

Ranking of Pakistan's One-Day International Cricket Players Based on Link Fusion

Muhammad Adnan^{1,*}, Akmal Khan², and Dost Muhammad Khan²

¹ Department of Computer Science,, NCBA&E Lahore, Pakistan.

²Department of Computer Science, The Islamia University of Bahawalpur , Pakistan.

*Corresponding author: Akmal Khan (e-mail: akmal_shahbaz@yahoo.com).

Abstract- Cricket is one of the most popular game in the world. This game has been played between two teams; every team has 11 players. Every cricket team in the world belongs to a country having a cricket board that selects the best players and manage the team activities. Cricket matches are of three forms One-Day International (ODI) cricket matches, First class or Test Matches and T-20 matches. The main issue in this game is to select the best suitable players for the team and ranks them according to their performance. We mainly focus on Pakistan's One-day International ODI cricket players ranking. We proposed a method that consist of statistical formulas apply to the significant features of current players in Pakistan's One-Day International ODI cricket and rank them according to the rank score calculated by our method. For the implementation, we make application named TeamMaker that automatically scarp the information, and after applying our algorithm display, the results in the form of ranking tables. Similarly, ranking tables also available on the International Cricket Council ICC website, and too many researchers rank the cricket players of all teams in the world with different algorithms. Still, these methods are universal and not for a specific country. Our methodology based on link fusion that focuses on single country Pakistan with 27 One-Day International (ODI) cricket players that are currently available for the team. This application selects the exclusive features that are affected by their performance. *TeamMaker* application displays a ranking table based on these features. In the end, we compare and analyze the players ranking results of our methodology with the players ranking of International Cricket Council ICC. Our findings show that previous universal ranking methods neglect many countries and other prominent features of players, that's why many cricket player does not present in ranking tables.

Index Terms-- International-Cricket-Council (ICC), TeamMaker, One-Day International, Link Fusion

I. INTRODUCTION

Teams in sports consist of players, and a better team will win the match. Ranking of players in any game evaluates the importance of players in their teams [1-19]. Players are ranked according to their performance. A highly ranked player has more chance to select in the playing side, such as cricket, tennis, hockey, football etc. [6, 19].

In the previous methodologies of ranking the players in cricket, primary focus on both types of players such as batsman and bowler. Some previous research methodology also ranks the teams. Every team will rank on the performance of their players [19]. In the past, player ranking depends upon both past and recent performance. This performance includes different key factors like, experience, batsman's batting position, his batting experience, advantage of home ground, opposition team strength, batting strike rate, batting average, bowling average, bowling strike rate and economy rate for a bowler, runs and wickets by which a team won the match, or by applying PageRank algorithm [19, 16, 5, 6, 27, 1, 2]. PageRank algorithm basically applied to rank the web pages based on their importance later on this method applied on ranking the players

in sports of soccer and baseball [20-23]. International-Cricket-Council ICC [2] ranks the players of all formats of cricket One-Day-International ODI, Test Cricket or First-Class Cricket and T20 cricket on the base of PageRank algorithm [17-24, 6].

Using PageRank algorithm ranking of teams and players in cricket are calculated and a general ranking table displayed at the website of International Cricket Council ICC [7, 13, 25, 28, 26]. The scheme mentioned above for ranking the players is not only for a specific country, it ranks the players after each match played in the world, so that ranking of players may change rapidly. Any cricket Board [3] not able to manage the ranking of their own players those are currently available for their team. They get help from the International Cricket Council's ICC website [7] to select players for their team. The players from the pool of players selected as bowler, batsman, wicket-keeper, all-rounder and a captain [24]. Ranking table for bowlers also available on this website [7] but some bowlers are also exist in the list; these are retired or may be pass away from the world. So this factor confuses the players and cricket boards [3] to determine the actual ranking of their players and team. We proposed an algorithm that implemented in Python language

[4] named as *TeamMaker* to show the ranking of the Pakistanis One Day International ODI players based on some features that are important for every Player [19, 16]. This ranking may be helpful for cricket boards in selecting winning combination for a team, this algorithm also useful in different cricket leagues in searching of best team squad among all the best players in the world.

