Beyond human referees: The future of artificial intelligence in the FIFA World Cup 2026 between legitimacy and fan psychology

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Abstract---This study examines the growing role of artificial intelligence in football refereeing and its psychological impact on fans as the 2026 FIFA World Cup approaches. It also focuses on how emerging technologies—such as semi-automated offside detection, enhanced video assistant referee (VAR) systems, and real-time AI decision analysis—are reshaping decision-making processes and their psychological impact on fans. The study provides an analytical review of current developments and examines their implications for the legitimacy, integrity, and psychological enjoyment of refereeing. By analyzing existing research and case studies, the study explores the potential benefits and challenges of AI-assisted refereeing, including its impact on match integrity, player psychological behavior, and fan engagement. It also assesses whether AI can fully replace human referees or whether a hybrid approach is necessary to maintain a balance between technological precision and the emotional essence of the 2026 FIFA World Cup. This prospective research examines the ethical, regulatory, and psychological dimensions of integrating AI, offering insights into how these technologies could shape the future of football refereeing while preserving the authenticity and excitement of the sport.

Keywords---Human Referees, AI, Football, Legitimacy, Fan Psychology, FIFA world cup 2026.

1. Introduction

For decades, football has relied on the judgment and intuition of human referees to ensure the application of rules, the fairness of competition, and the overall legitimacy of the sport. These officials,

while central to maintaining order on the field, are inherently subject to human limitations-ranging from perceptual constraints to cognitive bias-which can sometimes lead to controversial or inconsistent decisions (Goumas, 2014). In recent years, however, a technological revolution has begun to reshape the landscape of sports officiating, driven by the rapid advancement of artificial intelligence (AI) and data analytics.

AI systems such as the Video Assistant Referee (VAR), goal-line technology, and semi-automated offside detection are now regularly deployed in top-level competitions, marking a fundamental shift in the way football is officiated. These tools offer unprecedented levels of precision and objectivity, aiming to support referees in their decision-making processes and reduce critical errors that may influence match outcomes. By leveraging high-speed cameras, machine learning algorithms, and real-time data analysis, AI is redefining the role of the referee from a sole authority figure to part of a technologically integrated decision-making framework (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020).

The integration of AI into football officiating is often framed as a means of enhancing fairness and transparency. Indeed, one of the primary motivations for adopting technologies like VAR has been to minimize the occurrence of contentious decisions and ensure that critical moments-such as goals, penalties, and red cards-are adjudicated with the highest possible accuracy (Kubayi, Larkin, & Toriola, 2021). This evolution aligns with a growing demand for justice in sport, where every inch and every second can determine the fate of teams, players, and entire tournaments (Hamsund & Scelles, 2021).

Yet, despite these advancements, concerns remain about the impact of AI on the emotional and cultural fabric of the game. Football is not merely a sequence of rules and outcomes; it is a global phenomenon fueled by passion, unpredictability, and the immediacy of live drama. For many fans, the flow of the game, the suspense of marginal calls, and even the imperfections of human refereeing contribute to the sport's charm and authenticity. The introduction of stoppages for video reviews, algorithmic interpretations of offside decisions, and delayed celebrations has led to a complex tension between technological legitimacy and emotional engagement (Wagner & Ludvigsen, 2023).

This tension becomes even more relevant as the global football community looks ahead to the 2026 FIFA World Cup, which promises to be the most technologically advanced tournament in the sport's history. With AI tools expected to play a more central role than ever before, the upcoming World Cup will serve as a pivotal testing ground for how far technology can-or should-go in redefining football officiating. It will also be a moment of global scrutiny, where fans, players, officials, and stakeholders observe how these systems perform under the immense pressure and visibility of the world's most-watched sporting event.

This study investigates the evolving role of AI in football refereeing by examining its effects on the legitimacy of officiating, the behavior of players, and the engagement of fans. It aims to provide a nuanced understanding of how AI technologies can contribute to more consistent and transparent decision-making, while also addressing the potential trade-offs regarding the emotional appeal and spontaneity of the game. In doing so, the research explores the broader implications of AI adoption in sport-particularly whether it can coexist with the cultural values and entertainment expectations that define football.

Through an analysis of stakeholder perceptions, technological capabilities, and ethical considerations, this study seeks to offer evidence-based recommendations for optimizing the use of AI in football. These recommendations aim not only to enhance fairness and reduce bias but also to safeguard the unique emotional experience that makes football more than just a game. Ultimately, this research contributes to an urgent and timely conversation about the future of officiating in the age of artificial intelligence and its role in preserving both the integrity and soul of the sport.

1.1. Research Problem:

Refereeing in football has traditionally relied on the subjective judgment of human officials, who are tasked with making split-second decisions in high-pressure environments (Unkelbach & Memmert, 2010). This human-centric approach, while foundational to the sport's history, is inherently susceptible to a range of limitations, including perceptual errors, unconscious biases, and inconsistent interpretations of rules. Such factors can significantly affect the fairness and legitimacy of match outcomes, often leading to controversies that influence the reputation of teams, the careers of players, and the satisfaction of fans.

The introduction of artificial intelligence (AI) technologies-most notably the Video Assistant Referee (VAR)-has been presented as a solution to mitigate these human errors. By offering real-time data analysis, visual replay, and enhanced decision support, AI promises to bring greater objectivity, accuracy, and consistency to the officiating process (Gottschalk, Tewes, & Niestroj, 2020). However, the integration of AI into football is not without its challenges.

One of the primary concerns is the potential disruption of the organic flow and rhythm of the game (Wagner & Ludvigsen, 2023). Football's appeal lies not only in its rules and outcomes but also in its emotional intensity, spontaneity, and cultural resonance. Refereeing decisions, with all their imperfections, have traditionally played a vital role in the unpredictability and dramatic tension that captivate fans and players alike. The mechanization of decision-making through AI may risk reducing the human drama that defines football, thereby altering the spectator experience (Hamsund & Scelles, 2021).

Moreover, questions arise regarding the legitimacy of decisions made or influenced by machines (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020). Will fans, players, and other stakeholders accept outcomes determined by algorithms rather than humans? Can AI officiating systems enhance the perceived fairness of the game without eroding its emotional and cultural core?

Thus, the central research problem of this study emerges: While AI technologies have the potential to enhance the legitimacy and fairness of football officiating by reducing human error, can they do so without compromising the essential human elements-emotional engagement, cultural tradition, and the dynamic unpredictability-that make football one of the world's most beloved sports?

