Application of Artificial Intelligence in Sports: A case study of cricket.

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Abstract—The game of cricket has developed over the years and has completely transformed.

Very obviously technology has affected the game a lot. Many developments have come in the game as a concept, rules and even how teams and players look and prepare for a match.
This paper looks at the various uses of Artificial Intelligence as a whole.

INTRODUCTION and LITERATURE REVIEW

Artificial intelligence (AI) is being used in cricket to analyze player performance, predict match outcomes, and improve coaching. Machine learning algorithms process large amounts of data, such as ball-by-ball records and player statistics, to identify patterns and trends. This can be used to make predictions about future performance and to identify areas where players need to improve. AI is also being used to analyze footage of matches to provide a detailed analysis of players' techniques and to identify areas where they can make adjustments. Additionally, AI is being used to help coaches and analysts quickly identify key game moments that may have influenced the outcome.

The use of artificial intelligence Enterprises various topics and different fields inside of the sport of cricket that helps enhance the quality of the game. Whether it be the accuracy of the decisions which are to be made by the umpire or the team selection by the team coach - A.I. today has indeed helped make cricket even more competitive. It has made the game more accurate and has, in fact, pushed the players to work harder, and put more effort into training which in turn has resulted in increased performance on the pitch.

AI is being used in cricket for the following applications:
→ Ratings for Individual players
→ Selection of players in IPL
→ Effects of AI on umpiring decisions
→ Number of runs required while chasing.
→ AI in cricket coaching

I.   Rating Player Performances

The main technique used to rate players is fuzzy logic. A huge amount of literature is available on fuzzy logic and its applications. Fuzzy logic can handle problems with imprecise data and give more accurate results. Professor L. A. Zadeh introduced the concept of Fuzzy logic. After that, researchers used this theory for developing new algorithms and decision analysis.
Basically, instead of giving a solid output or absolute output, it gives an output which is from the range of 0.1

- 1.0. In this paper, they have taken eight parameters as linguistic variables that affect the ranking or performance of a cricket player. The parameters taken for the system are RunsScored, BallsFaced, StrikeRate, Out, Fours, Sixes, TeamStrength and TeamAgainstStrength. We have taken Ranking as an output parameter. All these input variables affect the ranking of a player.

Here are a couple of examples of the software that was developed:
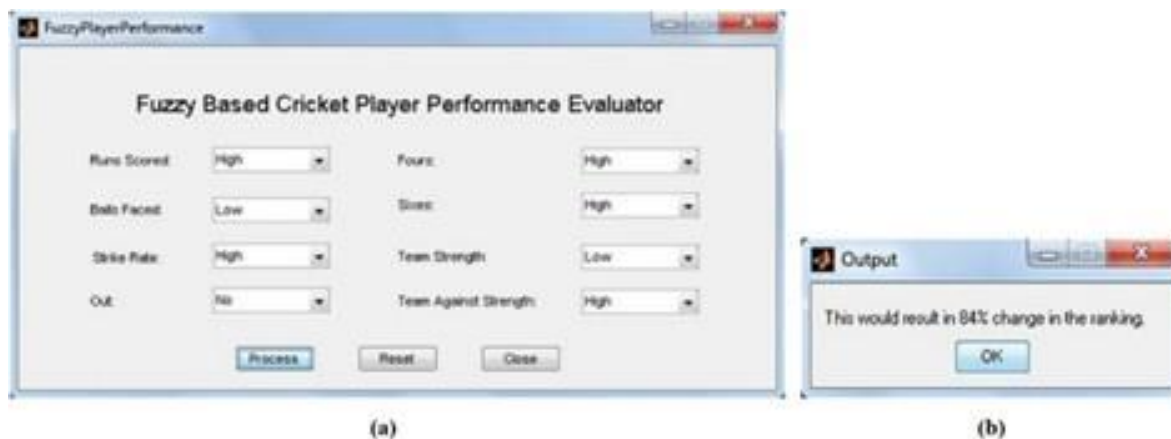

(a)   (b)

(a)   (b)

Image Source: IJCA Special Issue on "Artificial Intelligence Techniques - Novel Approaches & Practical Applications" AIT, 2011

However, this brings up an important issue.

