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A Bibliometric Analysis of Online Extremism Detection

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A Bibliometric Analysis of Online Extremism Detection

Abstract:

The Internet has become an essential part of modern communication. People are sharing ideas, thoughts, and beliefs easily, using social media. This sharing of ideas has raised a big problem like the spread of the radicalized extremist ideas. The various extremist organizations use the social media as a propaganda tool. The extremist organizations actively radicalize and recruit youths by sharing inciting material on social media. Extremist organizations use social media to influence people to carry out lone-wolf attacks. Social media platforms employ various strategies to identify and remove the extremist content. But due to the sheer amount of data and loopholes in detection strategies, extremism remain undetected for a significant time. Thus, there is a need of accurate detection of extremism on social media. This study provides Bibliometric analysis and systematic mappings of existing literature for radicalisation or extremism detection. Bibliometric analysis of Machine Learning and Deep Learning articles in extremism detection are considered. This is performed using SCOPUS database, with the tools like Scienescape and VOS Viewer. It is observed that the current literature on extremist detection is focused on a particular ideology. Though it is noted that few researchers are working in the extremism detection area, it is preferred among researchers in the recent years.

Keywords: Extremism Detection, Bibliometric Analysis, Social Media, Radicalization

1. Introduction:

Today social media is an essential part of an online communication. Social media comprises of blogs, photo-sharing platforms, forums and social networks. On Facebook, a person can share short videos, photos, and messages. Every minute, 3,17,000 statuses are updated, 400 new users are added, and 1,47,000 photos are uploaded on Facebook (Aslam, 2020). Short messages of 140 characters are a unique feature of Twitter. Every minute, 3,50,000 tweets are written on Twitter (Sayce, 2020). So, using social media, content creation, and sharing has become relatively easy. Though social media has made significant contributions to the way people interact with each other, it also has a dark side. The large user base and anonymity provided by social media have attracted the extremists' attention to the social networks. The extremist groups like Islamic State, Alt-Right, Neo-Nazis use platforms like Twitter, Facebook, and Reddit to propagate hate and radicalized youth (Berger & Morgan, 2015)(Berger, 2018). The extremist groups use social media to recruit young people. Using social media, extremist groups try to incite people in committing lone-wolf attacks (Chorev, 2019)(Cohen et al., 2014).

Social networks enforce their own rules and regulations to maintain civility on their platform (Twitter, 2020)(Facebook, 2020). The extremists actively try to find loopholes in these rules and stay active as long as possible (Sánchez-Rebollo et al., 2019). The extremists may have different ideologies, therefore making the online extremism detection challenging. One such challenge authorities faced when Christchurch Attack was live-streamed on Facebook (Loewenstein, 2019). The attack video was shared numerous times, and Facebook failed to take down the video, as the users didn't report it as harmful (Martinson, 2019). Twitter uses the same user reporting strategy about harmful content. The sheer amount of data shared on the social media platforms makes it impossible to detect extremism solely based on the user reporting. Therefore, there is a need for real-time extremism detection. The analysis forms major part of research conducted earlier. So, the issue of detection, as well as identifying the targets of the extremists is overlooked. Identifying extremism irrespective of ideology is not addressed by any of the earlier studies.

As extremism detection is specialized research, there is a need for a Bibliometric analysis in extremism detection research. The following are the contributions of this study:

- Identification and creation of search queries.
- Statistical analysis of published research work.
- Identification of authors and journals in extremism research.
- Recognition of trending keywords in extremism research.
- Analysis of Geography Based research contributions.
- Identification of frequently cited authors and documents.

Section '*Creation of First Query*' and '*Creation of Second Query*' deals with analyzing the documents retrieved by queries. Section '*Observation*' presents the learnings from the analysis. Section '*Limitations of Current Work*' describes the drawbacks of the study. Section '*Conclusion*' concludes the study and outlines the future work.

2. Creation of First Search Query

The identification of authors, journals, and publishers for particular research is necessary. This knowledge can be obtained through various methods, like Bibliometrics, Webometrics, Scientometrics, and h-index. Bibliometrics provide information about authors, country of origin of research, institutes, funding organizations, and journals. Thus, it helps the researcher in the planning of the research. For this study, SCOPUS database was used for Bibliometric analysis. Two different queries were created. Table 1, shows the keywords used to gather information about the extremism research.

Primary Keyword	Online extremist detection
Secondary	(OR) Radicalisation, Radicalization
	(OR) Extremist

Thus, Query 1 created is: ("radicalisation" OR "radicalization" OR "extremist" OR "extremism") AND "detection").

Hundred and Seven documents were retrieved using Query 1. All retrieved documents have a title or abstract containing query keywords. All documents are published studies. It is observed that English language is used for the publication of 106 documents.