II. RESEARCH QUESTIONS

- How can we check which Player is suitable for captaincy in a cricket team?
- What are the main characteristics of the best player?
- What are the main features that affected the performance of a player?
- How can we filter out only the current Player from the pool of so many players?
- In which programming language we implement our methodology?
- Is the proposed algorithm producing a ranking that is helpful for any cricket board? Which phase is used in this method or which techniques will be helpful in this way?
- How can we check the ranking of cricket players for a specific country?
- Is the algorithm used for other cricket leagues?
- Is the proposed algorithm helpful to rank the Player of those countries where no home ground or cricket is ban?

III. OUR CONTRIBUTIONS

In this research we scrap the data of Pakistan's One-Day International (ODI) Cricket players from live updated websites [6, 1]. We build an application using python [4] code to fetch the data from the live updated cricket website and save it in the MYSQL database [9]. In the Previous techniques for ranking the cricket players, PageRank algorithm is used [27, 28]. Using PageRank algorithm, ranking of teams and players in cricket are calculated, and a general ranking table displayed at the website of International Cricket Council ICC [7, 13, 25, 28, 26]. The International-Cricket-Board ICC produces the positioning of all cricket players on the planet; it also includes both current and retired players[19, 2]. This ranking is not for a specific country.

Our methodology focused on current Pakistan's One-Day International ODI players only, because the cricket is ban in Pakistan from more than a decade, that's why these players neglected from the International Cricket Council's ICC ranking [19, 2, 19]. We filter our significant features of players that are mainly affected the ranking.

IV. LITERATURE REVIEW

There are some factors that are under consideration in ranking the batsman. Opponent's bowling ranking and runs scored by the batsman. A batsman score 100 runs in a match where the two groups score 500 runs is less esteemed than a circumstance where the two groups bowled out under 250. A batsman gets additional focuses when his group wins against exceptionally positioned group [27]. Wickets taken by a bowler in a high-scoring match has more worth than a low-scoring match. If a bowler bowls his

maximum over in a match, get credit, even if he not takes any wicket in this match. A bowler who gets more number of wickets in a victory gets bonus points [16, 7].

Daud et al. [19] analyzed previous methods for ranking the players and proposed a new method based on regions of cricket. According to the authors, the previous algorithm has the framework that mainly depends upon the intra type links which contains the information of players according to single generic link like team to team and Player to Player that ignore many characteristics of players. In our framework we are focusing on the intra type links that are based on the other main features of the Player. In this relationship we will focus on the other aspect like the relationship of a player with his team, a team with other team, a player with other Player, a player of one team the Player of the opposite team, a player with the region, bowler to batsman and batsman to bowler. Our principle is based on region based player link fusion RPLF that is mainly focused on the game of cricket. This method also extends and applied to different games in the world. In this system, they have used both the existing systems as well as their system in which they have also included inter types links between players and teams. The importance of RPLF is based on as playing conditions are not same in all the regions and you must pick the best players for your team. The major contributions of the purposed system include are both types of relations that are described earlier. The dimensionality of players and the algorithm is applicable to all kind of sports.

V. METHODOLOGY

We have developed an application in Python language TeamMaker that process and extracts required information of cricket players, i.e., data of cricket players are mainly gathered from a live updated website crickinfo [6] that is used for our method in producing results.

Our purposed method based on link fusion in which we apply our algorithm on the recent players of Pakistan to rank them. Link fusion means the inter-type and intra-type relation between players and teams. International cricket council (ICC) generate ranking the players, which mainly depend upon the win and loss of the team and some other features. Still, in our method, the intra-type and inter-type based feature is considered. Ranking of players is helpful for the team management, and this ranking rapidly changes when a new match played. We get the record for this purpose from live updated cricket website [5, 6] of 27 current players who played more than 5 One-Day International matches. Fig. 1 shows the entire players along with the year of their debut in one-day international (ODI) cricket.