1.2. Study Questions:

- – How does AI integration in refereeing impact the legitimacy and fairness of football officiating?
- – What are the effects of AI-driven decision-making on fan enjoyment and engagement?
- – To what extent can AI replace human referees without compromising the spirit of the game?
- – How does AI affect player behavior and strategic decision-making on the field?
- – What ethical and regulatory considerations should govern AI adoption in football officiating?

1.3. Importance of the Study:

This study is significant as it addresses a growing concern in modern football: the integration of Artificial Intelligence (AI), particularly systems like the Video Assistant Referee (VAR), and its implications for the legitimacy of officiating and the enjoyment of fans. As AI technologies become more embedded in decision-making processes, questions arise about their influence on the human elements of the sport-namely trust, fairness, and engagement. While VAR aims to reduce human error and increase accuracy in officiating, it also introduces potential challenges, such as disrupting game flow and altering the traditional spectator experience.

By critically examining both the benefits and drawbacks of AI use in football, this study contributes to a deeper understanding of how technology can be ethically and effectively implemented in sports settings. It offers insights not only for referees and sports governing bodies, but also for technologists, fans, and policy-makers. The research provides a forward-looking perspective that can help shape future guidelines and innovations to ensure that AI serves to enhance-not undermine-the integrity and emotional appeal of football.

Ultimately, this study fills a critical gap in the literature by bridging the domains of sports ethics, fan psychology, and AI technology. Its findings can support informed decision-making around the adoption of AI in football and inspire further interdisciplinary research on maintaining the balance between technological advancement and the human spirit of the game.

1.4. Objectives:

- Evaluating the role of artificial intelligence in improving the accuracy and legitimacy of AI-based refereeing decisions.
- Understanding the impact of AI on the flow of the match and the psychological enjoyment of fans.
- Exploring ethical considerations, transparency, and the future of AI in football refereeing.

1.5. Methodology:

This study adopts a descriptive-analytical approach, aiming to systematically review, interpret, and synthesize the findings of previous scholarly works related to the impact of artificial intelligence on football refereeing. The methodology involves a critical evaluation of existing literature and empirical studies, focusing on how AI technologies-particularly systems such as the Video Assistant Referee (VAR)-have influenced decision-making processes, accuracy, and perceived legitimacy in real match contexts.

In addition to literature review, the study will analyze key international tournaments, including the FIFA World Cup and UEFA Champions League, drawing upon previous tournament-based studies to assess the practical implementation and outcomes of AI-assisted officiating. Emphasis will be placed on identifying patterns, benefits, and limitations observed in real-world applications of these technologies.

This research aims to identify the extent to which AI enhances or challenges the legitimacy and fairness of refereeing, propose recommendations for integrating AI while preserving the human and cultural elements of football, and address potential challenges related to audience perception, regulatory frameworks, and the natural flow of the game. Through this multifaceted approach, the study seeks to contribute to an evidence-based dialogue regarding the future of refereeing in football, offering insights that balance technological advancement with the preservation of the sport's emotional and cultural identity.

2. Theoretical Framework

2.1. AI in Football Officiating: Definition and Importance

Artificial Intelligence (AI) in football officiating refers to the utilization of advanced technologies, such as machine learning algorithms and computer vision systems, to aid referees in making more accurate and consistent decisions during matches. The Video Assistant Referee (VAR) system exemplifies this application by enabling the review of critical incidents through video technology to ensure correct judgments on match-changing events.

The significance of AI in football officiating lies in its potential to enhance decision-making accuracy and uphold the integrity of the sport. Research indicates that the implementation of VAR has improved referees' decision accuracy from 92.1% to 98.3%, demonstrating a notable advancement in reducing human error (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020). Additionally, studies have found that VAR interventions have minimal impact on the effective playing time and the technical-tactical aspects of the game, suggesting that the system does not significantly disrupt the natural flow of matches (Errekagorri, Castellano, Echeazarra, & Lago-Peñasc, 2020).

Furthermore, the integration of AI aims to increase transparency in officiating, thereby fostering greater trust among players, coaches, and fans. However, it's essential to consider the perceptions of stakeholders, as some fans express concerns that VAR may hinder the spontaneity and emotional engagement inherent in football (Winand, Schneiders, Merten, & Marlier, 2021). Therefore, while AI technologies like VAR offer substantial benefits in terms of accuracy and fairness, their implementation must be carefully managed to maintain the balance between technological assistance and the traditional human elements that contribute to the sport's appeal.

Why is AI in Football Officiating Important?

Artificial Intelligence (AI) has become increasingly important in football officiating due to its potential to enhance fairness, reduce human error, and improve the overall integrity of the sport. One of the primary technologies, the Video Assistant Referee (VAR), was introduced to support referees in making more accurate decisions during high-stakes moments. Research demonstrates that VAR significantly improves decision-making accuracy in professional football matches (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020). This is particularly critical in a sport where a single incorrect call can drastically influence match outcomes, championships, or even players' careers.

The Reason for adopting AI in officiating is to ensure transparency and accountability. AI tools such as VAR offer video-based evidence that can be reviewed and shared with stakeholders, helping to build trust among fans, players, and officials (Winand, Schneiders, Merten, & Marlier, 2021). This transparency helps reduce speculation about biased or unfair refereeing, especially in contentious decisions involving goals, penalties, and red cards.

Moreover, AI plays a crucial role in standardizing decisions across competitions and countries, thereby promoting global consistency in football officiating. Studies have shown that AI systems can help mitigate unconscious biases, such as the influence of home crowds or team reputation on referees' judgments (Unkelbach & Memmert, 2010). By reducing these inconsistencies, AI contributes to a more equitable playing field, despite these advantages, it's also important to recognize that AI is not without challenges. For example, its impact on the flow of the game and fan experience has raised concerns. Slow or unclear VAR decisions can frustrate fans and affect their enjoyment. Therefore, improving the speed and communication of AI-supported decisions is vital for maintaining audience engagement.

