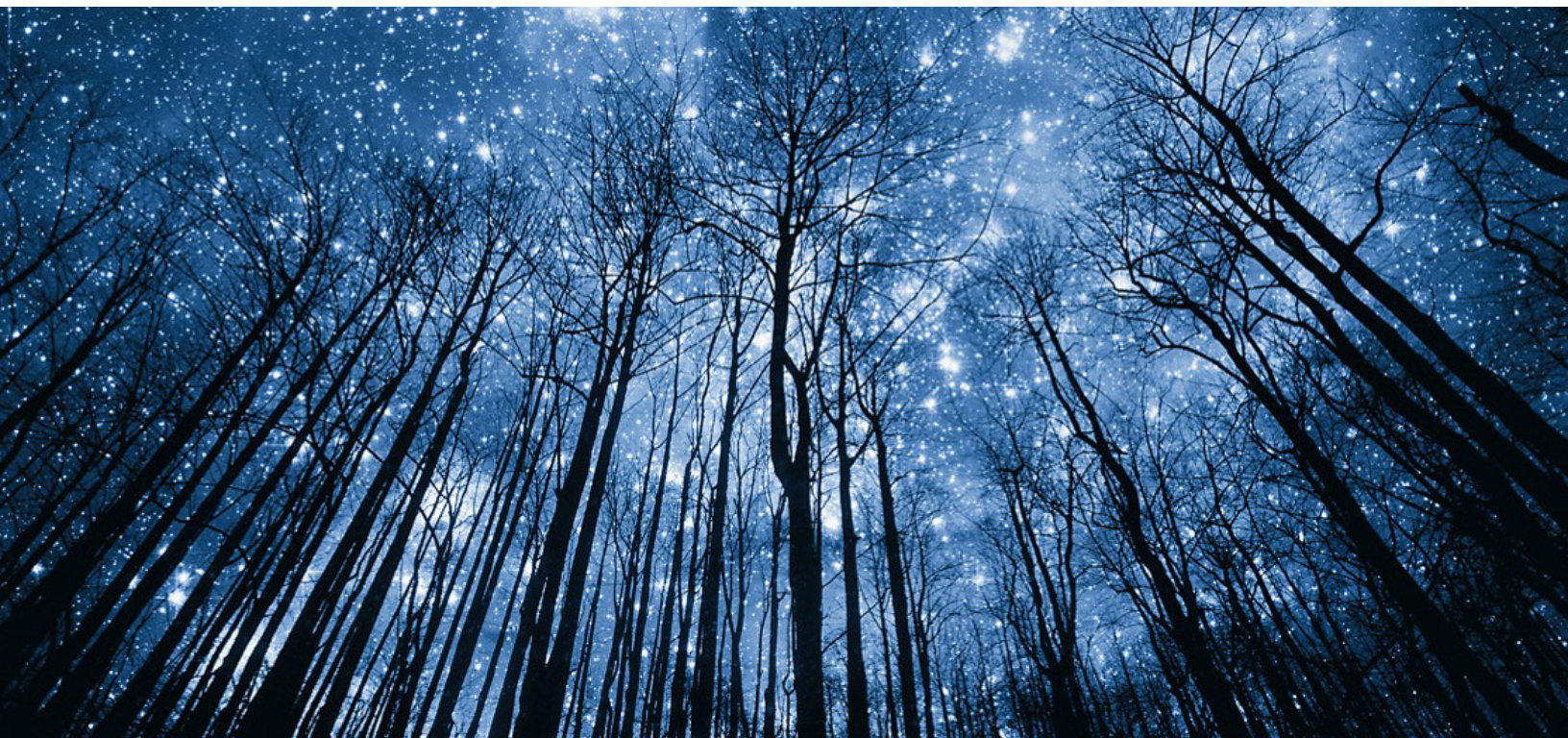


ML AND AI IN SPORTS: AN OVERVIEW



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Abstract

This article offers a brief overview of AI and ML has integrated into all aspects of life, including sports. It explores the latest developments in AI and sports through case studies related to football, tennis, and other sports.

It also delves into the future scope of cognitive thinking to analyze player skillsets, abilities, and behavior on the field based on heatmaps, video processing analysis, and so on. The latest research and accepted use cases such as Video Assistant Refereeing (VAR) will be used as examples. It will also shed light on challenges faced in today's world and the future targets for the same.

This article has been written for analysts and sports enthusiasts seeking to integrate their learning in the field of AI and ML into their sport. Our hope is to enlighten and spark the enthusiasts into the future where techno-sport can be a field by itself.

