Artificial Intelligence and Data Analytics in Cricket

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Abstract

Cricket, as we all know, is one of the most popular sports in the world. Selection of the right players, team strategy, conditions, and match-ups all play a vital role in the outcome of a cricket match. Each of these factors can be improved with the use of latest technologies. Artificial Intelligence(AI) and Data Science have helped take the game a step forward. Technologies such as Bat Sense, Ball Sensors, Hotspot, Ultra edge and many others have helped bring fairness as well as competitiveness in the game. Latest Machine Learning and Deep Learning techniques have also made the teams smarter while selecting their players, making combinations, deciding strategies and many more. These techniques help predict the performance of batters, bowlers, or even teams as a unit based on their previous performances and different factors. Teams also use strategies on when and where to use specific players. Roles of specific players have been made much clearer with the help of data. Teams such as England Cricket Team, Nottinghamshire County Cricket Club, Multan Sultans and many others have used these techniques and have achieved very quick success with limited resources. This Paper reviews different types of Machine Learning and Deep Learning techniques being used in the Cricketing Industry. Mostly the techniques being used are Linear Regression, K

Nearest Neighbors(KNN), Decision Tree and other similar techniques. From the success of different teams, it is clear that data is helping teams go a step ahead of their opponents and is becoming a vital part of their success.

Keywords: Data Analytics, Data Science, Cricket, Artificial Intelligence

Introduction

Overview

The introduction of data into baseball by the Oakland Athletics in Major League baseball opened a completely new door for strategy and preparation in sports. Baseball changed completely after that. It took long enough but thankfully it has now entered into cricket as well. From selection of the playing 11 to predicting the target and individual performances of players, data has revolutionized cricket completely.

Latest Machine learning techniques have helped teams practice using the same bowling actions and speeds using bowling machines. Models give unbiased statistics to help select the best available players. Even ball by ball strategies can be made using data. The players have now started watching specific videos made for them about the opposition and now prepare according to the weakness of the opponents. Match-ups have become one of the most important parts of strategy making. Left arm batsmen are now being used more and more to cope with leg spinners.

There are a lot of recent success stories of teams who have won major trophies with the help of data. Every team carries data analysts with them and are a very important part of their dressing room. The England Cricket team is one of the main examples of this ideology. After the shameful exit from the 2015 world cup they completely changed their team and playing method with the help of data which helped them get the first ever world cup in 2019. Many teams in IPL, Islamabad United and Multan Sultans in PSL, and numerous county teams all follow the same ideology and have seen a lot of success recently

Problem Statement

Data Science and Artificial Intelligence (AI) like many other fields have now helped improve the game of cricket as well. Data is as important as it gets, especially in sports. From making player vs player or even game by game strategies, data plays such an important role. Selecting the best available players and then helping them execute the plans perfectly, data has made things very easy for the management and the coaches. This study aims to look into different uses and techniques of data science and data analysis that are being used in the current sports ecosystem.