In limited-over matches too there are a lot of instances where there arises need for a player to play the anchor role. In case of a batting collapse, it is often required for a player to steady the ship. He may play with a low

S.No.	Feature	Definition
1.	Consistency Index	(Total Runs Scored) / (No. Innings Played in which he got out)
2.	Attacking Index	(Total Runs Scored / Total Balls Faced) * 100
3.	Experience Index	No. Matches Played
4.	Runs Index	Total Runs Scored
5.	Big Score Index	(No. Hundreds + Fifties) / No. Innings Played
6.	Power Hitter Index	(No. Boundaries) / (No. Balls Faced)
7.	Finishing Index	(No. Not Out's / No. innings)
8.	Strike Rotating Index	(No. Runs Scored without Boundaries)/ (No. Balls Faced without a Boundary)
9.	Winning Consistency Index	(Total Runs Scored in winning matches) / (No. Innings played in the winning matches in which he got out)
10.	Winning Attacking Index	(Total Runs Scored in winning matches / Total Balls Faced in winning matches) * 100
11.	Loosing Consistency Index	(Total Runs Scored in loosing matches) / (No. Innings Played in the loosing matches in which he got out)
12.	Loosing Attacking Index	(Total Runs Scored in loosing matches / Total Balls Faced in loosing matches) * 100
13.	Pressure Consistency Index	(Total Runs Scored in finals or semi-final matches) / (No. Innings Played in the finals or semi-final matches in which he got out)
14.	Pressure Attacking index	(Total Runs Scored in finals or semi-final matches / No. Balls Faced in finals or semi-final matches) * 100
15.	Night Consistency Index	(Total Runs Scored in Night matches) / (No. Innings Played in the Night matches in which he got out)
16.	Night Attacking Index	(Total Runs Scored in Night matches / Total Balls Faced in Night matches) * 100
17.	Target Setting Consistency Index	(Total Runs Scored while Batting First) / (No. Innings Played while Batting First in which he got out)
18.	Target Setting Attacking Index	(Total Runs Scored while Batting First) / (Total Balls Faced while Batting first) * 100
19.	Target Chasing Consistency Index	(Total Runs Scored while Batting Second) / (No. Innings Played while Batting Second in which he got out)
20.	Target Chasing Attacking Index	(Total Runs Scored while Batting Second) / (Total Balls Faced while Batting Second) * 100
21.	Asian Pitch Consistency Index	(Total Runs Scored on Asian Pitches) / (No. Innings Played on Asian Pitches in which he got out)
22.	Asian Pitch Attacking Index	(Total Runs Scored on Asian Pitches) / (Total Balls Faced on Asian Pitches) * 100
23.	Previous Consistency Index	(Total Runs Scored in Previous Year) / (No. Innings Played in Previous Year in which he got out)
24.	Previous Attacking Index	(Total Runs Scored in Previous Year/ Total Balls Faced in Previous Year) * 100
25.	Previous Experience Index	No. Matches Played in Previous Year
26.	Previous Runs Index	Total Runs Scored in Previous Year
27.	Previous Big Score Index	(No. Hundreds + Fifties in Previous Year)/ (No. Innings Played in Previous Year)
28.	Previous Power Hitter Index	(No. Boundaries in Previous Year) / (No. Balls Faced in Previous Year)
29.	Previous Finishing Index	(No. Not Out's in Previous Year / No. innings in Previous Year)
30.	Previous Strike Rotating Index	(No. Runs Scored without Boundaries in Previous Year)/ (No. Balls Faced without Scoring a Boundary in Previous Year)
31.	IPL Consistency Index	(Total Runs Scored in IPL) / (Number of Innings Played in IPL in which he got out)
32.	IPL Attacking Index	(Total Runs Scored in IPL / Total Balls Faced in IPL) * 100
33.	IPL Experience Index	No. Matches Played in IPL
34.	IPL Runs Index	Total Runs Scored in IPL
35.	IPL Big Score Index	(No. Hundreds + Fifties in IPL)/ (No. Innings Played in IPL)
36.	IPL Power Hitter Index	(No. Boundaries in IPL) / (No. Balls Faced in IPL)
37.	IPL Finishing Index	(No. Not Out's in IPL/ No. innings in IPL)
38.	IPL Strike Rotating Index	(No. Runs Scored without Boundaries in IPL)/ (No. Balls Faced without Scoring a Boundary in IPL)

