Smart Coaching with Artificial Intelligence (AI): Designing an Ethical Model for Real-Time Sports Analytics

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Divya Kuruvilla
Computer Science
The University of Virginia
School of Engineering and Applied Science
Charlottesville, Virginia USA
yaq7fm@virginia.edu

ABSTRACT

Coaches in sports face the difficulty of relying on inefficient and biased methods to analyze athlete data, making it challenging to optimize player performance and ensure safety on the field. To address this issue, I propose utilizing an AI model that can quickly parse through game data, providing easily interpretable and accurate results to coaches. In order to combat existing problems and ethical concerns with AI technology, this model will ensure that the data used for training is reflective of a broad range of demographics to mitigate biases and ensure fair outcomes for all athletes. This AI model will generate faster predictions in real time and will enforce strong security protections to protect athlete privacy. Additionally, the model will analyze various types of data—player health, opponent performance, and real-time game data—to provide meaningful recommendations for coaches before, during, and after a game. Future work on the model will be done to ensure that the model correctly anonymizes sensitive athlete data, follows authorization protocols so only authorized users can view athlete data, and outputs meaningful statistics for coaches to use.

1. INTRODUCTION

Over the course of four NFL seasons, one study reported an alarming total of 3,025 injuries, of which 582 (19%) injuries occurred during weeks 1-4 of the 2020-2021 regular season (Baker, et. al., 2021). With football being one of the most watched sports and the risk of injuries being high, it is critical to prioritize player safety and coaches should make calls that protect their players. In a world where technology is becoming integrated into data analytics, AI can capture real-time data on each player for every play. With this real-time data, AI can create customized training programs for athletes, allowing progress to be tracked and targeted feedback given to address each player's specific needs. Coaches and teams can benefit from this analysis to monitor player health and predict which players are susceptible to being injured.

Along with using AI to protect player health, coaches can use AI to make more informed game decisions, such as more effective play-calling and drafting defensive and offensive line formations. AI enhances real-time decision-making, especially in high-stakes environments like Formula 1 racing, where coaches need to make quick decisions to ensure player safety. By utilizing AI, coaches can dynamically respond to changing conditions, allowing them to optimize performance on the field.

While AI offers many significant benefits in sports analytics, it also raises privacy and ethical issues due to the sensitive nature of player data and accuracy issues in algorithm development. Thus, it is imperative the AI models used are ethical and implement a robust framework to protect athlete data.

2. RELATED WORKS

The foundation for my model is grounded in findings from AI systems, which highlight how AI can significantly enhance sports prediction with a fast execution speed. Tan (2003) created a system to improve athlete performance, health monitoring and game decision-making. A questionnaire among 200 sports professionals, including coaches and athletes, assessed how AI is being used in the sports industry. The findings revealed that AI significantly enhanced the precision of sports prediction, allowing for coaches to make more effective game decisions, as faster predictions allow for real-time adjustments during games. This result highlights the need for my proposed AI model to continuously analyze trends and adapt to new data.

Findings from another AI system highlighted the importance of integrating performance measures with game data to provide insights for coaches. Researchers used algorithmic models to evaluate 16 Division-1 women's basketball players. The data collected ranged from tracking training data, sleep data, and in-game performance statistics (Taber, et. al., 2024). The researchers assessed how performance can be determined by various features and predicted using AI models, with the goal of optimizing coaching strategies, player training and game performance. The findings suggest that integrating data from various performance measures provides valuable insights for coaches, allowing them to better monitor athlete performance, optimize player training and strategize calls to improve team performance. This research will be helpful as I propose an AI model that will allow for better monitoring of player health and creating game calls, all while ensuring the model is ethical.

3. PROPOSED DESIGN

Developing an AI model that is unbiased and efficient is vital for coaches to make more informed on-the-field decisions that improve player performance and safety on the field. My proposed model will rely on several key components, discussed below, to effectively provide data-driven insights to coaches that ensure player health is prioritized.

3.1 High Execution Speed

Designing a model with a high execution speed is critical, as it enables faster predictions to be generated in real-time. Executing predictions at a quicker speed allows coaches to make rapid adjustments during games, such as substituting out players who are at a high risk of being injured. This execution speed is essential in high-stake environments like Formula 1 racing, where coaches need to make split-second decisions that can affect the safety of their athletes. With this speed, coaches can make decisions that rely on predictive analysis, rather than making decisions out of instinct. That is why I plan to propose a model that can dynamically respond to changing conditions on the field, allowing coaches to optimize player performance based on real-time data.