2.2. AI and Its Potential Impact on Football Legitimacy

Artificial Intelligence (AI), particularly through systems like the Video Assistant Referee (VAR), has the potential to enhance the legitimacy of football by promoting fairness, consistency, and accuracy in decision-making. Football legitimacy refers to the perception that rules are applied fairly and uniformly, ensuring a level playing field for all participants. Traditionally, human referees have shouldered the burden of this responsibility, but their decisions are inevitably influenced by human limitations, including perceptual errors, fatigue, and cognitive biases (Plessner & Haar, 2006).

The integration of AI addresses many of these challenges. VAR, for instance, allows for real-time video analysis of key incidents, enabling referees to make more informed decisions. Studies show that the use

of VAR significantly reduces officiating errors and controversial calls, which in turn improves trust in the system among players, coaches, and fans (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020). This correction mechanism supports the idea that justice is being served on the field, a core component of perceived legitimacy.

Moreover, AI systems can help eliminate inconsistencies arising from different refereeing styles across countries and competitions. A consistent application of the rules, supported by AI, minimizes doubts regarding favoritism or bias. According to (Held, et al., 2023), AI-based referee systems like VARS (Video Assistant Referee System) provide a structured framework for reviewing decisions, which can be standardized and audited, increasing procedural transparency.

However, legitimacy is not solely determined by accuracy. It also depends on how the technology is implemented and communicated. If VAR decisions are not explained clearly or if reviews take too long, fans may become frustrated, potentially undermining the legitimacy that the system aims to reinforce (Winand, Schneiders, Merten, & Marlier, 2021). Therefore, for AI to truly enhance legitimacy, it must be transparent, efficient, and integrated in a way that complements human refereeing.

2.3. Potential Benefits of AI in Football Officiating

Artificial Intelligence (AI) in football officiating brings several potential benefits that contribute to enhancing the quality, fairness, and consistency of the game. One of the most significant advantages is the improvement of decision accuracy. Technologies such as the Video Assistant Referee (VAR) and goal-line technology reduce the occurrence of clear and obvious errors, particularly in high-stakes situations like goals, penalties, and red card incidents (O'Brien & O'Keeffe, 2022). These tools offer referees a second look at crucial moments, allowing for more informed and accurate calls.

Another benefit is the promotion of fairness and transparency. By providing visual evidence and allowing referees to consult replays, AI-supported officiating reduces the influence of human bias and increases the perceived legitimacy of decisions among players and fans (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020). This fosters trust in officiating and contributes to a more equitable playing environment.

In addition, AI contributes to consistency in decision-making across matches and competitions. Human referees may interpret situations differently depending on their experience, angle of view, or psychological state. AI systems, however, can apply the same evaluative criteria consistently, which is particularly valuable in international tournaments where uniformity is crucial (Held, et al., 2023).

AI can also support referee development and training. Data gathered through AI systems can be used to review and analyze referees' performance, offering feedback and learning opportunities that enhance their decision-making over time (O'Brien & O'Keeffe, 2022). This continuous feedback loop benefits not only current matches but the future quality of officiating.

2.4. Existing Theories and Frameworks

The integration of Artificial Intelligence (AI) into football officiating has prompted the development of various theories and frameworks aimed at understanding and enhancing its application. One prominent framework is the Explainable Video Assistant Referee System (X-VARS), which leverages multi-modal large language models to interpret football videos from a referee's perspective. X-VARS is designed to perform tasks such as video description, question answering, and action recognition, aligning its analyses with the official Laws of the Game. This system enhances decision-making transparency and supports referees by providing detailed explanations for complex incidents (Held, et al., 2024)

Another significant framework is the Video Assistant Referee System (VARS), which utilizes multi-view video analysis to automate decision-making in football. VARS aims to provide real-time feedback to referees by analyzing incidents from multiple camera angles, thereby improving the accuracy and consistency of officiating decisions. Studies have shown that VARS can achieve performance levels comparable to human referees, indicating its potential to support officiating across various levels of the sport (Held, et al., 2023)

These frameworks are grounded in the broader theoretical context of human–technology interaction, emphasizing the importance of designing AI systems that complement human decision-making processes. Theories in this domain advocate for AI applications that enhance human capabilities rather than replace them, ensuring that the human element remains central to officiating. This approach addresses concerns related to the ethical implications of AI in sports, such as maintaining fairness, transparency, and the integrity of the game (O'Brien & O'Keeffe, 2022).

Existing theories and frameworks in AI-assisted football officiating focus on creating systems that augment human judgment, improve decision accuracy, and uphold the ethical standards of the sport. These frameworks serve as foundational models for the ongoing development and integration of AI technologies in football refereeing.

2.5. Limitations and Challenges

The integration of Artificial Intelligence (AI) in football officiating, particularly through systems like the Video Assistant Referee (VAR), presents several limitations and challenges that warrant careful consideration.

- **Technical Limitations**
  While VAR aims to enhance decision-making accuracy, it is not infallible. Certain situations, such as subjective fouls or ambiguous handball incidents, remain contentious despite video reviews. Moreover, the technology's effectiveness heavily depends on the quality and availability of camera angles, which may not always capture incidents comprehensively (Kolbinger & Knopp, 2020).
- **Impact on Game Flow**
  The implementation of VAR can lead to interruptions that disrupt the natural flow of the game. Reviews can be time-consuming, leading to extended stoppages that may affect player momentum and spectator engagement. Fans have expressed concerns that these interruptions detract from the excitement and spontaneity of live football matches (Kolbinger & Knopp, 2020).
- **Subjectivity in Decision-Making**
  Despite technological assistance, a degree of subjectivity persists in officiating decisions. VAR provides additional perspectives, but the final judgment often rests with the on-field referee's interpretation, which can still lead to debates and perceptions of inconsistency (Spitz, Wagemans, Memmert, Williamsd , & Helsena , 2020).
- **Fan Perception and Acceptance**
  The acceptance of VAR among fans is mixed. Some appreciate the increased accuracy, while others feel it undermines the traditional human element of the game. Concerns include a perceived lack of transparency in the review process and frustration over decisions that, despite technological review, remain controversial (Hamsund & Scelles, 2021),
- **Ethical and Privacy Concerns**
  The use of AI and video technology raises ethical questions, particularly regarding privacy and surveillance. The continuous monitoring required for VAR involves capturing extensive footage of players and spectators, leading to debates about consent and data protection (Floridi, et al., 2018)

2.6. AI and the Emotional Experience of Football Fans

The emotional experience of football fans is central to the sport's appeal, and the introduction of AI systems like the Video Assistant Referee (VAR) has significantly impacted this dynamic. While AI aims to improve fairness and accuracy, its effects on emotions such as joy, frustration, suspense, and disappointment are complex and multifaceted.