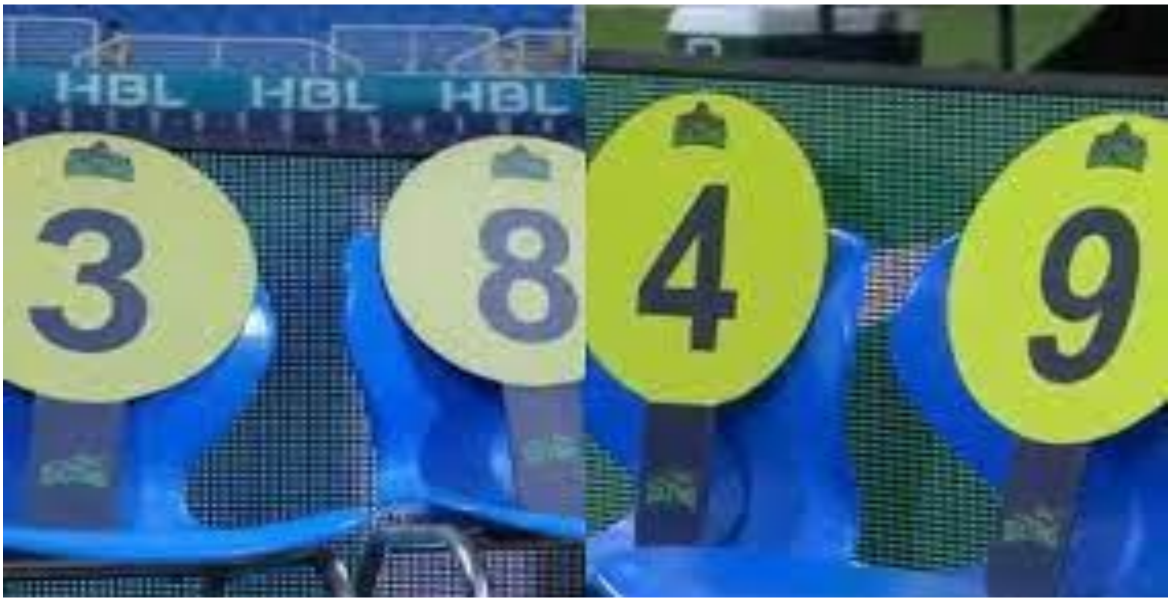


Figure 1: Multan Sultans using Data Codes to help the on-field captain.

Objectives

Data in sports has a lot of uses. In cricket the main thing is selecting the best possible players from the set of available players. Auction and drafting systems of all the major leagues are being run using the data. Keeping all the personal bias aside, teams want to select the best for themselves. Data gives them plan A, B, C and the list goes on. In that case they are completely ready to go into the tournament with the best available team.

It then occurs that data then helps make and execute the plans to win games in the tournament. Opponents' playing style, their best areas, their weaknesses, their dependent and independent players, and much more such useful information is only clicks away.
Teams also run predictive models to simulate what could happen in the game in similar scenarios. Based on what has happened in the past, teams can get an idea of what challenges and tasks are ahead of them. Which player is more useful against which player and in what phase of the game? All this and much more information can be extracted and then applied to help increase the chances of victory.

Limitations and Scope

Data as useful as it can be, will always have limitations. It can help you to succeed most of the time but the scenario in sports changes in the matter of balls. Opponents can change their style of play. Many other factors can come into effect. So data can always help but you must always have backup plans to cope with the opponents. It can be very useful but only for those who use it intelligently. Otherwise it can come back and haunt you badly.

Literature Review

A study in (Singh et al., 2015) talks about the prediction of the total number of runs scored by a team in the first as well as the second innings. The earlier predictions are based only on the run rate of the team at a particular moment. This study also takes into consideration the venue, number of wickets fallen and the opposition. 2nd innings score prediction takes extra consideration, i.e. the target. These methods have been implemented using Naive Bayes and Linear regression classifiers. All the ODIs played between 2002 and 2014 were used at 5 over intervals for the 50 overs of each match. The results showed that the Linear regression model is less prone to error than the one being used currently. Also, the accuracy of Naive Bayes increased from 68 percent to 91 percent from 5th to the 45th over.

This study in (Wickramasinghe et al., 2014) shows the prediction of a batsman's performance in a test series. Data was taken from the test matches played between a 5-year gap. Different characteristics of the player and the team he plays were taken into consideration. A 3 layered hierarchical model is proposed to cater to the hierarchical nature of the data. The study concludes that the batting hand, and the rank of the opposition are the major factors that affect a player's performance.

Another study in (Passi et al., 2018) talks about how difficult it is to select the best 11 for any specific game and tries to predict the individual player's performances to help the coach and the captain in making the right decisions. Player's previous record, current form, opposition, and venue, all play an important role in this prediction. The study tries to predict the runs scored by a batsman and the wickets taken and runs conceded by a bowler. These problems are classified using different ranges and multiple models such as SVM, Naive Bayes, Decision Tree, and Random Forest are used to predict the outcomes. It is concluded in the study that Random Forest has the highest accuracy amongst all these models.

A study conducted back in 2011 (Amin et al., 2014) proposed a method of a team's selection using Data Envelopment Analysis(DEA). After the evaluation the players can be ranked on the basis of their DEA scores. A dataset consisting the records and details of IPL season 4(2011) was used to conduct this research. Players were evaluated using different attributes and their score was then aggregated using a linear DEA model.

The study in (Pathak et al., 2016) looks to explore the field of data mining and machine learning in sports. This study attempts to predict the outcome of an ODI game. The outcome usually depends on different factors such as, venue, toss, strategies, weather, and even the time of the game. Modern techniques such as Naive Bayes, Space Vector Machine(SVM), and Random Forest are used to predict the outcome. Using the predictions, a tool Cricket Outcome Predictor(COP) has been developed which tells the probability of winning or losing the game.