3.2 Performance Metrics and Analysis

Incorporating the ability to analyze a variety of performance metrics, such as player weight and number of injuries, is another component to my proposed model. By analyzing performance metrics for each player, my model can output predictive statistics on how well an athlete is likely to perform in an upcoming match and assess the injury risk associated with each player. Since predictive statistics in sports relies on game data to forecast future outcomes, potential statistics that can be outputted would be projected injury risk, likelihood of a basketball player making a three-point throw, or probability of a football player making a field goal. These insights will allow coaches to adjust the starting lineup to prioritize athletes

who have a higher performance condition and lower risk of injury.

3.3 Real-Time and Prior Game Data & Feed Integration

Along with performance metrics, my model will be designed for live, on-the-field-use to be able to track player movement. Research emphasizes the benefit of using AI to analyze player movement data in real-time, allowing coaches to make better decisions during the game (Nauck, et. al., 2022). By analyzing game data in real-time, my model can output predictive statistics and health assessments for each player, providing coaches with actionable insights during a match. This will allow coaches to make timely and accurate decisions on which players need to be substituted out based on health, further improving team performance and player safety.

My model will also be able to analyze game feeds from previous matches, offering an analytic assessment of the opponent's performance patterns and statistics. This analysis will enable coaches to train their athletes and prepare them for upcoming matches, familiarizing players with their opponents' tendencies and strengths.

3.4 Ethical Framework

An important component of my model will be the ethical framework it incorporates to address privacy and security concerns. Scholarly authors emphasize the importance of ensuring AI models have robust ethical frameworks to ensure AI is being utilized with care (Dubber, et. al., 2020). To protect athlete privacy, my model will securely store athlete data by anonymizing names and assigning each athlete with a unique number identifier instead. Only authorized people, like senior coaches and managers, will have access to the mapping between the names and the unique identifiers. This framework helps minimize the risk of unauthorized access and address security concerns. Additionally, I plan for the predictive statistics outputted by my model to be viewed by the same authorized people, further reducing the risk of rival competitors accessing this sensitive data.

To ensure that it also addresses problems with bias and historical data, my proposed model will utilize training data reflective of a broad range of demographics, including race, gender and age, to mitigate biases and ensure fair outcomes for all athletes.

4. ANTICIPATED RESULTS

With my proposed model, problems like limitations on current models and existing ethical concerns will be addressed. When successfully implemented, this proposed AI model can yield key results that enhance decision-making, player performance, and player safety.

Coaches will be able to receive real-time insights on key factors, such as injury risk and performance trends, allowing coaches to make more data-driven adjustments during games. Additionally, coaches will be provided with these predictive insights at a faster rate due to the high execution speed the model will operate on. Predictive insights, such as injury assessments and performance monitoring for each player, will reduce injuries by warning coaches when players exhibit signs of fatigue or increased injury risk. As a result, this use of AI will help teams prevent overtraining by monitoring player performance during games.

Team performance will also be optimized as coaches can strategically adjust formations based on predictive performance metrics, ensuring that the best-fit players start the game. The integration of real-time and prior game data will enhance decision-making by identifying vulnerabilities in the opposing team's strategies, leading to better game preparation.

Last, sensitive athlete data will be protected from unauthorized users, as player data will be securely anonymized. The

model's reliance on bias-mitigation strategies will be utilized to promote fairness by ensuring predictions are trained on diverse and representative data.

5. CONCLUSION

AI is a rapidly evolving technology with the potential to revolutionize sports analytics by providing more informed, data-driven insights for coaches. The proposed AI model addresses the increasing demand for strategic decision-making in sports by analyzing player health, opponent performance, and game data to deliver valuable insights for coaches before, during, and after a game. Designed to enhance game strategy, prevent injuries and optimize player performance, this model can benefit teams across various sports organizations. Due to the sensitive nature of athlete data, my model prioritizes data privacy to prevent unauthorized access. By addressing the ethical concerns and limitations of current AI models, I aim to develop a solution that reduces bias and safeguards athlete privacy. This project highlights the advantages of AI in sports while emphasizing the need for ethical implementation, ultimately leading to a more secure, fair and data-driven environment for teams and athletes.

6. FUTURE WORK

The next steps after developing the model are to verify that authorization protocols are properly implemented and that sensitive data is correctly anonymized to ensure privacy. Testing will ensure that only authorized users, such as coaches and athletes, can access the data. Once these safeguards are validated, the model will be trained using real athlete data to assess its predictive accuracy, with refinements made to improve speed and accuracy as needed. Future steps can include adapting the model for specific sports, integrating wearable technology for real-time insights, and adjusting bias mitigation strategies to ensure the model remains ethical.

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