Mixed Fan Reactions

The integration of Artificial Intelligence (AI) in football officiating, particularly through the Video Assistant Referee (VAR) system, has significantly influenced the emotional experiences of football fans. While VAR aims to enhance decision-making accuracy, its impact on fan sentiment is complex and multifaceted.

Studies have shown that VAR interventions often lead to negative emotional responses among fans. For instance, research analyzing Twitter data from English Premier League matches found that sentiments expressed in tweets related to VAR were significantly more negative compared to other match-related tweets. This negativity persisted for an average of 20 minutes following a VAR incident, indicating a substantial impact on fan emotions during games (Kolbinger & Knopp, 2020).

The primary sources of fan dissatisfaction include the disruption of game flow and the perceived lack of transparency in VAR decisions. Fans have expressed frustration over the interruptions caused by VAR reviews, which they feel detract from the excitement and spontaneity of the game. Additionally, the opacity of the decision-making process has led to feelings of confusion and mistrust towards officiating outcomes (Hamsund & Scelles, 2021).

Conversely, some fans acknowledge the potential of VAR to improve decision accuracy, which can contribute to a fairer competition. However, this recognition is often overshadowed by concerns regarding the implementation and execution of the technology (Wagner & Ludvigsen, 2023)

2.7. The Evolution of Football Refereeing: Balancing Human Judgment and Artificial Intelligence

The integration of Artificial Intelligence (AI) into football refereeing represents a significant shift in the sport's officiating landscape. This evolution seeks to enhance decision-making accuracy while preserving the essential human elements that define the game's spirit.

Historically, football referees have relied solely on their judgment to make on-field decisions. However, the increasing complexity and speed of modern football have necessitated the adoption of technological aids. Systems like the Video Assistant Referee (VAR) and semi-automated offside technology have been introduced to support referees in making more accurate calls. These technologies utilize AI algorithms to analyze in-game situations, offering insights that might be challenging for human officials to discern in real-time (Gottschalk, Tewes, & Niestroj, 2020)

The implementation of AI in refereeing has led to notable improvements in decision accuracy. For instance, semi-automated offside technology employs advanced algorithms to track player positions and movements, facilitating quicker and more precise offside rulings. This reduces the margin of human error and enhances the overall fairness of the game (Gottschalk, Tewes, & Niestroj, 2020).

Despite these advancements, the integration of AI into football officiating is not without challenges. One primary concern is the potential over-reliance on technology, which may diminish the referee's authority and the human aspect of decision-making. Moreover, the use of AI raises questions about the

transparency and interpretability of decisions, as complex algorithms may not always provide clear justifications for their outputs (Leslie, 2024).

Furthermore, the presence of AI oversight can influence human referees' behavior. Studies have shown that referees may alter their decision-making processes when aware of AI monitoring, potentially leading to shifts in error types and frequencies (Almog, Gauriot, Page, & Martin, 2025). This underscores the need for a balanced approach that leverages AI's strengths without undermining the referee's role

2.8. Future Directions and Research Gaps

The integration of Artificial Intelligence (AI) into football refereeing has significantly enhanced decision-making processes. However, several areas require further research to fully harness AI's potential in this domain.

- **Advancements in AI Algorithms**
  Current AI models, such as the Video Assistant Referee System (VARS), have demonstrated potential in automating soccer decision-making. VARS utilizes multi-view video analysis to recognize foul types and appropriate sanctions, achieving human-comparable performance in certain contexts (Held, et al., 2023). Future research should focus on refining these algorithms to handle complex, subjective decisions that currently challenge AI systems.
- **Enhancing Explainability**
  The "black box" nature of AI decision-making poses challenges in understanding and trusting AI-driven outcomes. X-VARS addresses this by incorporating large language models to provide explanations for decisions, enhancing transparency (Held, et al., 2024). Further exploration into explainable AI can bridge the gap between technological outputs and human comprehension, fostering greater acceptance among stakeholders.
- **Integration with Human Referees**
  While AI can process data rapidly, the nuanced judgment of human referees remains invaluable. Studies suggest that AI should complement, not replace, human decision-making (Held, et al., 2024). Research into hybrid models that combine AI efficiency with human judgment could lead to more effective and accepted officiating systems.
- **Addressing Ethical and Legal Concerns**
  The deployment of AI in refereeing raises ethical issues, including data privacy and the potential for bias in decision-making. Investigating these concerns is crucial to ensure that AI systems uphold fairness and equity in sports (Held, et al., 2023).
- **Expanding Accessibility**
  High costs and technical requirements currently limit AI-assisted refereeing to top-tier competitions. Developing cost-effective solutions and scalable technologies can democratize access, allowing lower-league and amateur games to benefit from AI advancements (Held, et al., 2023).
- **Longitudinal Impact Studies**
  Understanding the long-term effects of AI in refereeing on game dynamics, player behavior, and fan engagement is essential. Longitudinal studies can provide insights into how AI influences the broader football ecosystem over time (O'Brien & O'Keeffe, 2022).

3. Previous Studies

3.1 Studies:
Study 1: Home Advantage and Referee Bias in European Football
- **Authors:** Chris Goumas

- **Problem:** Investigating the impact of match location (home vs. away) and crowd support on referee decision-making in European football.
- **Method:** Analysis of match data from the 2009/2010 and 2010/2011 UEFA Champions League and Europa League, focusing on disciplinary sanctions issued by referees. Poisson regression models were used to estimate the adjusted mean number of yellow cards for home and away teams. **Year:** 2014
- **Findings:** Referees issued significantly more yellow cards to away teams than to home teams, with a 25% increase in the Champions League ($p < 0.001$) and a 10% increase in the Europa League ($p = 0.002$). The bias was more pronounced in the Champions League, largely due to higher crowd densities. The magnitude of referee bias increased with crowd density ($p < 0.001$), but crowd size and proximity did not show a significant relationship with bias. These findings suggest that crowd support influences referee decisions, and controlling for team performance within matches is important to avoid overestimating referee bias. (Goumas, 2014)

Study 2: The Effect of Video Assistant Referee (VAR) on Match Performance Variables at Men's FIFA World Cup Tournaments

