; and IBM Decision Optimization for Watson Studio to help choose which ideas to show fans [8]. IBM Power Rankings and Match Insights can also help fans understand what they are saying about players ahead of upcoming matches with new features like Win, Beware, and Sad Alerts (Flushing, 2021).

8. **Wyscout** (https://www.wyscout.com/): Wyscout is a company that provides an AI-based platform for professional football clubs, offering analysis, scouting and performance monitoring services.

9. **Metrica Sports** (https://metricasports.com/): Metrica Sports is a company that provides AI-based solutions for sports analysis, including player tracking, tactical analysis, and match performance analysis.

10. **Deltatre** (https://www.deltatre.com/): Deltatre is a company that provides AI-based solutions for sports broadcasting, including augmented reality graphics and live data analytics.

11. **Interstices Solutions** (https://intersticesolutions.com/): Interstices Solutions is a company that provides AI-based solutions for sports broadcasting, including real-time data analysis and automatic highlights generation.



[7]For a detailed overview, see: https://www.ibm.com/cloud/watson-discovery.
[8]For a detailed overview, see: https://www.ibm.com/cloud/decision-optimization-for-watson-studio.

SpeedGate AI-Based Sports Game

Design agency AKQA introduced Speedgate, the first sports branch designed by artificial intelligence. Today's sports branches are based on hundreds of years of cultural origins. In this way, they maintain their recognition and popularity with the accumulation of knowledge. AKQA[9], a design agency, approached the event from a different perspective. They fed the neural network of AI with the data of 400 different sports already in existence and wanted the AI to create a new sports branch.

Speedgate was recorded as the first sport created by AI and is like adding lacrosse to a mix of rugby and quidditch. The game is played with a rugby ball between two teams of six players each. There is another goal in the field center, apart from one goal that the teams must protect. The team that passes the castle in the center with a pass or kick gets the right to score against the opponent's goal. Passing the ball through the goal with a kick is worth 2 points, while passing the ball through the goal by bouncing is counted with 3 points. The basis of the game is based on the fact that the ball does not stop and moves constantly. Also, pushing, hitting, or kicking is illegal on the Speedgate. 2 referees manage the competition, consisting of 3 parts of 7 minutes. Speedgate looks like a mix of American football and field hockey. It is also news that AI invented the 'exploding frisbee' game with the same data.

As for the production process, after the AKQA team uploaded the data of 400 different branches to artificial intelligence, many meaningless branches such as "exploding frisbees" were among the possibilities. Speedgate achieved victory among the three branches that made it to the finals at the end of certain eliminations. The team used the same method to determine the game's logo. They even have a strange slogan such as "face the ball to be the ball to be above the ball," which becomes meaningless when translated into our language. The California-based company contacted the Oregon Sports Authority (an organization supporting sports organizations) to prepare a summer league for the game. The team is aware that this new game cannot rival today's popular sports. However, it is an essential source of happiness for them that Speedgate shows how practical AI can be, even under human domination due to cultural ties and structure accumulation.

TURKISH MARKET

There is no doubt that the most critical and labor-intensive compound of industrial football, which has become a significant sector economically, is football players. The primary

[9] For a detailed overview, see: https://www.akqa.com/work/speedgate/

goal of clubs and national teams is to ensure that they are in their healthiest condition and create the infrastructure to reflect the highest performance. For this reason, it has become crucial to monitor and monitor the athletes, follow the training loads, and determine the risk of injury. Technologies that can analyze facial recognition and body movements develop more creative applications every day. This application, developed by Sony Interactive Entertainment, is a candidate to replace the trainer in the gym. At the center of this application, for which Sony has recently applied for a patent in the USA, is a walking system that can navigate like Facebook's camera robot. This walking robot connects to the game console or computer and observes thanks to its camera.