S.No.	Feature	Definition
1.	Consistency Index	(No. Runs Given)/ (No. Overs bowled)
2.	Attacking Index	(No. Balls Bowled)/ (No. Wickets Taken)
3.	Experience Index	No. Matches Played
4.	Wickets Index	No. Wickets Taken
5.	Big Wickets Index	(No. Times 4 or 5 Wickets Taken)/(No. Matches Played)
6.	Short Performance Index	(No. Wickets Taken Excluding the Big Wickets)/ (No. Matches Played Excluding the Big Wicket Matches)
7.	Average Index	(No. Runs Given)/ (No. Wickets Taken)
8.	Maiden Index	No. Maiden Overs Bowled
9.	Winning Economy Index	(No. Runs Given in Winning Matches)/ (No. Overs bowled in Winning Matches)
10.	Winning SR Index	(No. Balls Bowled in Winning Matches)/ (No. Wickets Taken in Winning Matches)
11.	Loosing Economy Index	(No. Runs Given in Loosing Matches)/ (No. Overs bowled in Loosing Matches)
12.	Loosing SR Index	(No. Balls Bowled in Loosing Matches)/ (No. Wickets Taken in
13.	Big Match Economy Index	(No. Runs Given in Finals or Semi-Final Matches)/ (No. Overs bowled in Finals or Semi-Final Matches)
14.	Big Match SR Index	(No. Balls Bowled in Finals or Semi-Final Matches)/ (No. Wickets Taken in Finals or Semi-Final Matches)
15.	Night Economy Index	(No. Runs Given in Night Matches)/ (No. Overs bowled in Night Matches)
16.	Night SR Index	(No. Balls Bowled in Night Matches)/ (No. Wickets Taken in Night Matches)
17.	Target Defending Economy	(No. Runs Given while Bowling Second)/ (No. Overs bowled while Bowling Second)
18.	Target defending SR	(No. Balls Bowled while Bowling Second)/ (No. Wickets Taken while Bowling Second)
19.	Target Restricting Economy	(No. Runs Given while Bowling First)/ (No. Overs bowled while Bowling First)
20.	Target Restricting SR	(No. Balls Bowled while Bowling First)/ (No. Wickets Taken while Bowling First)
21.	Asia Economy Index	(No. Runs Given on Asian Pitches)/ (No. Overs bowled on Asian Pitches)
22.	Asia SR Index	(No. Balls Bowled on Asian Pitches)/ (No. Wickets Taken on Asian Pitches)
23.	Previous Consistency Index	(No. Runs Given in Previous Year)/ (No. Overs bowled in Previous Year)
24.	Previous Attacking Index	(No. Balls Bowled in Previous Year)/ (No. Wickets Taken in Previous Year)
25.	Previous Experience Index	No. Matches Played in Previous Year
26.	Previous Wickets Index	No. Wickets Taken in Previous Year
27.	Previous Big Wickets Index	(No. Times 4 or 5 Wickets Taken in Previous Year)/(No. Matches Played in Previous Year)
28.	Previous Short Performance Index	(No. Wickets Taken Excluding the Big Wickets in Previous Year)/ (No. Matches Played Excluding the Big Wicket Matches in Previous Year)
29.	Previous Average Index	(No.Runs Given in Previous Year)/ (No. Wickets Taken in Previous Year)
30.	Previous Maiden Index	No. Maiden Overs Bowled in Previous Year
31.	IPL Consistency Index	(No. Runs Given in IPL) / (No. Overs bowled in IPL)
32.	IPL Attacking Index	(No. Balls Bowled in IPL)/ (No. Wickets Taken in IPL)
33.	IPL Experience Index	No. Matches Played in IPL
34.	IPL Wickets Index	No. Wickets Taken in IPL
35.	IPL Big Wickets Index	(No. Times 4 or 5 Wickets Taken in IPL)/(No. Matches Played in IPL)
36.	IPL Short Performance Index	(No. Wickets Taken Excluding the Big Wickets in IPL)/ (No. Matches Played Excluding the Big Wicket Matches in IPL)
37.	IPL Average Index	(No. Runs Given in IPL)/ (No. Wickets Taken in IPL)

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Image Source : Artificial Intelligence in Sport: An Ethical Issue by Suman DC April 2022.