The main aim of the researchers in this study (UmaMaheswari et al. 2009) is the modeling of an automated framework so that specific movements, strategies, and correlation between playing patterns can be identified. This will eventually help the coaches in making certain decisions and strategies. The real time data is humongous. So to get a sophisticated structure, an Object-relational model is used. Principal component analysis is applied to take a look at the data in lesser dimensions but still get a decent amount of accuracy. It works as a comparison mechanism and frequent patterns are analyzed to get interesting outcomes.

The researchers in (Elliot et al., 2007) talk about a topic that has developed a lot over the last 8-10 years, i.e. the 15-degree bend in the bowling arm. The paper mainly reviews the errors in the system and the modeling of the reconstruction process with respect to elbow extension tolerance. The rules have been set by the International Cricket Council(ICC). The researchers talk about the differences of Laboratory based testing and on field testing of the bowler’s action. It is concluded that the opt reflective has a better accuracy than the video based systems and it is better if the tests are conducted in the laboratory.

A study in (Doljin et al., 2015) talks about the kinematics and dynamics of cricket. It attempts to develop a smart cricket ball which will help in collecting better data and understanding of the motions of the bowlers. Previously, technical limitations such as electric design and sensors have hindered the growth of such types of projects. Now very useful and tiny sized components are available which can be used to create a smart ball. The data will be used to help bowlers improve. The ball has the same weight and size thus; it will not affect the bowler’s performances in any case.

Another study in (Foysal et al., 2018) talks about how AI has become the new powerhouse of data analytics. Sports, like many other fields, has started to depend more on data. Applications of deep neural networks in sports data and performance analysis are still developing. In this paper they have proposed a 13-layer Convolutional Neural Network. It is called “Short Net” in order to classify the shots into six categories. The model has recorded a very high accuracy with a relatively low cross-entropy rate.

A study (Sankaranarayanan et al., 2014) provides a data mining approach to cricket simulation and prediction. Cricket, unlike other games, such as basketball and baseball, is not very much popular in data analytics and science but it has started to grow in this area. This paper takes in historical cricket data, state of the match, and other useful information. It then predicts the future match events which will lead to a win or a loss. A lot of match parameters are used and are modeled using linear regression and nearest neighbor clustering algorithms. The paper tends to predict the number of runs scored in the match to prove the usefulness of the model.

Methodology

Overview

There are a lot of different techniques used when it comes to the use of Data Science and AI in cricket. Mostly, the problems are based on predicting the total runs, player performances, and results. Sometimes, we want to make match-ups for different players, strategies for different scenarios, and sometimes we want to know what our best 11 players are according to the data. Fantasy cricket and simulation also work mainly on the idea of AI.

Techniques Used

The methods commonly used are classification techniques, principal component analysis and Data envelopment analysis.

Classification

Classification is mainly deciding the class where the new instance belongs. In cricket there are different types of decisions you have to make. Either a cricketer is a batsman or a bowler? Did a team win the game or lose it? Is the target more than or less than 100? and many more similar questions are answered using classification. Let's discuss a couple of these classifiers which are most commonly used.

a. Linear Regression

Linear Regression is used when the data and attributes are numeric. Expression of a class is obtained using the linear combination of weights and values which have been predetermined. In cricket mainly two classes are defined such as whether the wicket falls in 10 overs or not, then using the linear regression classifier the instance is defined to the class it belongs to. Many other such problems are solved using the linear regression method.

b. Naive Bayes

This classifier is based on Bayes's probability theorem. Conditional probability of an event based on another event is calculated. It used to train a supervised learning setting so that results can be extracted efficiently. An example of how this method is used can be represented by calculating the probability of number 3 batsman scoring a hundred. Here we have put a condition that the person must be a one down batsman. This is conditional probability. Probability of scoring a hundred and not scoring a hundred can then be calculated and the batsman can then be put into centurion or non-centurion class.

A. Principal Component Analysis(PCA)

The data of cricket is very diverse. PCA is a non-parametric method of extracting useful information from the data. It is a frequent pattern generation technique. Firstly, data is modeled and preprocessed according to cricketing rules and regulations. Then, dimensionality of the data is reduced as it is very hard to perform analysis on a high dimensional data. Frequent Pattern Analysis is then applied to see the most commonly occurring patterns and then it is summarized to create a generalized algorithm. Association analysis is then applied on the received patterns to extract useful knowledge and the knowledge is represented using different techniques.