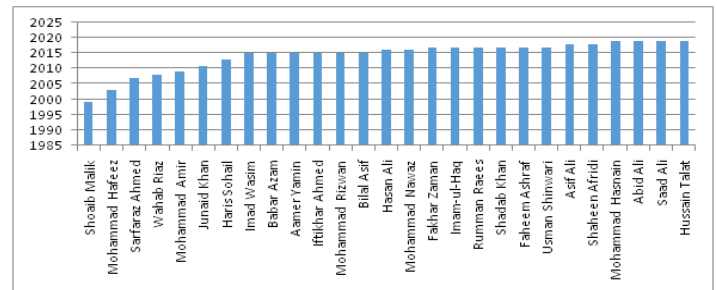


FIGURE 1: Current players of Pakistan's One-day international ODI cricket.

Our proposed methodology consists of statistical formula to apply on the features of Pakistan's one-day international ODI cricket player to rank them according to their field. To rank the one-day international ODI bowler of Pakistan, our method describe below.

$$SBowl = B.avg \times \alpha + B.SR \times \beta + B.Eco \times \gamma \quad (1)$$

where, SBowl is the strength of the bowler, B.avg is the bowling average, B.SR is the bowling strike rate and B.Eco is the economy rate of a bowler, where α , β and γ are 0.4, 0.3 and 0.3 respectively, because the bowling average is more important than other factors. By using (1) find the bowling strength and calculate the average, and it is denoted by Avg(SBowl).

$$Netscore = ((Avg(SBowl) * PL) + GS + V S) \quad (2)$$

Net score is the final score that is used for ranking the Player. Equation no (2) contains some factor that is described below. First factor is Player life PL in which each Player get some bonus points on the basis of his experience being a team member from a long time. Less credit has been given to the less experienced player, and a player with greater experience gets more credit. The bonus points assigned to each Player according to the formula that is given below in table 1.

S. No	Experience	Point
1	1 to 5 years	0.86
2	6 to 10 years	0.89
3	11 to 15 years	0.92
4	16 to 20 years	0.95
5	20 or more years	0.95

Table 1: Bonus points on the basis of experience

Grace Score GS is another factor that is used to give some credit to a bowler who throws more balls than a current player with a little experience. The points allocation is straightforward. Each bowler gets a credit of 0.007 on each ball. For example, if a player throws 1000 balls in his career, then the Grace score GS will be $1000 \times 0.007 = 7$.

A player's performance is affected by the Venue and crowd if a player played in front of his people his credibility and power is different than he played match away from home. Unfortunately Pakistan one-day international ODI player does not play in the house from 2009, that's why a player who played in the home ground get less credit than Player played away from home [23, 14]. In this regard, a player receives Venue score VS on each match, but the match away from home has more importance. A one-day international match at home ground get the point 0.01 and away from home, this point will be 0.02. To rank the one-day international ODI batsman of Pakistan, our methodology is given below.

$$SBat = BA \times \alpha + B.SR \times \beta \quad (3)$$

SBat is the strength of the batsman, B.A is the batting average, and B.SR is the batting strike rate. Where α and β are 0.6 and 0.4 respectively, because the batting strike rate is more important

than other factors. By using this (4) find the batting strength and calculate the average, and it is denoted by Avg(SBat).

$$Netscore = Avg(SBowl) \times PL + GS + V S \quad (4)$$

Net score is the final score that is used for rank the batsman. Equation (4) contains some factor that is described below. The first factor is Player life PL in which each Player get some bonus points same like the bowlers they get bonus points on experience. Grace Score GS is another factor that is used to give some credit to a batsman who played more balls than a current player with little experience. The points allocation is straightforward each batsman having experience more than 50 matches will get a credit of 20 marks. A player performance is really affected by the Venue and crowd, if a player played in front of his own people his credibility and power is different than he played match away from home. A player who played in home ground get less credit than Player played away from home. In this regard a player get venue score VS on each match but the match away from home has more importance. A one-day international match at home ground get point 0.01 and away from home this point will be 0.02 [23, 14].

VI. DATASET

Our Proposed method based on inter-type and intra-type relations between team and players and a huge amount of statistical data required for dataset. These datasets can be downloaded from different sources, but the most reliable sources are live updated website [5, 6].

For the sake of experiment, we scrap the complete statistics, match wise and inning wise of all current Pakistan's one-day international cricket players from live updated cricket websites [6, 1]. Figure 2 shows the years and number of Player in percentage who joined one-day international ODI cricket as Pakistani Player and currently available for Pakistan one-day international cricket team.