Introduction

As a sports enthusiast and avid reader of Artificial Intelligence (AI)/Machine Learning (ML) articles, I became intrigued by the idea of combining both fields to see how we can use the best of both worlds. AI and ML are backbones of one of the fastest and most developing technological fields today. Its integration with sports can be seen as an added advantage to enhancing a teams' performance. The statistical knowledge and demographics after each match can be used to assess the abilities of each player and to analyze weaknesses and strengths that can help the team grow and benefit.

However, some still believe otherwise. Perhaps AI and ML would only affect the natural way in which the game is being played and might create unnecessary confusion that may interfere with a player's ability to play their natural game. Or what if the statistical inputs are inaccurate and factors that affect the game are somehow unrealistic, i.e., the team met with an accident. This accounts for the larger picture where debate continues as to where we are and how much have we integrated our technological advancements into our day-to-day activities.

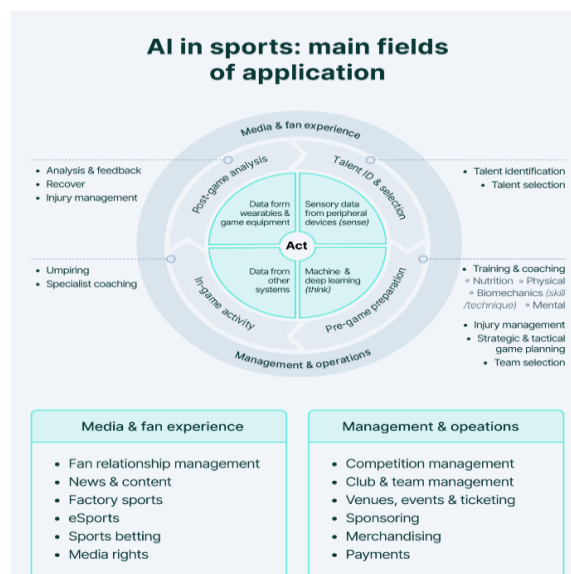
Data has become a particularly important part of our life. Most of the data is unstructured. In the world of sports, raw data are abundant, and ML helps analyze and interpret this data. With the technical advancements put together while considering the present-day shortcomings and what the future of such an amalgamation can offer, I decided to author this article to present a few case studies that demonstrate advancements made in this field thus far.

AI and ML in Sports Today

Data analytics has been imbibed into sports, creating a new role, Sports Analytics and a new persona, the Sports Analyst. This emerging field uses advancements in data analytics through ML algorithms in sports. The sports analytics industry market is predicted to grow by 2.46 billion dollars by 2025.

Sports-related areas where AI and ML is used today are:

1. Player Recruitment.
2. Analysis of players' strengths and weaknesses, fitness studies
3. Officiating – Video Assistant Referees, Goal Line Technology, Heat Maps
4. Talent scouting
5. Sports Live sports telecasting, Chatbots



The following case studies offer a view of how AI/ML has integrated in various sports around the globe.

Case Study 1 – AI and ML in Tennis

Tennis is an international sport this is loved by fans around the world, with players from vast and diverse backgrounds. Undoubtedly, we see players with different playing styles and skills, having developed these skillsets by playing on different surfaces (clay, hard court, and grass) leading to differences in strategies as well. There are a lot of variables that decide the outcome of a tennis match which makes the sport very unpredictable.

Today, many scholars use this as motivation to create ML models that can try to analyze the statistics and predict the outcome of the game. The new “Informative Betting Algorithm” looks promising and could potentially

predict the winner of a game using a Random Forest Algorithm.¹ This algorithm ran on a dataset consisting of factors like the ranking on the player, previous results, number of aces, tournament, court (indoor/outdoor), surface, number of sets won, number of sets lost, double faults during a match, ATP ranking, etc.

The model performed successfully to generate a confusion matrix², that was generated between Favored Player to Win vs Unfavored Player in a match. The algorithm was able to predict the highly favored player but failed to capture the reason a few lower ranked players could win a match against odds. This does not look right, now does it.

That is the question for the future, where the study looks to improve their algorithm by considering human factors that affect the sport such as injury history, weather, coaching strategy, and so on.

This Case Study was based on research conducted by the University of Stanford on tennis data that was available from tennis.data.co.uk.

Case Study 2 – ML and AI In Football

Football is perhaps one of the most popular sports in the world, which has given most sports enthusiasts reason to stop what they are doing and just enjoy the game be it playing it or watching it. This team sport teaches the importance of sportsmanship, teamwork and coordination, strategic thinking, cognitive thinking to make quick responsive decisions, interpersonal skills like leadership qualities, and so on, both on and off the field.

Thus, integrating AI with the sport comes as no surprise. AI and technology have enormous potential to reach unprecedented heights of innovation and advancements in this field. There are a variety of use cases where ML has actively participated football, such as implementation of Goal Line Technology (GLT) and Video Assistant Referee System (VARs).