Table 1. Language Used for Publication of Extremist Detection Research

Sr No.	Languages	Document Count
1	English	106
2	Russian	1
	Total	107

2.1. Clustering and Co-occurrences

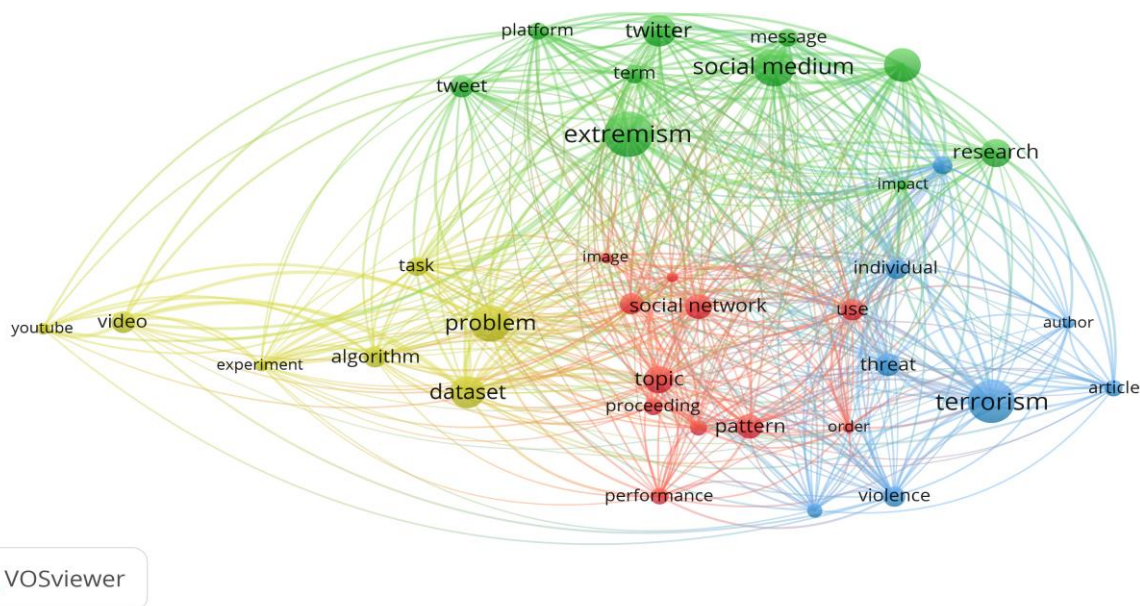


Figure 1. Co-occurrence of Text in Titles and Abstract (Accessed 16 September 2020)

Figure 1, shows text occurrence and their relation in titles and abstracts of information collected using SCOPUS Database. Sixty words met the minimum requirement of 10 co-occurrences in title and abstract. Thirty-Six words were selected to represent co-occurrence clusters.

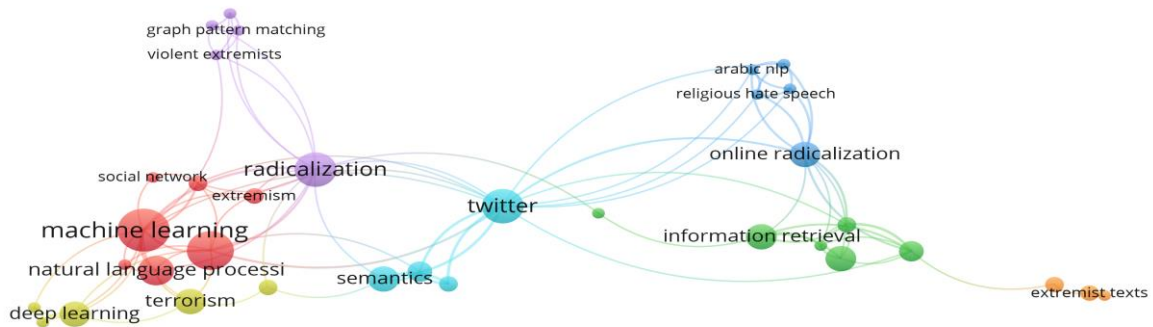


Figure 2. Co-occurrence of Author Keywords (Accessed 16 September 2020)

Figure 2, provides clusters and associations of the author's keywords. Circle size determines the author keywords' count. Thirty-Five keywords met the minimum co-occurrence count, which is 2, means these words appear together at least two times. As noted, keywords like 'Machine Learning', 'natural language processing', 'social network', 'extremism', and 'radicalization' are close to each other. The keyword 'Twitter' connects to 'radicalization' and 'online radicalization' shows researchers' interest in these topics.

The co-citation involves the papers, or the authors are cited together. For the author co-citation analysis in Figure 3, 161 authors met threshold criteria, which is, authors should be co-cited at least 5 times.

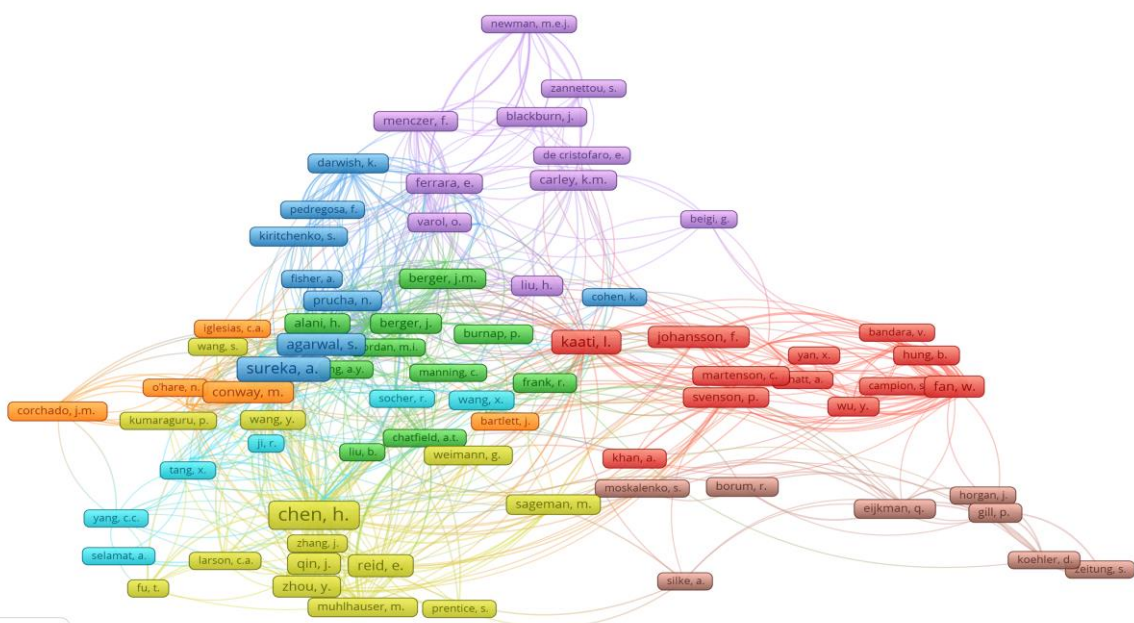


Figure 3. Co-citations of Authors (Accessed 16 September 2020)