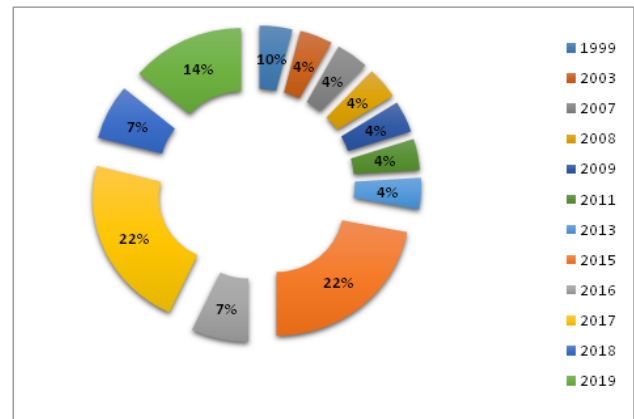


FIGURE 2: Number of players in percentage who join Pakistan one-day international cricket team and their respective joining year.

VII. TeamMaker DEVELOPMENT

To deploy our proposed method on the features of Pakistan's one-day international cricket player, we developed an application using Python TeamMaker, because python has more powerful

and strong libraries for natural language processing, i.e., scikitlearn, nltk, scrapy, etc [9, 21, 11]. This application consists of six steps, these basic steps described below in detail.

A. SCRAP THE DATA

Pakistan's one-day international cricket players career record is present in many cricket websites [5, 6, 1] they store the statistics of players, match by match and inning by inning. The ranking of players only generated by International cricket council ICC, but their ranking result include all players in the world and does not consider some features that are directly related to the performance of the Player, i.e., Venue, experience, economy rate, run rate, etc. For this purpose, I used python language containing scrapy library to get all the features of the players in Pakistan one-day international ODI cricket team players, and save it into MYSQL database [12].

B. EXTRACTING REQUIRED DATA

In this stage features of all the one-day international players who are currently serving the Pakistan's cricket saved in to Micro Soft MS Excel sheets [12]. In this step, we filter out the data and select the features that are required for our methodology.

C. PREPROCESSING ON DATA

Record of 27 current players of Pakistan's One-Day international cricket is filtered out and save it MYSQL database [8]. Our python based application TeamMaker use API scrapy that scrap all the data from online cricket websites [6, 1]. The data of these players consist of Venue of the match, opposite team, strike rate, average rate and an economy rate of each Player [19, 28, 20].

D. APPLY ALGORITHM/METHOD

At this stage, the algorithm is applied to the data of players to calculate the final result.

E. RANK THE PLAYER

All the calculations on our method were done in the previous step now a single value assigned to each batsman and bowler, and the next step is to arrange all the players according to their field i.e., bowling and batting. In the report section, two tables generated, first table for Pakistan's One-Day International ODI cricket batsman's ranking and the second ranking table contains the data Pakistan's One-Day International ODI cricket bowlers. The final data stored in MYSQL database [8].

F. Presentation of Raking

Our application TeamRank which is created in python, fetches the final results from MYSQL database [8] that are stored after the implementation of our proposed methodology, and shows it in the tabular and Graphical form which is the final result that shows the ranking bowler and batsman of Pakistan's one-day international ODI cricket team. Figure 3 represents a framework of *TeamMaker* process steps.

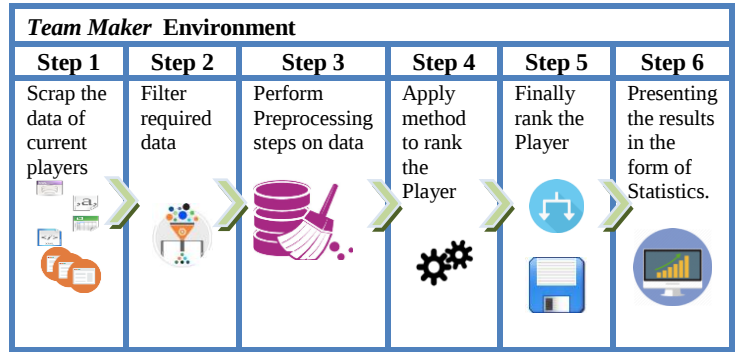


FIGURE 3: A Framework diagram with data flow and basic steps performed by TeamMaker.