GLT was designed to sharpen the game with AI. It was developed by Cairo Technology (Germany) and Adidas. The system sends out a signal to the referee via an embedded microchip every time the ball crosses the goal line, to indicate the goal. An algorithm uses the Optical Tracking System³ to identify the goal line and create contours around the ball to pinpoint the exact time when the ball has crossed the line, thereby declaring the result as a Goal/No-Goal.

¹ Refer to the Appendix section

² Refer to the Appendix section

³ Refer to Appendix Section



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Another use case where the influence of AI and ML was recently seen was for developing game strategies that were decided based on the opponent players' strengths and weaknesses. With the help of this information, it is easier for teams to decide who to play in a match beforehand while selecting the team and would eliminate any human factors on decision making before games.

This AI technology was successfully tried, tested, and implemented most recently with Leatherhead FC, who adopted this algorithm to plan the strategy for its team. Later the team ran a collaboration with IBM's Watson to help them refine the algorithm.



Other use cases related to football that are being tested include:

1. **Enhanced Fan Viewing System:** This AI algorithm generated real-time insights for fans watching the game online. It forecasts results and assesses the live probability of a team winning the match, goal updates, heat maps of players, goal probabilities, and many more features. This system has been tested and is being used by Germany's Bundesliga, the Top Tier League Football of Germany.

⁴ Image of Goal Decision System

⁵ The microsensor detects a goal as the ball crosses the Goal Line.

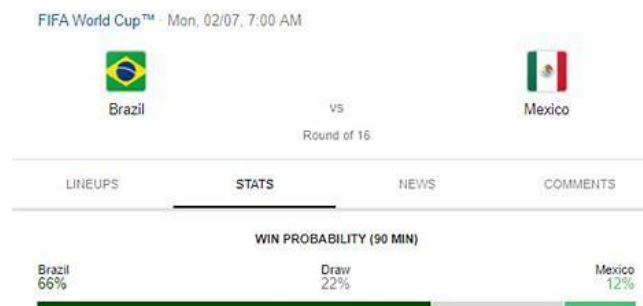


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2. **Predicting the Game Result** using KNN and Random Forest Algorithms to run heuristics on datasets containing various factors, such as goals scored in the match, number of assists, shots on target, total shots, fouls committed, number of cards, tackles won, interceptions, offsides, home/away ground, result of previous games, etc. The algorithm ran across multiple models, with the best results coming from the Logistic Regression Algorithm. The result was successful but again lacked luster while identifying human/environment factors that can affect a game, like weather, the form of the player, and so on.

TEAM STATS		
14	Shots	18
4	Shots on target	10
40%	Possession	60%
471	Passes	695
86%	Pass accuracy	89%
9	Fouls	12
4	Yellow cards	4
0	Red cards	0
0	Offsides	0
4	Corners	3

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Case Study 3 – ML AND AI in other Sports

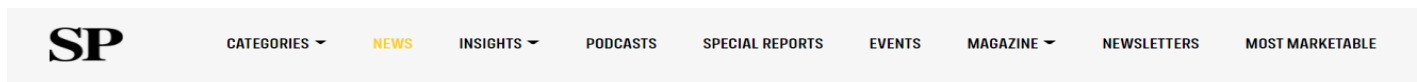
⁶ Realtime Insights currently implemented in German Bundesliga

⁷ Live winning Probability and Match Statistics generated in Realtime using AI for analysis.

ML and AI have not only found their way into football and tennis, but also across many sports across the world, not only benefitting the organizers but also the media, players, and fans. Examples of how ML and AI have impacted other sports include:

Basketball

America's National Basketball Association (NBA) along with innovation specialists Game On, created a joint venture tying up Facebook's AI technology to create an AI-driven chatbot that gives the audience watching the match real-time score updates, along with insightful statistics about the players. This is an innovative and interactive application that enables fans to access the account and interact with the bot in real-time. Currently, the live scores aspect of it along with match insights have been implemented. Organizers are working on developing the tool further to integrate with Computer Vision and other fields of AI/ML to create an automated ticketing system for fans who would otherwise face long queues to buy tickets. With this new feature, the organizer plans to simplify the selling of tickets and use the facial recognition application to identify the fan. Integrating the application to the fan's bank account can take care of the payment aspect of the purchase request.



NBA launches AI Facebook chatbot for in-game highlights

Basketball league to also send out targeted personalised notifications.
Sacramento Kings Add Glowing Chatbot to Message Fans

By Joe Lemire
February 16, 2022



The Sacramento Kings have contracted Glowing, Inc., an automated text messaging service, to boost their fan experience.

Glowing is an AI-powered engagement platform best known for its work with luxury hospitality brands such as Auberge Resorts, the Mandarin Oriental and Rosewood Hotels. The NBA's Kings began use of Glowing earlier this season for premium account holders and have since expanded the deployment to groups and road trips. The plan is for further rollout to all fans entering Golden 1 Center for a game or event.