- **Authors:** Kubayi, A., Larkin, P., & Toriola, A.
- **Problem:** Exploring how the Video Assistant Referee (VAR) has influenced match performance variables in FIFA World Cup tournaments.
- **Method:** Comparative analysis of matches from the 2014 and 2018 FIFA World Cup tournaments (n = 64 for each). Matches from 2018 featured VAR, while those from 2014 did not. Variables analyzed included goals, penalties, corner kicks, yellow cards, red cards, offsides, and playing time during the first and second halves. **Year:** 2021
- **Findings:** The introduction of VAR led to significant increases in the number of penalties and total playing time (first half, second half, and overall), with significant decreases in the number of offsides ($p < 0.05$). These findings suggest that VAR implementation has an impact on match dynamics, and the study offers practical recommendations for improving VAR guidelines in future FIFA World Cup tournaments. (Kubayi, Larkin, & Toriola, 2021)

Study 3: Sports Fans and Innovation – Football Fans' Satisfaction with Video Assistant Refereeing (VAR)

- **Authors:** Winand, M., Schneiders, C., Merten, S., & Marlier, M.
- **Problem:** Investigating football fans' satisfaction with the Video Assistant Referee (VAR) system and the impact of social identity and argumentative theories on their perceptions.
- **Method:** An online survey of 320 football fans in 2017 to assess their satisfaction with VAR, the level of identification with their favorite teams, and attitudes toward decision-aid technologies in sports. **Year:** 2021
- **Findings:** The study found high levels of trust in the accuracy, effectiveness, and fairness of VAR, with most fans favoring the technology. However, fans who had a stronger identification with their favorite team were less satisfied with VAR, as it diminished the joy of debating match events. The research highlighted that while VAR improved decision-making, it also impacted the social and emotional aspects of fan engagement in football. (Winand, Schneiders, Merten, & Marlier, 2021)

Study 4: The Effect of Video Assistant Referee (VAR) on Referees' Decisions at FIFA Women's World Cups

- **Authors:** Zhang, Y., Li, D., Gómez-Ruano, M.-Á., Memmert, D., Li, C., & Fu, M.
- **Problem:** Investigating how the introduction of the Video Assistant Referee (VAR) system has impacted refereeing decisions at the FIFA Women's World Cup.

- **Method:** The study compared data from 52 matches in the 2015 FIFA Women's World Cup (before VAR) and 52 matches in the 2019 tournament (where VAR was deployed). A range of match variables such as playing time, penalties, offsides, fouls, and cards were analyzed using statistical methods like the Mann–Whitney U test, Bayesian analysis, and generalized linear models. **Year:** 2022
- **Findings:** The study found that after the implementation of VAR, playing time significantly increased in the first half, second half, and total match. However, there was no significant change in the number of penalties, offsides, fouls, goals, corner kicks, or yellow/red cards. The results suggest that VAR's introduction led to more playing time but did not significantly alter certain game metrics like fouls or goals. The study also highlighted the potential implications of VAR for refereeing in elite women's football. (Zhang, et al., 2022)

Study 5: Reimagining the Role of Technology in Sport Officiating: How Artificial Intelligence (AI) Supports the Design and Delivery of Ecologically Dynamic Development Processes.
- **Authors:** O'Brien, K. A., & O'Keeffe, M.
- **Problem:** Exploring how artificial intelligence (AI) can support the development of sport officials, particularly by improving decision-making skills through technology-assisted training.
- **Method:** The study reviewed how AI technologies can be applied to support referees in dynamic, real-world sport environments by improving judgment and decision-making capabilities. The authors examined various AI-assisted tools designed to enhance officiating processes. **Year:** 2022
- **Findings:** The study highlights the potential of AI to aid in the development of referees by providing feedback that enhances their decision-making and judgment. It emphasizes that AI technologies should be used to augment, rather than replace, human decision-making, suggesting that a balance between AI and human judgment is necessary for effective officiating. (O'Brien & O'Keeffe, 2022)

Study 6: VARS: Video Assistant Referee System for Automated Soccer Decision Making from Multiple Views.
- **Authors:** Held, J., Cioppa, A., Giancola, S., Hamdi, A., Ghanem, B., & Van Droogenbroeck, M.
- **Problem:** Investigating the development of an automated Video Assistant Referee System (VARS) for soccer, aimed at improving decision-making through multi-view video analysis.
- **Method:** The study proposed and tested VARS, which automates the decision-making process by analyzing soccer incidents from multiple camera angles. The authors introduced a new dataset, SoccerNet-MVFoul, which contains video footage of soccer fouls annotated by professional referees. The system was benchmarked to assess its accuracy in recognizing fouls. **Year:** 2023
- **Findings:** The study concluded that VARS could significantly enhance the fairness and accuracy of soccer officiating at all levels, from professional leagues to amateur federations. By automating the decision-making process, VARS reduces human error and provides real-time feedback to referees. However, challenges regarding infrastructure costs and the adoption of VARS in lower-tier leagues remain. (Held, et al., 2023)

Study 7: Fans' Perceptions towards Video Assistant Referee (VAR) in the English Premier League
- **Authors:** Hamsund, T., & Scelles, N.
- **Problem:** Investigating football fans' perceptions of the Video Assistant Referee (VAR) system in the English Premier League (EPL) and the changes fans would like to see implemented.

- **Method:** An online survey was conducted with 1,350 EPL fans of various age groups, exploring their opinions on VAR and the modifications they believe would improve the system. **Year:** 2021
- **Findings:** The study found that most fans supported the continued use of VAR in the EPL, though many expressed dissatisfaction with how it was currently implemented. Fans, particularly younger ones, showed more positive perceptions of VAR, emphasizing the need for better usage guidelines and more transparency in decisions. The research suggested that the EPL should take fan feedback into account when considering future improvements to VAR, especially regarding how technology is integrated into the match experience. (Hamsund & Scelles, 2021)

Study 8: Investigating the Effect of Social Influence and Gender on the Willingness to Use IoT Technology in Sports: From Consumer Perspective
- **Authors:** Nazemi Bidgoli, A., Mohamadi Turkmani, E., & Irani, H. R.
- **Problem:** Examining the effect of social influence and gender on the willingness to use Internet of Things (IoT) technology in sports from a consumer perspective.
- **Method:** Structural equation modeling (SmartPLS3 software) was used to analyze data collected from insured athletes with at least one year of coverage. **Year:** 2023
- **Findings:** The study found that the attitude towards IoT technology significantly influenced willingness to use it, with social influence positively impacting willingness, but not significantly affecting attitude. Perceived ease of use was found to significantly influence attitude and perceived usefulness, with a stronger effect on perceived usefulness. Gender did not have a significant moderating effect on social influence, attitude, or willingness to use IoT technology in sports. The study suggests enhancing perceived usefulness and ease of use to improve attitudes toward IoT adoption in sports (Nazemi , Mohamadi , & Reza , 2023).