VIII. RESULTS AND COMPARISONS

In our methodology of ranking players, we divide the players into two categories batsman and bowler. Every bowler includes in batting ranking, but some batsman does not bowl, so they are not included in ranking sheet. In the previous work only consider a few characteristics regarding a player. Still, in our work, we have some other factors that may be important in ranking the players especially Pakistan's One-Day International players. International Cricket Council ICC [20] display the ranking of each Player based on the PageRank algorithm [5, 13, 27, 28] but this ranking is not so helpful for individual country or cricket board.

We rank the players of cricket in two categories bowlers and batsman. First, we present the ranking of batsman and bowler then we compare it with ICC International Cricket Council's ranking. Table 2 shows the final ranking of Pakistans one-day international ODI batsman based on link fusion [19] by our application *TeamMaker* that works on our proposed methodology. Link Fusion means we check the combined information as a player against a team and a player on a venue. This would help rank the batsman to get the real ranking concerning the country.

Name of Batsman	Rank Score	Rank
Imad Wasim	65.0694	1
Babar Azam	63.99645	2
Shoaib Malik	61.56715	3
Sarfraz Ahmad	58.8896	4
Mohammad Hafeez	58.51965	5
Hasan Ali	55.1246	6
Wahab Riaz	50.65424	7
Mohammad Amir	50.44496	8
Mohammad Hasnain	45.078	9
Asif Ali	43.17682	10

Table 2: Ranking of Pakistan's One-Day International ODI cricket Batsman by our method

Table 3 shows the final ranking of Pakistan's one-day international ODI bowler based on link fusion [18, 19] by our application *TeamMaker* that works on our proposed methodology. Link Fusion means we check the combined information as a player against a team, a player against a venue. This would help rank the bowler to get the real ranking

concerning the country. In-home ground a bowler is more comfortable than away from home.

Name of Bowler	Rank Score	Rank
Shoaib Malik	91.3746	1
Mohammad Hafeez	90.1227	2
Fakhar Zaman	75.805	3
Iftikhar Ahmad	74.896	4
Wahab Riaz	55.97916	5
Aamer Yamin	51.012	6
Imad Wasim	49.0407	7
Junaid Khan	47.29914	8
Mohammad Amir	44.78132	9
Haris Sohail	42.22591	10

Table 3: Ranking of Pakistan's One-Day International ODI cricket Bowler by our method.

Shoib Malik is on the top of the table In the above ranking table of bowlers in Pakistan's One-Day International ODI cricket ranking having ranking score 91.37 and Haris Sohail on the last of the list among 10 players.

The ranking factors that are included in this ranking are universal and applied on the all teams in the world. We extract the ranking of One-Day International ODI bowlers from International Cricket Council ICC ranking table, given table 4 shows the Pakistan's One-Day International ODI bowlers ICC ranking [5].

Name of Bowler	Rating	Rank
Mohammad Amir	656	1
Shaheen Afridi	588	2
Shadab khan	560	3
Imad Wasim	520	4
Usman Khan	503	5
Hassan Ali	495	6
Junaid Khan	461	7
Wahab Riaz	433	8
Faheem Ashraf	432	9

Table 4: ICC Bowlers ranking table of Pakistan's One-Day-International ODI Cricket players [5, 28].

Above ranking table 4 shows that the bowler Mohammad Amir is top on the ranking but in our application TeamMaker this Player is on second position. Our methodology shows that the experience, home ground and link to other teams are matter in the ranking of player strike rate, economy rate etc, these are the main features that are required to rank the players. On the other hand International cricket council ICC ranks the Player on a universal formula [19, 15, 5, 28, 2] that neglects many features of a player.

We extract the ranking of One-Day International ODI batsman from International Cricket Council ICC ranking; table 5 shows the Pakistan's One-Day International ODI batsmans ICC ranking [5].

Name of Bowler	Rating	Rank
Babar azam	829	1
Imam ul haq	751	2
Fakhar zaman	710	3
Haris sohail	607	4
Mohammad hafeez	561	5
Imad wasim	535	6
Sarfraz ahmed	530	7

Table 5: ICC Batsman's Ranking table of Pakistan's One-Day International ODI players [5].