B. Data Envelopment Analysis

Data Envelopment Analysis - DEA is a linear programming technique. Efficient and Non Efficient players can be identified using the DEA scores. DEA scores are calculated for different players using a formula specifically made for this purpose. The DEA score tells

the utility of a player considering everything he offers and the overall contribution they can offer.

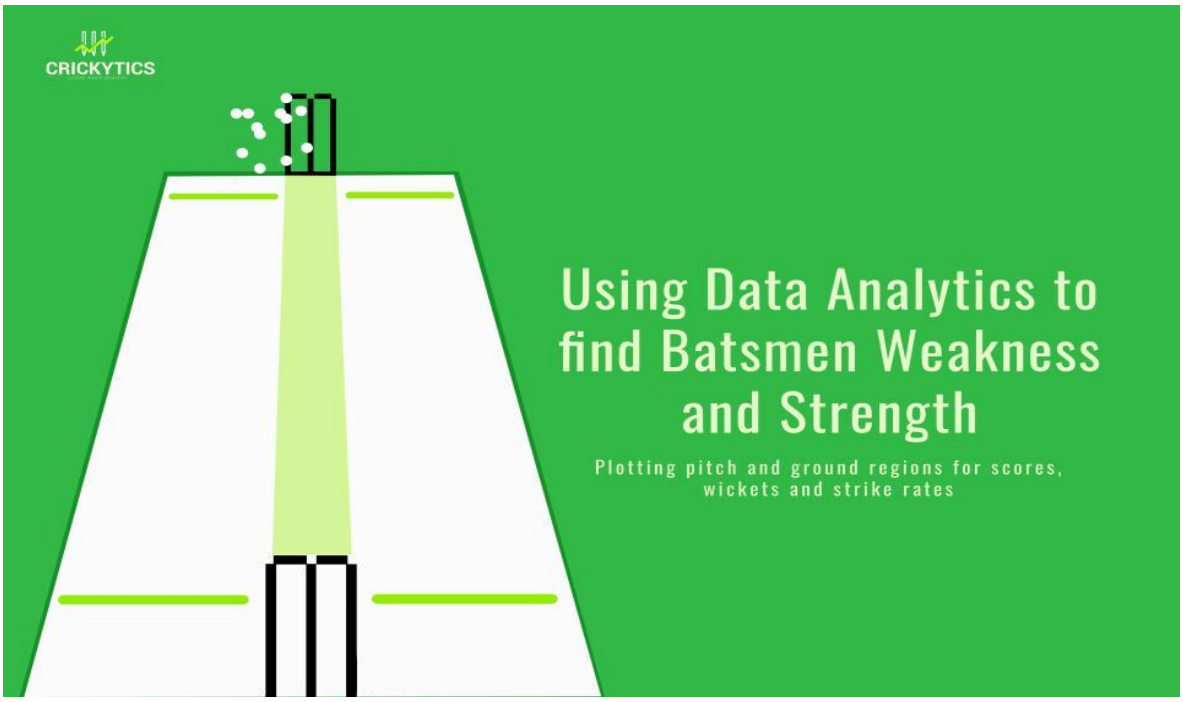

CRICKYTICS
Using Data Analytics to find Batsmen Weakness and Strength
Plotting pitch and ground regions for scores, wickets and strike rates

Figure 2: Example of How AI is being used in Cricket. Reprinted from the Twitter (https://twitter.com/crickytics/status/860550550588465155).

Experimental Results

The results from different papers have been discussed below. Different Models have been applied to predict the runs scored by the teams, batters, partnerships. Runs conceded by bowlers and wickets taken have also been predicted in some of the papers. Some of the papers select the best player or sometimes even the best possible 11 from the given players. Player vs player data has been used to create match-ups and strategies to use the right player at the right moment in the game. Other technologies such as LBW, Hawkeye, Ultraedge also use AI to predict the flow of the ball. Bounce, Speed and other similar factors are taken into context before the prediction is made.

Implementations

Linear Regression has been used to predict the runs by the team at the end of the innings based on how much they have scored in the first 5 overs of the game. Score is predicted for the next 5 overs using the 5 over interval scores. Variables such as current score and wickets fallen were considered to help predict the score accurately. Currently, run rate is used to predict the score, but the results have shown that linear regression can predict the score better than run rate. Figure 3 below shows the error in predicting the final score in both cases.