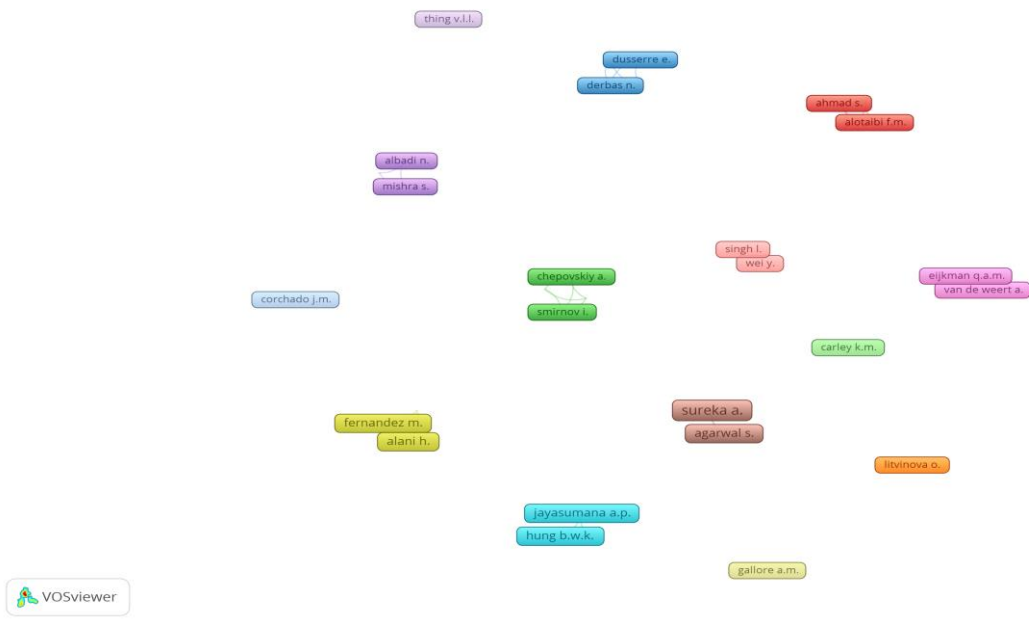


Figure 4. Authors and Co-authors appearing in the same paper (Accessed 16 September 2020)

Figure 4, determines the authors and co-authors appearing in the same paper. Only 33 authors met the threshold of at least 2 documents published. Disconnected clusters in the figure are due to a lack of collaboration between the authors. Figure 5, shows citations according to the source. Fifty-three documents fit the criteria of a minimum one citation. As observed, most items are disconnected from each other. Only four sources have an interconnection with each other.

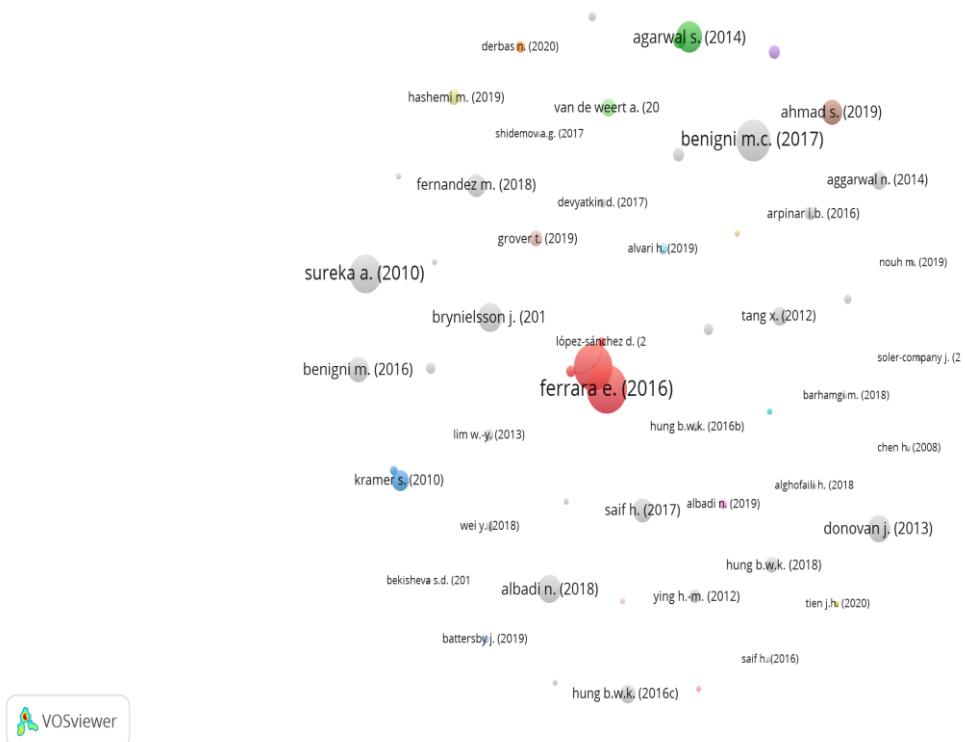


Figure 5. Citations by Source (Accessed 16 September 2020)