Above ranking table shows that the batsman Babar Azam is top on the ranking but in our application TeamMaker this Player is in the second position. Our methodology offers that the experience, home ground and link to other teams are matter in the ranking of Player. Still, in the above ranking table, a universal method [2,29-34] applied and extracted the results.

IX. CONCLUSION AND FUTURE WORK

We present *TeamMaker*, a python based application with MYSQL database, that scrap data of Pakistan's One-Day International ODI cricket players from online cricket websites [6, 1, 2]. This application is used to scrape the contents of each Player and give us the option to select only current players or all players from Pakistan's cricket history.

We select only current players and our application TeamMaker, according to our methodology, filter out all the features automatically, and the next step is to save these into MYSQL database[8]. These One-Day International ODI cricket players are of two categories batsman and bowler. Our application implements statistical formulas on the extracted features and assigns a rank score to individual Player. The statistical procedures are different for both categories.

In the same way, the ranking of players is two types, Pakistan's One-Day International ODI batsman's raking and bowlers ranking. In the last step, we analyze our results with International Cricket Council ICC ranking and comparison between these two ranking schemes. International Cricket Council ICC rank the players both batsman and bowlers under a universal formula PageRank [19, 15, 5, 28]. The ranking method under which International Cricket Council ICC rank players is versatile not for a single country, retired players also included in this ranking and many features of players are ignored that's why many Player neglected in this ranking list. Our methodology purely designed for a single country and considers all significant components of the players based on link fusion also ignore the Player who retired from cricket.

In future work, we will make TeamMaker a fully automatic application by adding Machine Learning and cloud-based analysis feature in it. It is ranking of players will enhance from single cricket team to all cricket teams in the world. TeamMaker with multiple options will provide robust predictions like a best captain for the team, suitable bowlers or batsman for the match for Cricket Boards, team selection committee and cricket fans. Furthermore, TeamMaker will be a helpful tool for the team owners to select players for their teams in cricket leagues such as

Indian Premier League IPL, Bangladesh super league, Big Bash league, Pakistan Super League PSL and others.