Naive Bayes has been used to predict the best possible playing 11 from the pool of available players. Factors such as playing conditions, opponents, and team combination were all considered to make the final decision. Stats of players are compared with each other. Batters, bowlers, all rounders, and wicket keepers are all compared separately and then the best combination is selected.

Another paper has used different models to compare the accuracy in predicting the runs scored by the team. Models such as Decision Tree Classifier, Naive Bayes, Random Forest, and Support Vector Machines were used. It was concluded that Random Forest is the best predictor while predicting both batting and bowling. Except for the Naive Bayes Classifier, Model accuracy for all cases also increased when the size of training data was increased.

The figure 4 below shows the accuracy of different models from different sets of training and testing data.

One research has found that the handedness of the batter does play a major role in predicting the score. While considering the options if the opponent is playing a right arm off spin bowler and the conditions are favorable for spinners, the left handed batsmen are more likely to fail in these conditions or against that specific player than the right handers. The research in (Sankaranarayanan et al., 2014) has tried to create a Home run prediction performance. The Spearman distance metric is compared with the different distance metrics used by them. They have used Jaccard, Cosine and Hamming metrics. It was reported that the spearmen metric was the best performer and the attribute bagging performed better than the nearest neighbor classifiers.

A smart ball was created by (Doljin et al., 2015) to analyze the movement of the ball in 4d. Specifically, off spin bowlers were used to collect the data. When plotted in 4d it showed much better results than in 2d. Figure 5 shows the ball plotted with color coded time information.

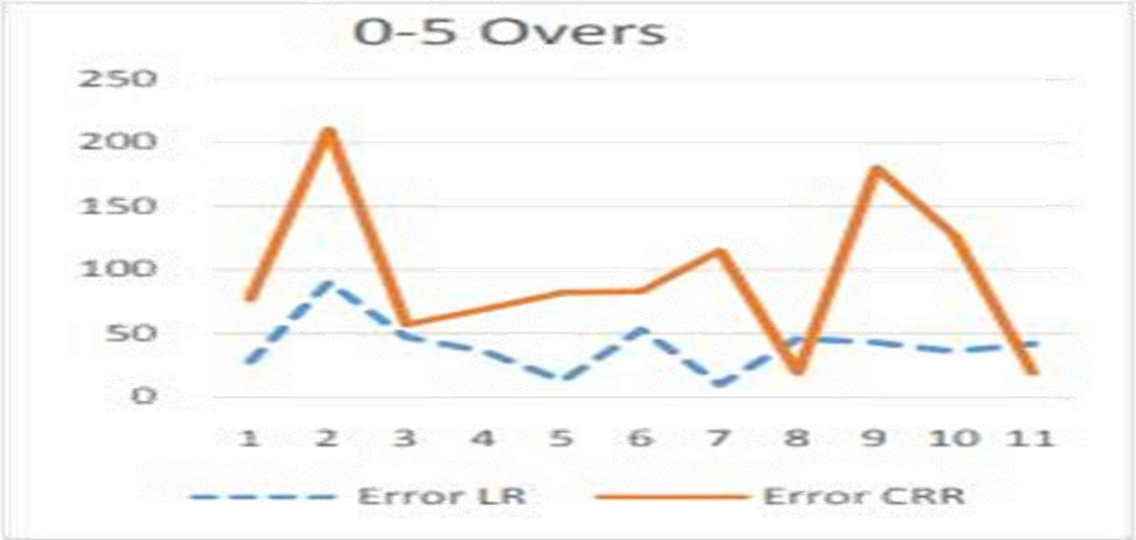
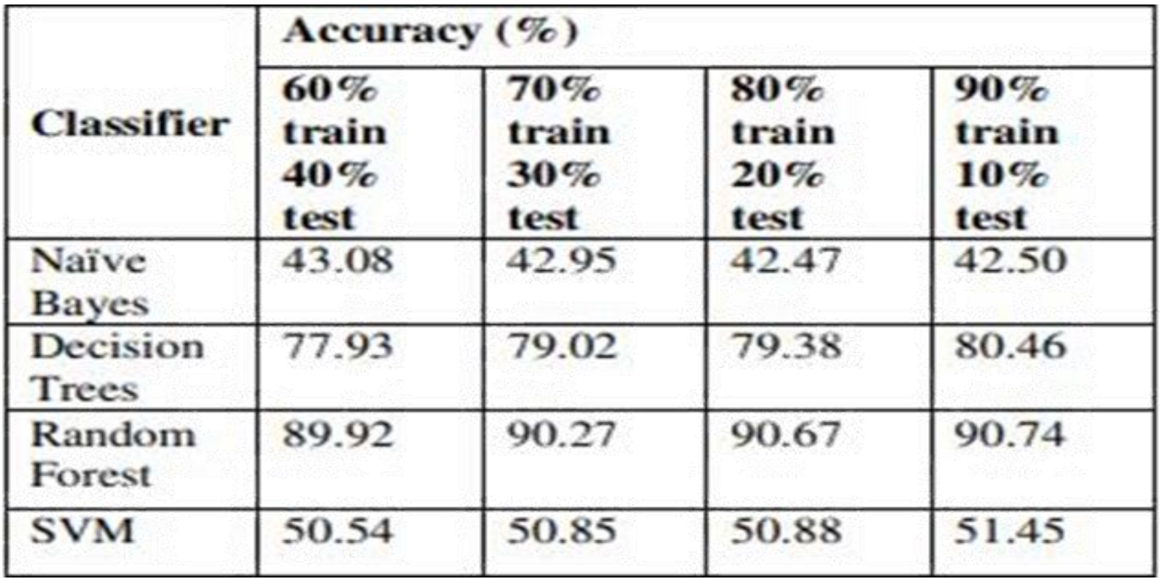