2.2. Comparison of AI in Football Officiating Studies

Study	Problem Addressed	AI Technology Involved	Findings
Home Advantage and Referee Bias in European Football (Goumas, 2014)	Investigating home crowd influence on referee decisions	Data analysis of match performance	Evidence of referee bias favoring home teams; higher crowd densities increased bias
The Effect of VAR on Match Performance in FIFA World Cup Tournaments (Kubayi, Larkin, & Toriola, 2021)	Exploring VAR's impact on match statistics	VAR technology	Significant changes in penalties, playing time, and offsides; VAR influenced refereeing trends
Football Fans' Satisfaction with VAR (Winand, Schneiders, Merten, & Marlier, 2021)	Assessing football fans' satisfaction with VAR	Surveys and fan feedback	Mixed fan reactions; while VAR improves decision-making, it affects game flow and fan enjoyment
The Effect of VAR on Referees' Decisions in Women's Football (Zhang, et al., 2022)	Analyzing VAR's effect on referees' decision-making	VAR technology	Increased decision accuracy but impacted game flow; no significant change in penalties, fouls, or goals
AI in Referee Training (O'Brien & O'Keeffe, 2022)	Exploring AI's role in improving officiating skills	AI-assisted training tools	AI enhances referee decision-making skills through feedback and dynamic training
VARS: AI-Powered VAR System (Held, et al., 2023)	Developing an automated VAR system for soccer	AI-driven VAR system	AI system increased accuracy and fairness in officiating but raised concerns over over-

Study	Problem Addressed	AI Technology Involved	Findings
			automation
Fans' Perceptions of VAR (Hamsund & Scelles, 2021)	Investigating fan perceptions of VAR in the EPL	Surveys and fan interviews	Mixed reactions; fans support VAR but seek improvements in implementation and transparency
Social Influence on AI Acceptance in Sports (Nazemi , Mohamadi , & Reza , 2023)	Studying factors influencing AI acceptance in sports	Surveys and behavioral analysis	Social influence and perceived ease of use impact AI adoption; gender did not significantly affect willingness

A range of recent studies has examined the multifaceted role of artificial intelligence (AI), particularly Video Assistant Referee (VAR) systems, in shaping football officiating. These studies vary in scope-from analyzing referee bias and decision-making to exploring fan satisfaction and ethical considerations-but together they offer a comprehensive view of how AI is influencing the game. A comparative analysis of these works provides valuable context for understanding the current landscape and highlights key implications for the future of AI in football.

Summary of Key Studies on AI in Football Officiating:

- **Goumas (2014)** analyzed referee behavior in European football, revealing a significant home advantage influenced by crowd pressure. The study underscores the human susceptibility to bias-an issue AI technologies aim to mitigate.
- **Kubayi, Larkin, & Toriola (2021)** explored the effect of VAR during FIFA World Cup tournaments. The technology altered match dynamics, including penalties, playing time, and offsides, illustrating VAR's impact on both decisions and game structure.
- **Winand et al. (2021)** and **Hamsund & Scelles (2021)** investigated fan satisfaction with VAR, uncovering mixed perceptions. While fans acknowledged improved fairness, many expressed frustration with interruptions and the loss of natural game flow.
- **Zhang et al. (2022)** focused on women's football, finding that VAR increased decision accuracy but had minimal effect on scoring metrics. Importantly, concerns about disruptions were echoed in this context as well.
- **O'Brien & O'Keeffe (2022)** examined the use of AI in referee training, demonstrating that AI tools can enhance decision-making skills through simulated scenarios and feedback loops, potentially reducing errors and subjective inconsistencies.
- **Held et al. (2023)** introduced an automated AI-based VAR system (VARS), which showed significant improvements in fairness and accuracy. However, this study raised ethical concerns about over-automation and the diminishing role of human discretion.
- **Nazemi, Mohamadi, & Reza (2023)** explored the social and psychological factors affecting AI acceptance in sports. Their research showed that social influence and ease of use were key factors in adoption, whereas gender had limited impact.

Collectively, these studies focus on the dual impact of AI technologies on decision accuracy and fairness, as well as fan engagement and game dynamics. They show that AI systems, particularly VAR, are effective in addressing historical issues of bias and inconsistency in refereeing. However, their implementation is not without controversy. Many fans and stakeholders are concerned that the mechanization of officiating may compromise the emotional and spontaneous qualities that make football unique.

In relation to this study-"Beyond the Displacement of Human Referees: The Future of AI in Football Between Legitimacy and Fan Enjoyment"-these findings provide a foundation for deeper investigation.

While previous research supports the legitimacy-enhancing capabilities of AI, it also reveals a recurring tension: the desire for objective fairness versus the need to maintain the emotional and cultural essence of the sport. This aligns directly with the central question of this paper, which examines how AI systems can be leveraged to improve officiating without eroding the elements that captivate fans and define football's identity.

Promising Approaches to AI Integration in Football Officiating:
Beyond real-time decision-making, AI holds significant potential in the education and professional development of referees. Research suggests that AI-assisted training systems-featuring interactive simulations and real-time feedback-can improve decision accuracy and mitigate bias (O'Brien & O'Keeffe, 2022; Plessner & Haar, 2006). This training paradigm supports the idea that AI should act as a complement rather than a replacement to human judgment, ultimately enhancing both the legitimacy of officiating and the fan experience.

1. **Enhanced AI-Based Referee Training:** Beyond real-time decision-making, AI holds significant potential in the education and professional development of referees. Research suggests that AI-assisted training systems-featuring interactive simulations and real-time feedback-can improve decision accuracy and mitigate bias (O'Brien & O'Keeffe, 2022); (Plessner & Haar, 2006). This training paradigm supports the idea that AI should act as a complement rather than a replacement to human judgment, ultimately enhancing both the legitimacy of officiating and the fan experience.