Use of artificial intelligence in Umpiring

One of the most important contributions of Artificial Intelligence in cricket is bringing accuracy in terms of decisions which are made by umpires. Historically, the first official third umpire was appointed in 1992 to officiate the Test match between India and

South Africa. At that time, the third umpire was consulted only for run-outs, stumping and boundaries (Bhattacharya, 2011). Since then, the roles of the third umpire have been expanding including assisting on-field umpires in making various decisions such as no-ball decisions that have been brought into play recently (ICC, 2021a). However, the process of using third umpiring technology has several ethical issues in modern-day cricket though these upgraded technologies have been implemented for the fairer execution and better experiences of the game. The following subsections reflect the current usage of umpiring technologies in cricket. Human intervention, however, is still a necessity. Thus, the introduction of the soft signal. Soft signal refers to 'the visual communication by the bowler's end umpire to the third umpire (accompanied by additional information via two-way radio where necessary) of his/her initial on-field decision prior to initiating an Umpire Review' (ICC. 2021a). In 2016, ICC came up with this human intervention which is known as 'soft signal.' According to this rule, 'if despite the available technology, the third umpire is unable to decide with a high degree of confidence whether the original on-field decision should be changed, then he or she shall report that the replays are 'inconclusive' and at the on-field decision shall stand. The third umpire shall not give answers conveying likelihoods or probabilities' (ICC, 2017). Hence, one point is clear from this: the current umpiring technology is 'inconclusive' at times.

Use of artificial intelligence in Coaching Cricket

Sports and exercise science have made big waves in technological advances and innovative approaches. The fact that physical activity can be monitored through wearable devices demonstrates the relevance, applicability, optimal use-case and sustainability of sports technology and automation. Over the last few centuries, cricket has consistently been recognized as a

complex yet multifaceted sport in which each player's 'position' has a role to play. As a result, this has made it increasingly challenging for a coach to manage. However, with 21st-century skills and the availability of technological advances as well as innovative systems in the coaches' footsteps, coaching and managing cricket teams has never been as exciting. The Cricket Brain. In modern times (approximately 2010–2022), technology has helped coaches, scientists and analysts win games, which was not the case in the eras of W.G. Grace, Sir Donald Bradman, Sir Viv Richards and more. The defining characteristics of Virat Kohli, AB de Villiers and Steven Smith are based on an advanced form of cognitive functioning (as well as an 'unconventional' orthodox batting technique), which can be rarely picked up with the naked eye, video and biomechanical analysis, and performance patterns. Instead, if scientists (and support staff) can understand what happens in a player's mind, this would provide a winning edge over any player(s)/team. If anyone would have access to this kind of (cognitive) technology and approach, we would have a more level playing field in further understanding the determinants of cricket batting success. This approach is known as 'the cricket brain'. One of the closest ways to administer and measure the cognitive functioning (and neuroscientific analysis) of batters is using an electroencephalogram (which would be entirely dependent on the approval of the Laws of Cricket Committee in London and the International Cricket Council). This kind of study would

allow one to track the brain activity and patterns of players while they are being analyzed biomechanically. In addition, motion capture analysis would be used, thereby understanding cognitive batting behavior. Only once we can attenuate advanced objective studies among batters (as well as bowlers) will we be able to understand (explicitly) why and how players display such talent on the field.

FUTURE WORK

There are several ways in which AI can be further used in cricket:

Umpire Decision Review System (DRS): AI can be used to improve the accuracy of DRS by analyzing the footage from multiple angles and using machine learning algorithms to make a decision.

Injury prevention: AI can be used to analyze data on player movements and biomechanics to identify patterns and trends that may indicate an increased risk of injury.

Game strategy: AI can be used to analyze data on player performance and team tactics to provide insights into how teams can improve their strategy.

Fan engagement: AI can be used to create personalized fan experiences, such as virtual reality (VR) and augmented reality (AR) simulations, to enhance the viewing experience.

Training: AI can be used to analyze player data and provide feedback to coaches and players on areas where they can improve.

Automation of Scorecards: AI can be used to automate the scorecard system and provide real-time updates on match progress, player performance, and statistics.

Pitch analysis: AI can be used to analyze data on pitch conditions, weather and other factors to predict the behavior of the pitch and help teams prepare accordingly.

Player Performance Prediction: AI can be used to predict the performance of a player based on their previous performance, fitness, and other factors, which can help teams make better decisions about player selection and strategy.

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