2.2. Author, Keyword and Journal Analysis

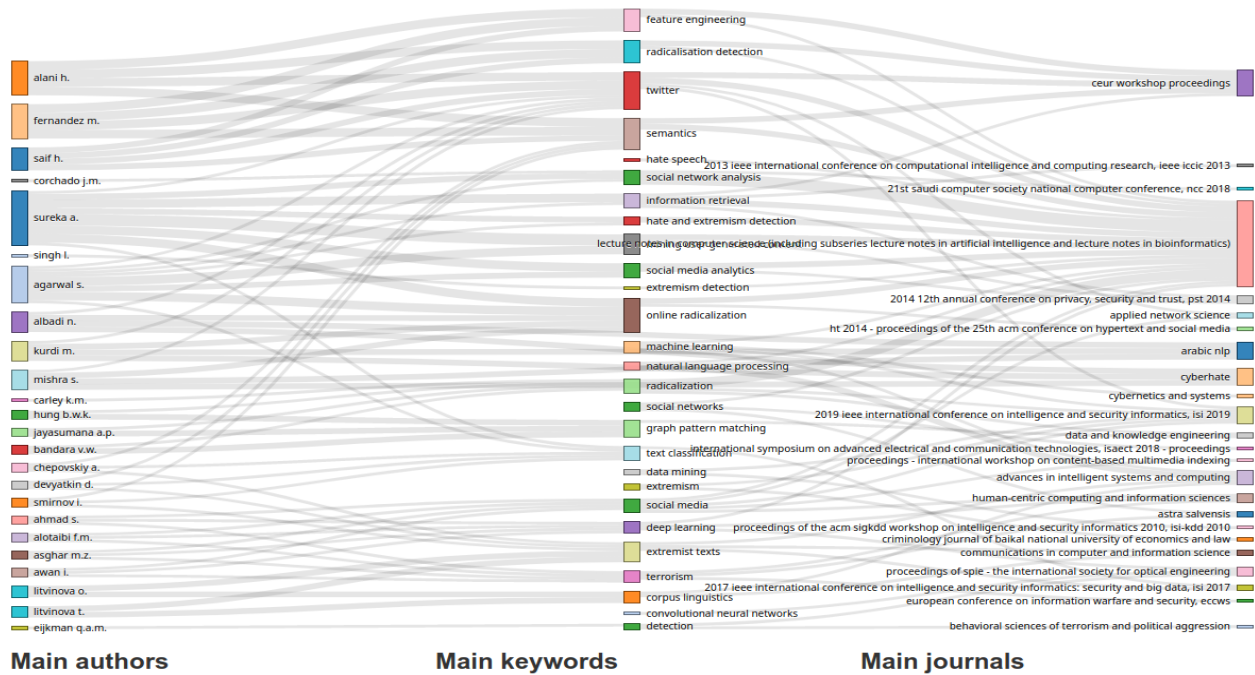


Figure 6. Network of Authors, Keywords and Journals (Accessed 16 September 2020)

Figure 6, shows authors, keywords, and journals in a network. Most authors have keywords associated with 'Radicalisation Detection', 'Twitter', and 'Online Radicalisation'. Most keywords are linked to 'Lecture Series in Computer Science' and 'CEUR Workshop Proceedings'.

2015

- online radicalization 2 papers
- mining user generated content 2 papers
- social media analytics 2 papers
- twitter 1 paper
- information retrieval 1 paper
- social network analysis 1 paper
- terrorism 1 paper
- dark web 1 paper
- hate and extremism detection 1 paper
- cybersecurity 1 paper

2016

- social media 1 paper
- radicalization 1 paper
- twitter 1 paper
- semantics 1 paper
- feature engineering 1 paper
- extremism 1 paper
- radicalisation detection 1 paper
- online social networks 1 paper
- community detection 1 paper
- controversial information materials 1 paper

2017

- text classification 2 papers
- twitter 1 paper
- deep learning 1 paper
- information retrieval 1 paper
- semantics 1 paper
- feature engineering 1 paper
- mining user generated content 1 paper
- extremism 1 paper
- extremist texts 1 paper
- radicalisation detection 1 paper

2018

- radicalization 3 papers
- machine learning 2 papers
- twitter 2 papers
- semantics 2 papers
- social networks 2 papers
- natural language processing 1 paper
- deep learning 1 paper
- online radicalization 1 paper
- social network analysis 1 paper
- terrorism 1 paper

2019

- social media 4 papers
- machine learning 3 papers
- radicalization 2 papers
- social network analysis 2 papers
- twitter 1 paper
- deep learning 1 paper
- online radicalization 1 paper
- semantics 1 paper
- terrorism 1 paper
- feature engineering 1 paper

2020

- machine learning 4 papers
- natural language processing 4 papers
- social media 2 papers
- deep learning 2 papers
- terrorism 2 papers
- radicalization 1 paper
- extremist texts 1 paper
- corpus linguistics 1 paper
- hate speech 1 paper
- radicalization detection 1 paper

Figure 7. Top Keywords in Year (Accessed 16 September 2020)

Figure 7, shows the top keywords in a particular year, from 2015 to 2020. It is observed that ‘Machine Learning’ and ‘Deep Learning’ keyword count has increased in recent years. Figure 8, shows that the online extremist detection research is presented frequently in the conferences. Few journals like *IEEE Access*, *Journal of Cyber Security*, and *Mobility and Advances in Intelligent Systems and Computing* have recently published extremist detection research.