Figure 3: Error in predicting the final score. Taken from (Singh et al., 2015)



Classifier	Accuracy (%)			
	60% train 40% test	70% train 30% test	80% train 20% test	90% train 10% test
Naïve Bayes	43.08	42.95	42.47	42.50
Decision Trees	77.93	79.02	79.38	80.46
Random Forest	89.92	90.27	90.67	90.74
SVM	50.54	50.85	50.88	51.45

Figure 4: Accuracy of different models while predicting the runs. Taken from (Passi et al., 2018)

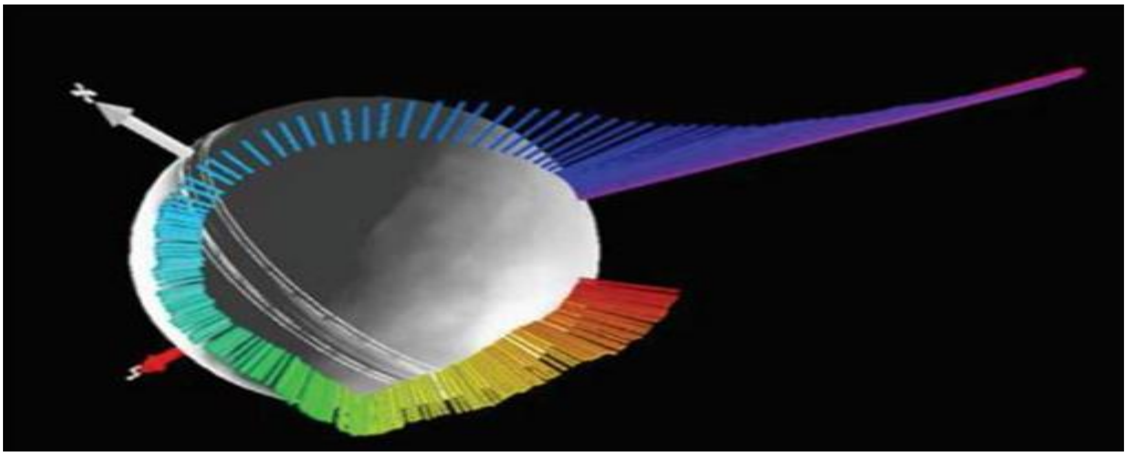
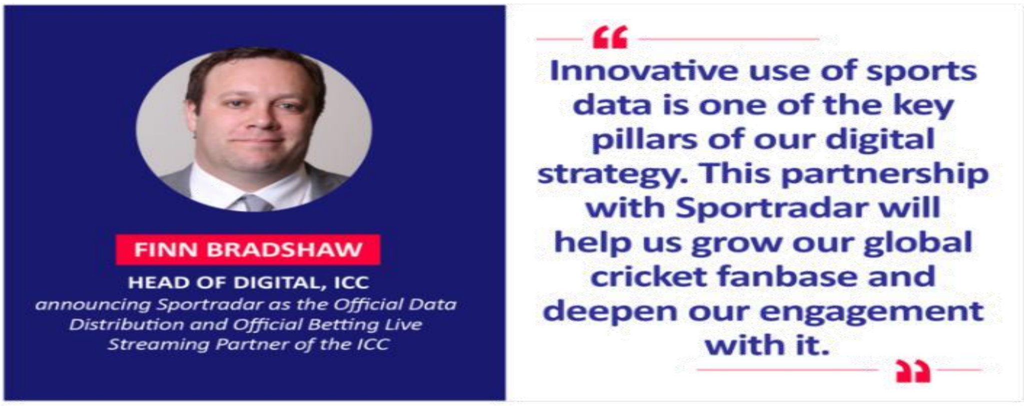