REFERENCES

- [1] <http://www.howstat.com/cricket/home.asp/>. [Online; accessed 21-March-2020].
- [2] Official International Cricket Council ICC website. <http://www.icc-cricket.com/>. [Online; accessed 21-March-2020].
- [3] Wikipedia-cricketdetail. <https://en.wikipedia.org/wiki/Cricket/>. [Online; accessed 21-March-2020].
- [4] B. Pang et al., (2002) Thumbs up?: sentiment classification using machine learning techniques. In Proceedings of the ACL-02 conference on Empirical methods in natural language processing-Volume 10. Association for Computational Linguistics.
- [5] IC Cranking calculation. http://www.ehow.com/how_6916968_calculate-icc-rankings.html/. [Online; accessed 21-March-2020].
- [6] Live updated cricket website. <https://www.espnricinfo.com/>. [Online; accessed 21-March-2020].
- [7] ICC Ranking 2020. <http://www.icc-cricket.com/player-rankings/about/>. [Online; accessed 21-March-2020].
- [8] A. G. McDonald, S. Boyce, G. P. Moss, H. B. Dixon, and K. F. Tipton (2007). Explorenz: a mysql database of the iubmb enzyme nomenclature. BMC biochemistry.
- [9] E. Loper and S. Bird (2002). Nltk: the natural language toolkit. arXiv preprint cs/0205028.
- [10] S. Mukherjee. Identifying the greatest team and captaina complex network approach to cricket matches (2012). Physica A: Statistical Mechanics and its Applications.
- [11] F. Pedregosa, G. Varoquaux, A. Gramfort, V. Michel, B. Thirion, O. Grisel, M. Blondel, P. Prettenhofer, R. Weiss, V. Dubourg, et a (2011). Scikit-learn: Machine learning in python. Journal of machine learning research .
- [12] S. Sharma, G. Rangaiah, and K. Cheah (2012). Multi-objective optimization using ms excel with an application to design of a falling-film evaporator system. Food and Bioproducts Processing.
- [13] R. Bhushan and M. Vats (2013). Information retrieval using web mining techniques. In Proceeding of All India Seminar On Emerging Trends in Cryptography (ETC-2013).
- [14] S. R. Clarke and J. M. Norman (1995). Home ground advantage of individual clubs in english soccer. Journal of the Royal Statistical Society: Series D (The Statistician).
- [15] A. Daud and F. Muhammad (2013). Ranking cricket teams through runs and wickets. In International Conference on Active Media Technology. Springer.
- [16] A. Daud, F. Muhammad, H. Dawood, and H. Dawood (2015). Ranking cricket teams. Information Processing & Management.
- [17] N. Hussain, H. Turab Mirza, G. Rasool, I. Hussain, and M. Kaleem (2019). Spam review detection techniques: A systematic literature review. Applied Sciences.
- [18] W. Xi, B. Zhang, Z. Chen, Y. Lu, S. Yan, W.-Y. Ma, and E. A (2004). Fox. Link fusion: a unifiedlink analysis framework for multi-type interrelated data objects. In Proceedings of the 13th international conference on World Wide Web.
- [19] A. Daud, A. Hussain, R. A. Abbasi, N. R. Aljohani, T. Amjad, and H. Dawood (2018). Region-wise ranking of sports players based on link fusion. In Companion Proceedings of the The Web Conference.
- [20] A. Hussain, Y. Qiang, M. A. Q. Bilal, K. Wu, Z. Zhao, and B. Ahmed (2019). Region-wise ranking for one-day international (odi) cricket teams. machine learning.
- [21] C. J. Hutto and E. Gilbert (2014). Vader: A parsimonious rule-based model for sentiment analysis of social media text. In Eighth international AAAI conference on weblogs and social media.
- [22] H. V. Ribeiro, S. Mukherjee, and X. H. T. Zeng (2016). The advantage of playing home in nba: Microscopic, team-specific and evolving features. PloS one.
- [23] A. Mudinas, D. Zhang, and M. Levene 2012. Combining lexicon and learning based approaches for concept-level sentiment analysis. In Proceedings of the first international workshop on ssues of sentiment discovery and opinion mining.
- [24] A. Y. Govan, C. D. Meyer, and R. Albright (2008). Generalizing googles pagerank to rank national football league teams. In Proceedings of the SAS Global Forum.
- [25] I. Ounis, C. Macdonald, and I. Soboroff (2008). Overview of the trec-2008 blog track. Technical report, GLASGOW UNIV (UNITED KINGDOM).
- [26] T. H. Haveliwala (2003). Topic-sensitive pagerank: A context-sensitive ranking algorithm for web search. IEEE transactions on knowledge and data engineering.
- [27] Khan MN, Jamil M, Gilani SO, Ahmad I, Uzair M, Omer H. Photo detector-based indoor positioning systems variants: A new look. Computers & Electrical Engineering. 2020 May 1;83:106607.
- [28] Kashif H, Khan MN, Altalbe A. Hybrid Optical-Radio Transmission System Link Quality: Link Budget Analysis. IEEE Access. 2020 Mar 18;8:65983-92.
- [29] Zafar K, Gilani SO, Waris A, Ahmed A, Jamil M, Khan MN, Sohail Kashif A. Skin Lesion Segmentation from Dermoscopic Images Using Convolutional Neural Network. Sensors. 2020 Jan;20(6):1601.
- [30] Uzair M, D DONY RO, Jamil M, MAHMOOD KB, Khan MN. A no-reference framework for evaluating video quality streamed through wireless network. Turkish Journal of Electrical Engineering & Computer Sciences. 2019 Sep 18;27(5):3383-99.
- [31] Khan MN, Gilani SO, Jamil M, Rafay A, Awais Q, Khawaja BA, Uzair M, Malik AW. Maximizing throughput of hybrid FSO-RF communication system: An algorithm. IEEE Access. 2018 May 25;6:30039-48.
- [32] Khan MN, Jamil M, Hussain M. Adaptation of hybrid FSO/RF communication system using puncturing technique. Radioengineering. 2016 Dec 1;25(4):12-9.
- [33] A. Hussain, Y. Qiang, M. A. Q. Bilal, I. Ullah, and N. Ullah (2019). Region-based teams ranking in the game of cricket using pagerank algorithm. International Journal of Computer Applications.