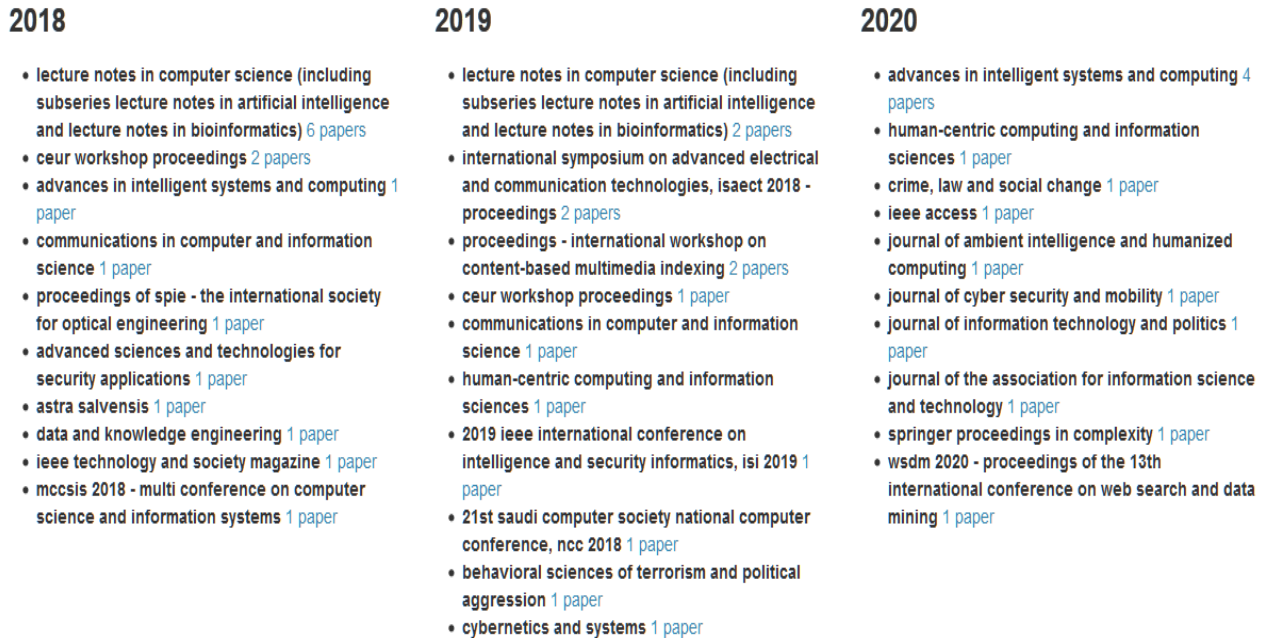


Figure 8. Top Journals Publishing Extremism Research (Accessed 16 September 2020)

2.3. Statistical Analysis



Figure 9. Year-wise Publication Count (Accessed 16 September 2020)

Figure 9, shows publications about extremism detection research, which have increased in recent years. This can be attributed mainly to the increased activity of the extremists on social media. The development of Machine Learning can also be one of the factors for an increase in extremist research.

The citations per year describe the importance of research. Figure 10, shows a rapid increase in the citation from the year 2017. This marks interest taken by researchers in the study of the extremism. As said earlier, it can be attributed to the spread of online extremism and advancement in machine learning.

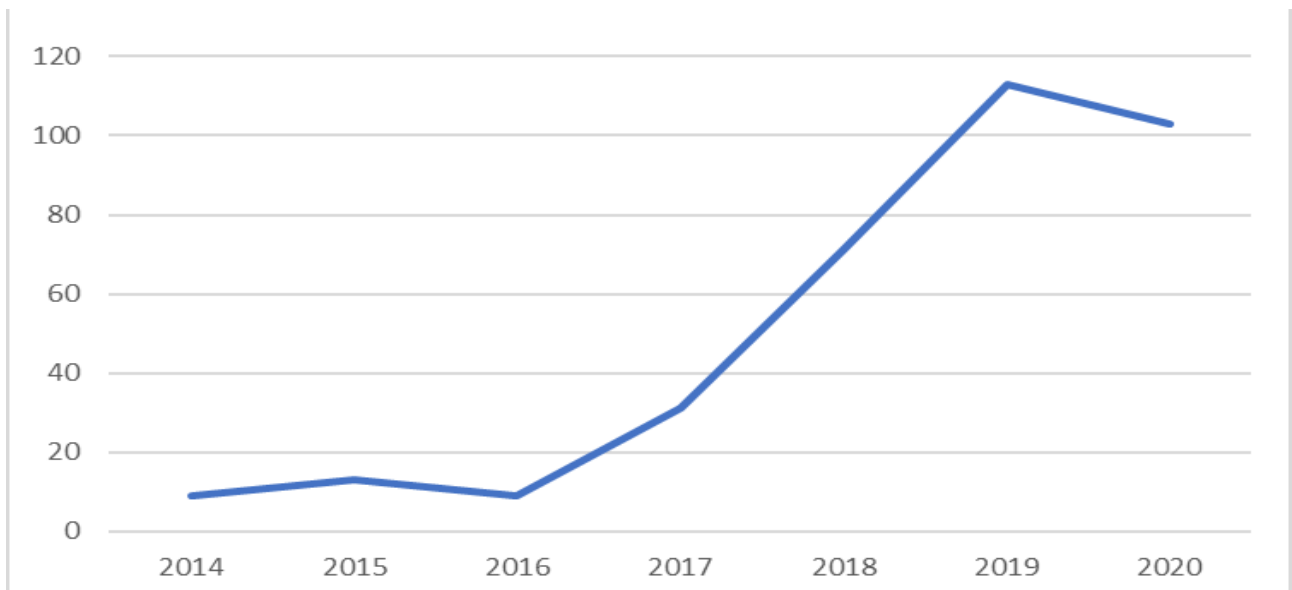


Figure 10. Citations Per Year (Accessed 16 September 2020)