Figure 5: Smart ball plotted in 4d with color coded information. Taken from (Doljin et al., 2015)



FINN BRADSHAW

HEAD OF DIGITAL, ICC

announcing Sportradar as the Official Data Distribution and Official Betting Live Streaming Partner of the ICC

“Innovative use of sports data is one of the key pillars of our digital strategy. This partnership with Sportradar will help us grow our global cricket fanbase and deepen our engagement with it.”

Figure 6: Digital Head of ICC about importance of data in Cricket

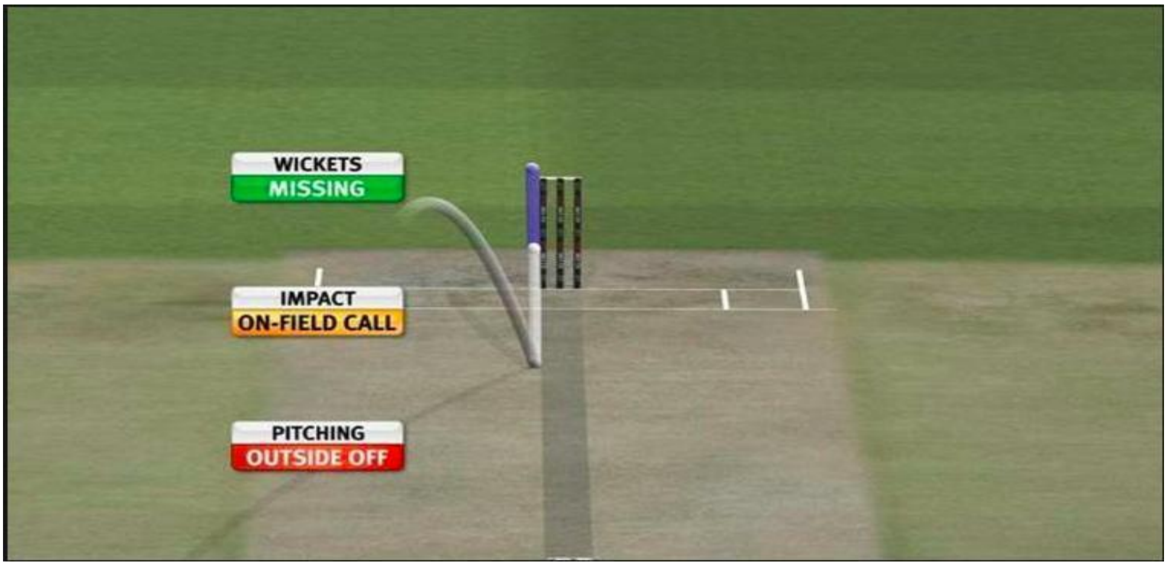


Figure 7: Use of AI to predict the route of the ball

Conclusion

Finally, it can be concluded that although the game of cricket was very complex earlier. It was getting difficult to keep up with all the innovations coming into the game but the use of data and AI in cricket has helped teams perform much better than they had been doing. Data has helped teams give value to the player performances and then select the best possible players using those values without any personal bias.

Data has also helped the team in making better strategies and match-ups to cope with all sorts of problems in the games. Whatever is going to happen in the game is already being simulated by the teams before the game even starts. Data, if used intelligently, takes you many steps ahead of your opponent and helps you win games much easily.

In conclusion, it can be said that the introduction of data into cricket has surely made a much positive impact in the game which clearly overshadows any negative impact, if it is there.

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