For example, DeepSport was implemented when those who exercise at home are unaware of doing the exercise wrong, even if they are conscious. DeepSport is the third eye to these people. In DeepSport, a mobile fitness application supported by artificial intelligence, AI sees the person with a phone camera, detects their joints, calculates body angles, and defines the position. Thus, while users are exercising at home, only their repetitions are counted with a smartphone, their accuracy is calculated, and people are kept active with voice notifications. It is ensured that people increase their quality of life by doing healthy and interactive sports. In addition, it aims to increase users' quality of life not only when they want to exercise but also at every moment of their lives with specific reminders. It was established with a grant of 200 thousand TL from Tübitak. Stating that they started working on this idea more than 1.5 years ago, Bedirhan Selvi says that he was a student in Italy when the pandemic first started. He suffered a knee injury while exercising at home during the closure period. While he was talking about the situation to his friend Kamil, with whom he was in close contact during that period, the idea of DeepSport was born. Bedirhan Selvi stated that the first thing to investigate about the feasibility of the work is the AI model, and after seeing the feasibility, team-building phase, business plans, etc. He says they were established nine months later with a grant of 200 thousand TL from Tübitak (Ulukan, 2021).

Monilabb is another SaaS (Software as a Service) software developed with AI (AI) models to predict the risks of injury and athletes' poor performance. It continues to be the first and only national software of our country in this field. Monilabb enables the collection, analysis, and simultaneous reporting of the athletes' load, recovery, and injury data at the bank security level and enables the necessary measures to be taken quickly. Data entry and viewing can be done easily by authorized departments' overall mobile devices. The most important pillar of the Monilabb risk analysis is the recovery measurement data, which must be

constantly collected from the athletes in a specific order and defined as athlete monitoring abroad. Monilabb software is still active in Başakşehir FK, which has achieved a stable success with the lowest injury statistics despite being one of the oldest squads in the league between 2016 - 2020, in Beşiktaş, the champion of the last season since 2019, and in Trabzonspor since last season. Many teams adopt the monitoring concept implemented by Monilabb and receive consultancy. On the other hand, TR National Team experienced the Monilabb concept and software for the first time during the 2016 European Championship preparation period and the tournament. It used it actively before and during the 2020 European Championship (Işık, 2021).

With the cooperation of TESFED and SenpAI.GG, AI Support for Esports begins in Turkey. Turkish E-Sports Federation (TESFED), established in April 2018 under the Ministry of Youth and Sports to develop Turkey as a manager and representative in the game and esports sector in national and international platforms, is the Turkish AI announced their partnership with the startup SenpAI.GG in a recent step. TESFED and SenpAI.GG joined forces to develop the esports ecosystem in Turkey, which continues to increase the participation of the players day by day, with the most exciting games in the world, comprehensive organizations organized by developers and investors, and to support the ongoing rise of the player. With the support of SenpAI.GG, TESFED's new technology partner, all licensed players affiliated with the federation will be able to use different features developed through advanced technology artificial intelligence, with Premium accounts, at the highest level, unlimitedly. SenpAI.GG is an Artificial Intelligence-based game assistant founded by Turkish entrepreneurs and developed with Turkish engineers and designers with various and extensive backgrounds. While SenpAI.GG is the first domestic production to use AI technologies in the esports industry. It aims to represent this power globally by providing language support to players worldwide and working with players worldwide (Osas, 2021).

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, we 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, we 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 PVK (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 we 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:

Policies to be developed:

1. Data protection and privacy policies to ensure that athletes' personal and sensitive information is protected.

2. 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. Policies for data sharing and collaboration between sports organizations, tech companies and academic institutions to promote innovation in the field of AI in sports.

Strategies to be developed:

1. Collaboration with tech companies to develop new AI-based technologies for sports performance analysis, injury prevention and player tracking.

2. Investment in AI research and development to drive innovation in sports technology.

3. Promoting the use of AI in sports education and training programs to ensure that athletes and coaches are equipped with the skills to take advantage of the technology.

Programs to be developed:

1. AI-powered injury prevention programs that use data analysis to identify risk factors and prevent injury in athletes.

2. AI-based performance analysis programs to help coaches and trainers evaluate the performance of athletes and make data-driven decisions.

3. Player tracking programs that use AI to monitor the physical and performance metrics of athletes during training and games.

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