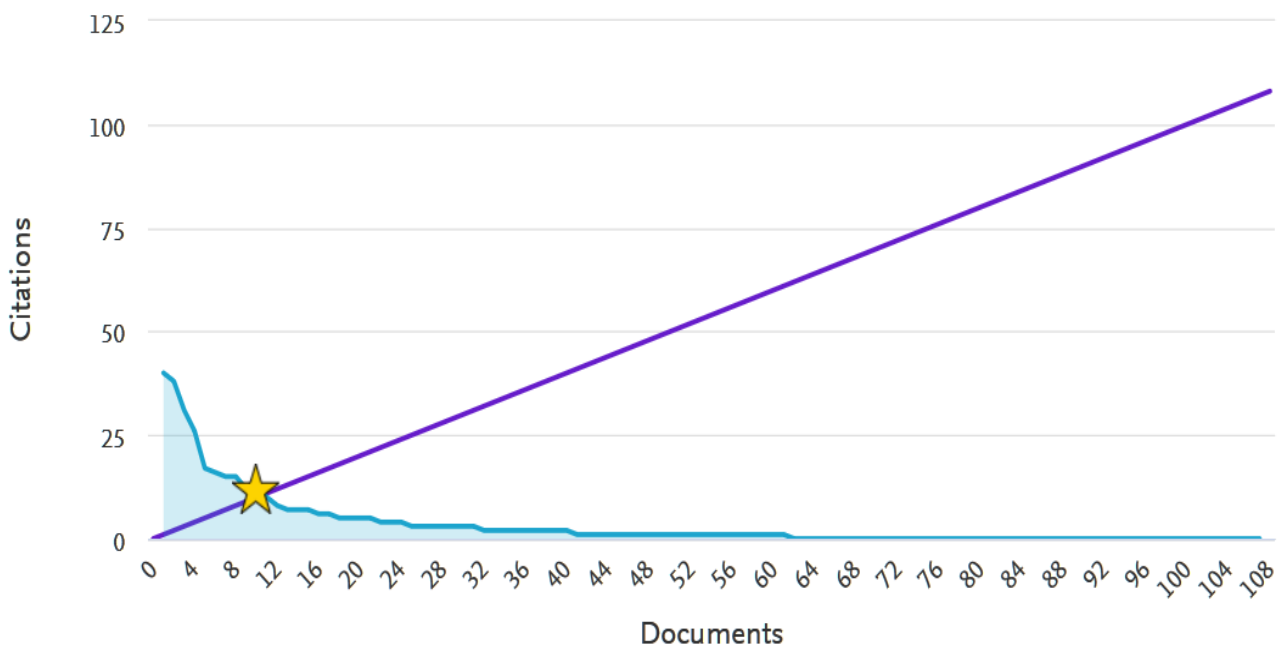


Figure 11. h-index for Documents (Accessed 16 September 2020)

The *h-index* is defined as value h such that a given author or journal has published h papers cited at least h times (McDonald, 2005). The *h-index* is used for determining the cumulative worth of research. The SCOPUS return an *h-index* of 10 means ten publications have been cited at least ten times for query passed. Table 2, shows the top 10 cited papers from 2014 to 2020. From these top-cited papers, it can be observed that online extremism detection is focused on one particular ideology.

2.4. Citation, Document, and Location Analysis

Table 2. Top 10 Cited Document by Year

Sr. No	Documents	2014	2015	2016	2017	2018	2019	2020	Total
1	(Ferrara et al., 2016)	-	-	-	7	13	15	5	40
2	(Agarwal & Sureka, 2015)	-	2	2	7	12	6	8	37
3	(M. C. Benigni et al., 2017)	-	-	-	1	9	14	7	31
4	(Sureka et al., 2010)	3	2	1	4	5	5	2	22
5	(Agarwal & Sureka, 2014)	-	2	2	3	3	5	2	17
6	(Albadi et al., 2018)	-	-	-	-	-	9	7	16
7	(Ahmad et al., 2019)	-	-	-	-	-	3	12	15
8	(Brynielsson et al., 2012)	2	-	-	2	4	-	1	9
9	(Saif et al., 2017)	-	-	-	-	3	5	4	12
10	(M. Benigni & Carley, 2016)	-	-	-	-	7	4	1	12

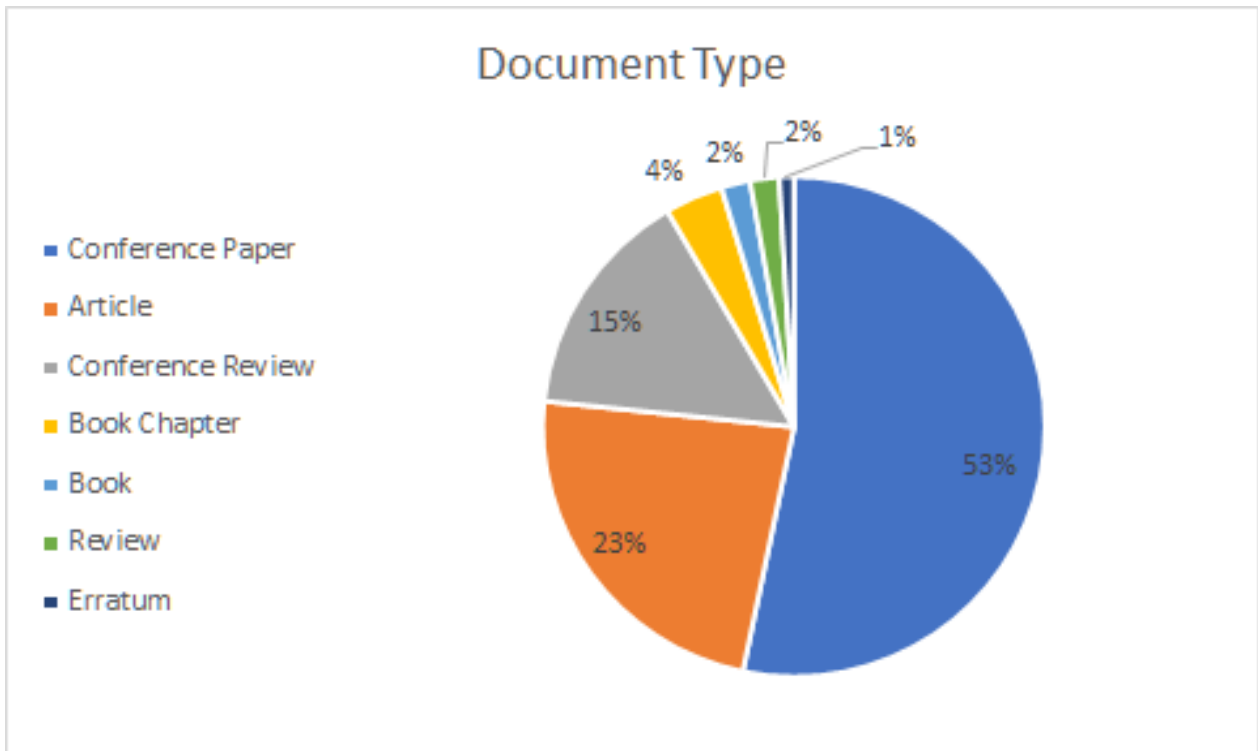


Figure 12. Document Type (Accessed 16 September 2020)

Figure 12, shows that the conferences are a popular choice of the researcher to publish extremism research. Twenty-three percent of the retrieved documents are published as the journal articles.