The Kings have long been early adopters of innovative technology, accepting Bitcoin as far back as the 2013-14 season, starting Blockchain fan programs in 2019 and launching on Discord in 2020. Glowing is a graduate of Y Combinator's accelerator and is a portfolio company of Scrum Ventures.

Future Scope for ML and AI in Sports

Although there has been a lot of improvements when it comes to the innovation and integration of ML and AI concepts in sport, there are still many factors to be addressed which result in the technology not being able to showcase its true strength in innovating the sport. Some of the main factors yet to be addressed are:

1. **Human Talent:** Yet a person's talent and hard work cannot be truly gauged by a machine; we might get insights and statistics, but not the big picture when it comes to spotting the talent of everyone who is always learning and evolving.
2. **Human Behavior:** This is another field that has posed certain concerns when it comes to leveraging AI in sports. The machine simply just fails to identify the emotions shown by players on the field. Yes, with facial recognition we can identify the mood as angry, happy, sad, etc. But understanding the actions made by the player while committing fouls and the refereeing decision is still under the scope of more improvement in the future.
3. **Physical Factors and Inaccurate Datasets:** This has posed a big problem in the present-day scenario where many of the algorithms fail to consider physical scenarios such as weather, human injury, postponement, logistical reason, and so on while running the algorithms. This, along with inaccurate datasets, result in the models underperforming and not providing the expected or accurate results.
4. **Legislative concerns:** Certain use cases have arisen recently where scholars have faced legislative lawsuits for trying to learn about the health concerns and injury history of players to assess the period it might take for the player to recuperate. The idea and intention behind designing such an algorithm that helps us understand how long it might take an injured player to come back seems noble. However, it remains legislatively unacceptable to work on the medical records of third persons in many countries.

Having specified a few concerning factors that play a major part of addressing the efficiency of AI and ML in sports, there is a long way to go before we have used our capacities to the fullest.

Upcoming research fields in AI/ML in sports include:

1. **Virtual Reality / Augmented Reality:** This is a field that is developing to create both video games realistically. With the VR/AR integration along with the studies conducted on Cognitive Thinking of humans, may lead to playing games by giving instructions through voice commands and hand signals.
2. **AI-based Advertising and Automated Journalism:** This is still much of a fantasy but imagine machine-building match reports automatically and keeping you updated on the match. The feature where AI helps create short highlight videos of the match is usually a time-consuming manual editing job.
3. **AI and ML using Computer Vision** learnings can help improve video processing in Formula 1 races to enhance driver safety, by recognizing malfunctions, gauging distance between objects, and so on.
4. Integrating AI and ML algorithms will help ease and smooth the recruiting process to identify the right candidate for the team and to build the perfect training schedule and fitness regime for everyone based on the requirements of the team.

Conclusion

Artificial Intelligence and Machine Learning have had huge impacts on the sports industry, due to the vast amount of data and the applications of the collected data using the technology. With the advancement spreading across like a forest fire over a large area, the industry faces new challenges, i.e., constant tracking and updating of knowledge to solve problems and complex situations.

However, a shortage of improvements across all areas of the sports industry remains. Emerging technologies such as AI will help drive success in this competitive market. Many investments and joint ventures are being made and introduced to support and assist players and sponsors.

Artificial Intelligence plays an important role in sports marketing, as it can improve and remain elevated, having seamlessly completed the initial phase of implementing unique concepts to improve performance and player engagement.

This article attempts to bring clarity to current advancements in AI and ML in the Sports Industry, highlighting the challenges and limitations faced currently at a 1000-foot level and the future ideas and innovations that this amalgamated field has to offer with human ingenuity.

Appendix

1. **Random Forest Classifier:** Random forests or random choice forests is an ensemble reading technique for kind, regression, and extraordinary responsibilities that operates through manner of the method of constructing a multitude of choice wooden at training time. For kind responsibilities, the

output of the random wooded area is the beauty determined through manner of the method of most wooden. For regression responsibilities, to mean or not unusual place prediction of the person wooden is returned.

2. **Confusion Matrix:** A better way to evaluate the general overall performance of a classifier is to look at the confusion matrix. The famous idea is to depend on the style of times instances of class A are categorized as beauty B.
3. **Optical Tracking System:** Usually record user data and then evaluates position and action of a particular object. There are a few techniques on how this is done. The most common area is to make use of a virtual camera that acts as a virtual eye to track an object or person. The video virtual camera is commonly in a hard and fast location.
4. **Computer Vision:** An interdisciplinary machine learning concept that takes advantage of high-level facts from digital snapshots or video files. From the mindset of engineering, it seeks to understand and automate responsibilities that the human seen tool can do.

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