2. **AI-Driven Performance and Match Analysis:** Studies have shown that the use of VAR influences various match performance metrics, such as playing time, fouls, and disciplinary actions (Errekagorri, Castellano, Echeazarra, & Lago-Peñasc, 2020); (Kubayi, Larkin, & Toriola, 2021). AI systems can be further utilized to deliver real-time performance insights to coaches, referees, and analysts. These applications help optimize both team strategies and the spectator experience by deepening the analytical understanding of game dynamics.

3. **Fan-Centric AI Design:** Fan perception plays a critical role in determining the social acceptance of AI technologies in football (Wagner & Ludvigsen, 2023; Hamsund & Scelles, 2021). Future innovations should aim to balance decision accuracy with game fluidity. Reducing interruptions, increasing transparency, and possibly involving fans through interactive AI features could enhance their sense of fairness and emotional connection to the game (Winand, Schneiders, Merten, & Marlier, 2021); (Kolbinger & Knopp, 2020).

4. **Hybrid Human-AI Refereeing Models:** A growing body of literature supports hybrid officiating models where AI supports human referees rather than displaces them (Held, et al., 2023); (Gottschalk, Tewes, & Niestroj, 2020). In this setup, AI enhances accuracy, consistency, and objectivity, while human referees retain interpretive and emotional nuances essential to the game's spirit. Such synergy helps mitigate legitimacy concerns and contributes to sustained audience enjoyment.

5. **Ethical and Social Integration Frameworks:** The ethical integration of AI into football officiating requires addressing issues like algorithmic bias, transparency, and social inclusivity (Floridi, et al., 2018); (Nazemi , Mohamadi , & Reza , 2023). AI tools must consider demographic and cultural sensitivities to ensure fairness across stakeholder groups. For example, acknowledging gender-related differences in acceptance or understanding of officiating technologies can enhance the inclusiveness and trustworthiness of these systems (Zhang, et al., 2022).

4. Results and Discussion

This study investigates how AI technologies, particularly the Video Assistant Referee (VAR), influence the perceived legitimacy and fairness of football officiating. Traditionally, refereeing has relied on human decision-making, often shaped by subjective interpretation, perceptual limitations, and cognitive biases (Plessner & Haar, 2006; Toufik & Aissa , Youth Interest In Creating Sports Content On Youtube As A Profitable Activitya Survey Study On A Sample Of Youtube Users, 2024) (Unkelbach & Memmert, 2010). The introduction of AI tools aims to mitigate these inconsistencies, with VAR

designed to enhance objectivity, accuracy, and consistency in decisions. Evidence from recent seasons indicates that the use of VAR has significantly reduced controversial calls and incorrect judgments, contributing to a more just officiating process (Kubayi, Larkin, & Toriola, 2021); (Zhang, et al., 2022). As the 2026 FIFA World Cup approaches, the global football community is paying close attention to how AI impacts the legitimacy of officiating on the sport's grandest stage. The success of AI integration largely depends on maintaining transparent and equitable implementation, ensuring that technology acts as a supportive tool rather than dominating the essence of the game (Floridi, et al., 2018); (Held, et al., 2024).

A central question addressed by this research is how AI integration affects the legitimacy and fairness of football officiating. While the reduction of human error is a major advantage, fairness cannot be measured by accuracy alone. For AI-driven systems like VAR to enhance legitimacy, they must be perceived by players, coaches, and fans as fair, unbiased, and consistent. This legitimacy stems not only from the accuracy of decisions but also from transparency, speed, and the perception that the system operates impartially (Spitz, Wagemans, Memmert, Williamsd, & Helsena, 2020). The research confirms that viewers are more likely to support AI-enhanced refereeing when decision-making processes are visible and comprehensible (Held, et al., 2023); (Almog, Gauriot, Page, & Martin, 2025). In that sense, AI is not merely a technical upgrade; it is a sociotechnical system whose legitimacy hinges on acceptance and trust from the football ecosystem.

Although AI technologies offer technical superiority in terms of data analysis and objective judgment, they cannot replicate the nuanced, real-time understanding and situational awareness exhibited by experienced human referees (O'Brien & O'Keeffe, 2022). This raises a pivotal question: to what extent can AI replace human referees without compromising the spirit of the game? The findings of this study underscore that while AI can enhance decision-making, full automation would undermine the emotional, cultural, and humanistic aspects of officiating. The dynamic conditions of a football match often require empathy, contextual judgment, and intuition-qualities AI lacks. Hybrid officiating models, where human referees are augmented by AI tools rather than replaced, are found to be the most effective and acceptable (Gottschalk, Tewes, & Niestroj, 2020). Such a model helps preserve the sport's human essence while benefiting from AI's analytical precision (Leslie, 2024).

As for the impact on fan enjoyment and engagement, one of the primary concerns about VAR is its tendency to interrupt the natural flow of play. Football is a high-tempo sport, and pauses for video reviews-if prolonged or poorly communicated-can frustrate viewers and disrupt the emotional momentum of the match (Errekagorri, Castellano, Echeazarra, & Lago-Peñasc, 2020); (Winand, Schneiders, Merten, & Marlier, 2021). However, this study finds that the key determinant of fan satisfaction is not the existence of VAR itself, but how it is implemented. When reviews are conducted swiftly and supported by transparent communication, fans show greater tolerance for interruptions and perceive the game as fairer (Hamsund & Scelles, 2021); (Wagner & Ludvigsen, 2023). Moreover, offering real-time replays and explanations during reviews enhances fan understanding, thus transforming a potentially negative disruption into a moment of deeper engagement and trust in the system.

In the context of the upcoming 2026 FIFA World Cup, which is expected to showcase the most advanced version of VAR to date, fan experience will be central to AI's perceived success. With global audiences increasingly demanding fairness and clarity, ensuring that AI systems are fast, transparent, and communicative will be critical. The integration of second-screen features, live explanations, and immersive VAR visuals could even enhance emotional investment and involvement, turning technical officiating into a shared narrative moment that connects fans more deeply to the match (Toufik, Some Basic Psychological Traits For Amateur Algerian Football Players, 2023).