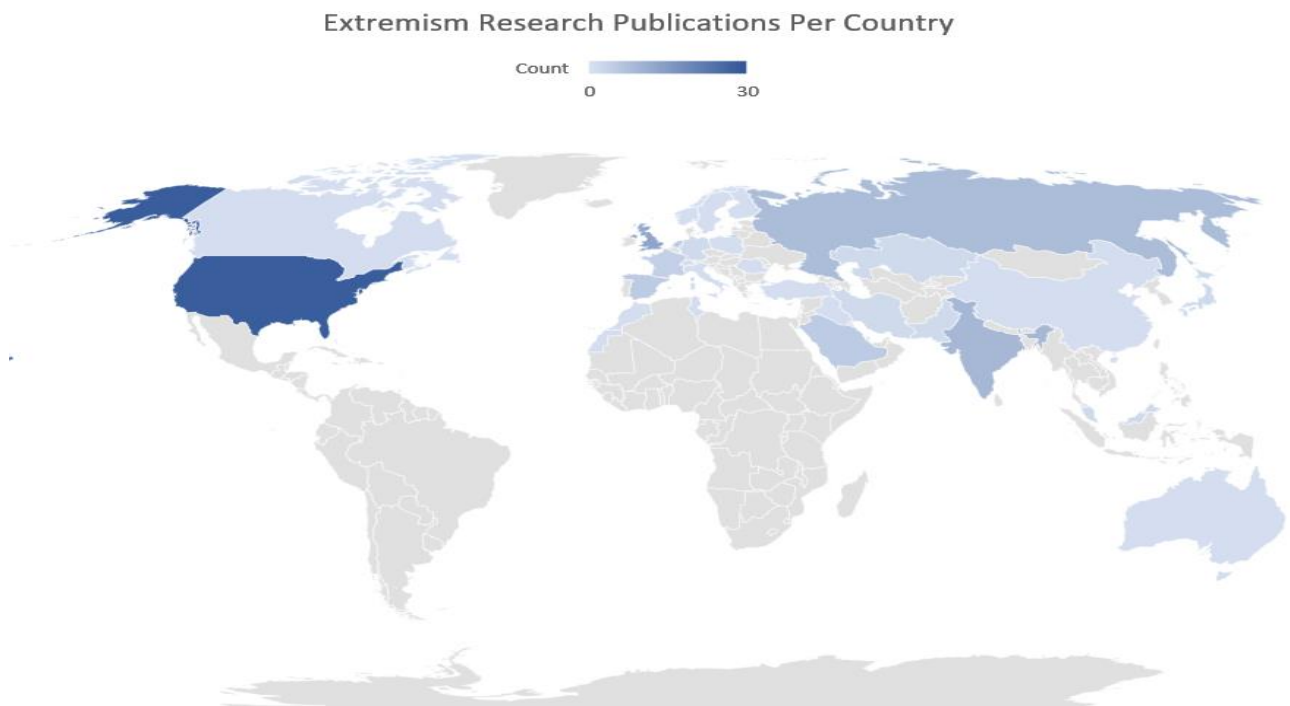


Figure 13. Extremism Research Publication Per Country (Accessed 20 August 2020)

Figure 13, shows that the USA leads in extremism research. The other countries like the United Kingdom and India, have a significant number of researches related to extremism.

3. Creation of the Second Query

The second query is created to retrieve extremism detection research which uses Machine Learning techniques:

Primary Keyword	Online extremist detection Machine Learning
Secondary Keywords	(OR) Radicalisation, Radicalization
	(OR) Extremists
	(OR) Deep Learning

So, Query 2 becomes, (*"radicalisation" OR "radicalization" OR "extremism" OR "extremist"*) AND (*"machine learning" OR "deep learning"*). Thus, the SCOPUS database has 66 documents regarding the extremist research and Machine Learning. Figure 9, describes the number of documents published with the online extremist detection and Machine Learning as a topic. As seen, in recent years, Machine Learning is well adopted in extremism research.