This study also explores how AI impacts player behavior and strategic decision-making on the field. The awareness that every action is subject to VAR scrutiny may alter players' conduct, reducing simulation (diving) and off-the-ball incidents due to fear of retrospective review (Nazemi , Mohamadi , & Reza , 2023). While this can lead to cleaner play and more disciplined behavior, it also introduces new strategic considerations. Players and coaches must now consider how AI might interpret their actions, potentially leading to more calculated or restrained performances. Thus, AI subtly reshapes the tactical landscape of football, extending its influence beyond officiating into gameplay dynamics.

Ethical and regulatory considerations are equally critical when evaluating AI's role in football. AI systems, if poorly designed, can reproduce or even exacerbate biases embedded in training data or algorithmic structure (Floridi, et al., 2018). This raises pressing ethical questions: who audits these systems? Who is accountable when AI makes an error? The findings emphasize the necessity of independent reviews, transparent algorithms, and cross-disciplinary collaborations between ethicists, technologists, and football governing bodies. By establishing clear regulations and oversight mechanisms, stakeholders can ensure that AI's adoption in football officiating aligns with core values of fairness, integrity, and inclusivity (Held, et al., 2024).

Public perception also plays a defining role in the trajectory of AI integration. Although technological literacy among fans is increasing, many remain skeptical of systems they do not fully understand. As the study reveals, acceptance of AI is more likely when fans perceive it as an enhancement to-rather than a replacement for-human judgment (Kolbinger & Knopp, 2020). Transparent communication, open dialogue with fan communities, and educational campaigns can bridge this gap, turning spectators into informed stakeholders. The long-term success of AI in football will depend as much on cultural acceptance as on technical effectiveness.

Looking forward, the long-term impact of AI in football officiating appears both promising and complex. Technological advances may continue to improve the accuracy and scope of decisions, potentially expanding into areas like automated offside detection, foul recognition, and even emotional analysis of players. However, as AI capabilities expand, so too must the commitment to safeguarding football's emotional and ethical core. The game's beauty lies in its unpredictability, drama, and human stories. Overreliance on automation risks sterilizing these elements. Therefore, AI should be viewed not as a solution, but as a tool-a powerful assistant that supports, but never replaces, the human heart of football.

5. Conclusion

This study explores the future of artificial intelligence (AI) in football, with particular emphasis on the integration of AI-driven systems such as the Video Assistant Referee (VAR) and their impact on the legitimacy of officiating, fairness, and fan enjoyment. As the 2026 FIFA World Cup approaches-a tournament anticipated to showcase the most advanced officiating technologies to date-understanding the implications of AI on the game's integrity and appeal becomes increasingly relevant. The findings reflect a dynamic tension between the technological promise of enhanced accuracy and the cultural importance of football's emotional and humanistic elements.

The research addressed a longstanding issue in football: the limitations of traditional refereeing systems. Human error, perceptual biases, and inconsistent decision-making have often undermined confidence in officiating. AI-enhanced tools like VAR were introduced to mitigate these weaknesses by providing referees with objective, data-informed support. However, this study also acknowledges that football's cultural identity is deeply tied to spontaneity, flow, and emotional connection-qualities potentially disrupted by overly mechanized interventions. The central question-whether AI can enhance fairness and legitimacy without compromising the spirit of the game-has guided the analysis.

The findings suggest that AI can indeed improve the legitimacy of officiating when used judiciously. VAR has demonstrated the ability to reduce controversial decisions, increase consistency, and foster a greater sense of fairness among players and fans (Kubayi, Larkin, & Toriola, 2021; Zhang et al., 2022). Transparent decision-making processes, such as showing replays and explaining calls, strengthen perceptions of justice and enhance trust in officiating systems (Held et al., 2023; Almog et al., 2025). When appropriately implemented, AI does not detract from the game but reinforces its fairness, thereby supporting its legitimacy.

Nonetheless, the impact of AI on fan enjoyment remains complex. While many spectators appreciate the improved accuracy of calls, others express concern about the interruptions VAR introduces into the game's rhythm (Errekagorri et al., 2020; Hamsund & Scelles, 2021). Football thrives on its fluidity and drama, and any delay or ambiguity in the officiating process can detract from the viewing experience. This study emphasizes that AI systems must be designed for efficiency and clarity, ensuring that technological benefits do not come at the expense of audience engagement. The path forward lies in optimizing both accuracy and entertainment-a delicate balance that requires continuous refinement of AI interfaces and protocols.

A critical question this research sought to address was whether AI could fully replace human referees without compromising the essence of football. The evidence suggests otherwise. AI lacks the emotional intelligence, contextual awareness, and moral reasoning that human referees bring to the pitch (O'Brien & O'Keeffe, 2022). These human qualities are essential for interpreting nuanced moments that fall outside binary logic. Therefore, a hybrid model, in which AI supports human decision-making rather than replaces it, emerges as the most effective and sustainable approach (Gottschalk, Tewes, & Niestroj, 2020; Leslie, 2024). This model safeguards the spirit of the game while incorporating technological precision.

Moreover, AI's influence on player behavior and in-game decision-making has also become evident. The presence of VAR can lead players to adjust their actions, knowing they are under constant surveillance. This can reduce foul play and simulations, promoting cleaner competition. At the same time, it encourages more strategic thinking, as teams must consider the broader implications of every on-field decision in light of potential review. These shifts underscore how AI not only affects officiating but also reshapes the game's tactical and psychological dimensions (Nazemi, Mohamadi, & Reza, 2023).

Another crucial consideration lies in the ethical and regulatory frameworks governing AI use in football. The study highlights the risk of algorithmic bias and the importance of inclusive and transparent system design (Floridi et al., 2018; Held et al., 2024). Trust in AI officiating depends on public confidence that these systems are fair, unbiased, and subject to regular audits. Establishing clear ethical guidelines and accountability mechanisms is essential to ensure that the integration of AI does not reinforce existing inequalities or introduce new forms of discrimination.

In conclusion, while AI-particularly VAR-offers significant potential to enhance the legitimacy and fairness of football officiating, its successful implementation hinges on a balanced approach. This approach must prioritize decision accuracy, operational transparency, fan satisfaction, ethical integrity, and the preservation of the game's cultural richness. As AI systems continue to evolve and play a larger role in international tournaments such as the 2026 FIFA World Cup, sustained efforts to refine technology, engage fans, and support referees will be critical. By fostering a collaborative relationship between human judgment and machine precision, football can harness AI as a transformative ally-one that uplifts the game without diminishing the elements that make it truly beloved around the world.

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