3.1. Statistical Analysis

Documents by year

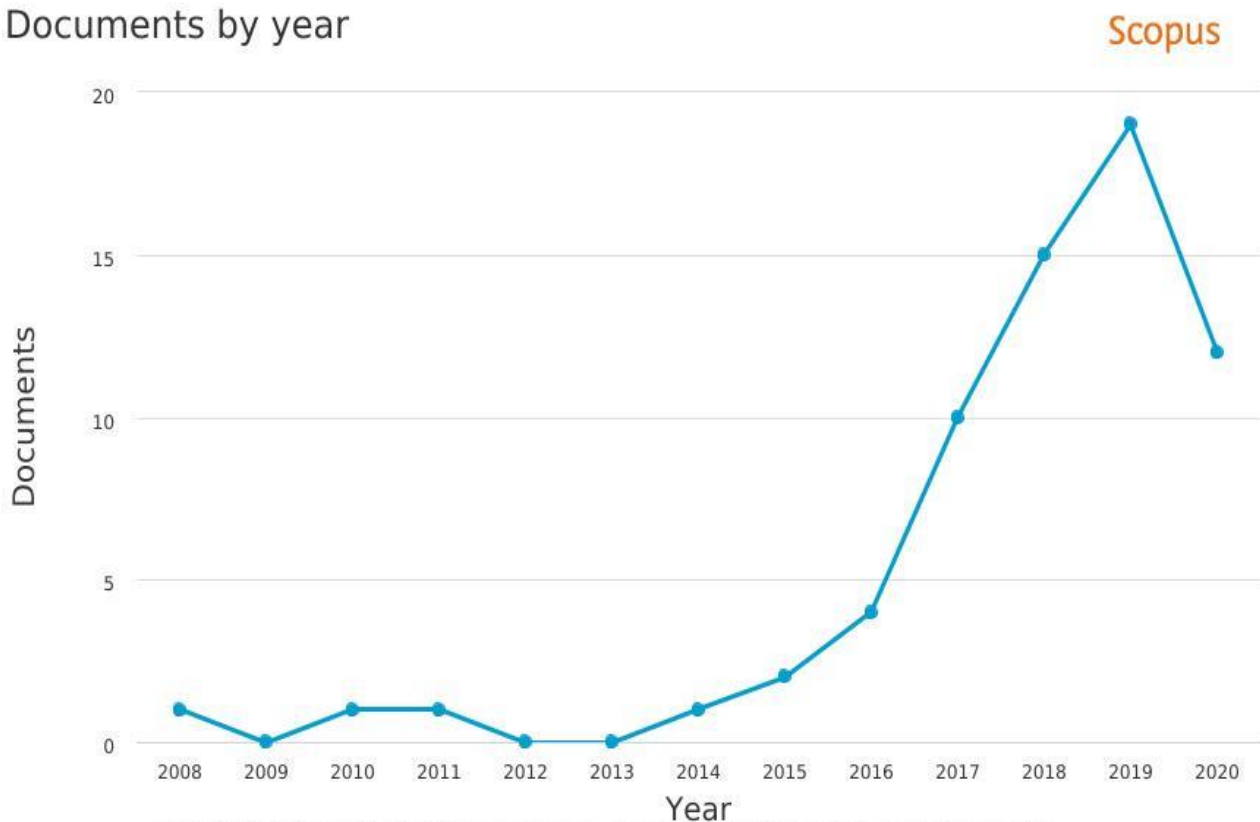


Figure 14. Extremism and ML Documents by Year (Accessed 16 September 2020)

Using “Machine Learning” and “Deep Learning” as compulsory keywords, only 66 documents are retrieved. This number is relatively less than the query without ML and DL keywords. This can be attributed to the earlier research, which focuses on different techniques, primarily on graph network. The document or the research using Machine Learning in the online extremist detection took off since 2014. An increased data about extremist organizations and development in machine learning can induce more significant research in extremist detection.

3.2. Author, Keyword, Journal and Document Analysis

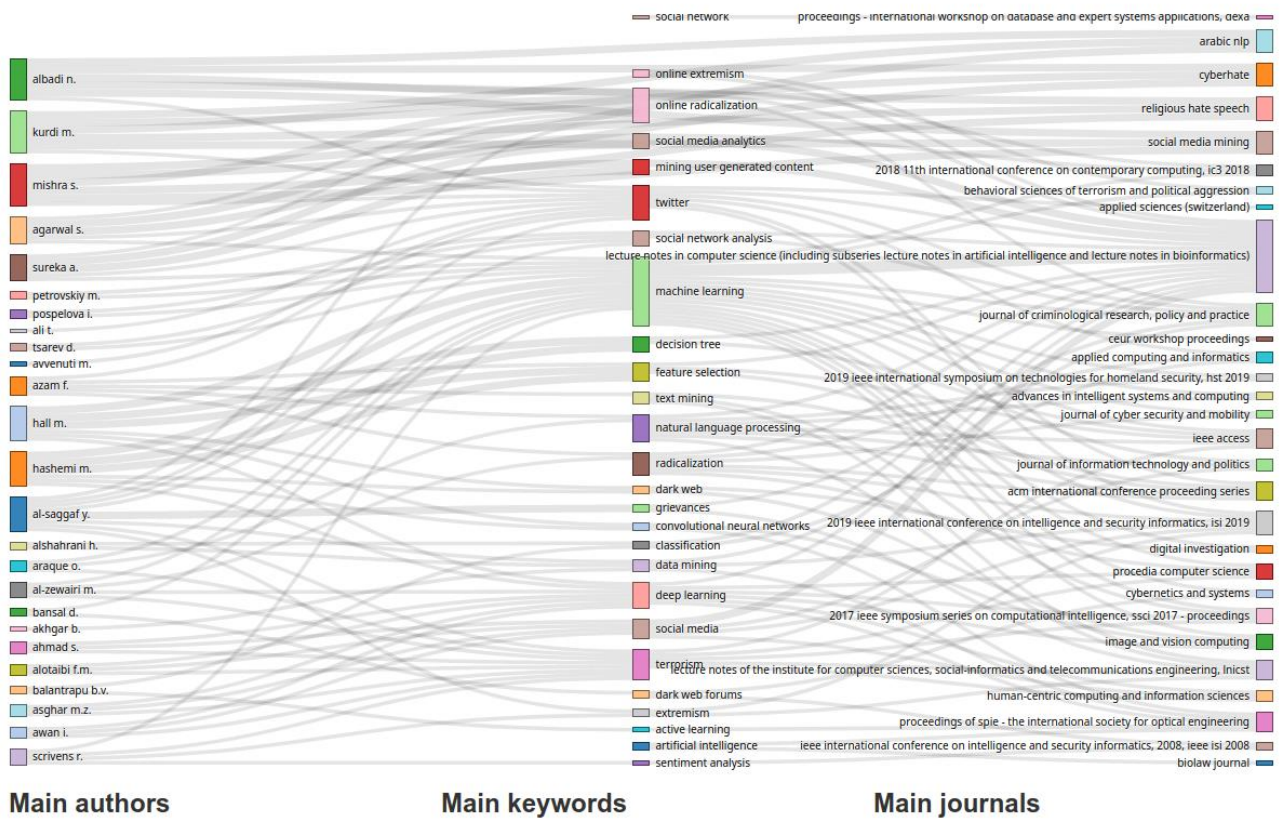


Figure 15. Network of Authors, Keywords and Journals (Accessed 16 September 2020)

Figure 15, shows the authors and the journals contributing to the extremism research using Machine Learning techniques. Figure 16, is different from Figure 7, as it prominently shows 'Machine Learning' as an essential keyword.



Figure 16. Main Keywords overtime (Accessed 16 September 2020)

Figure 16, shows the keyword ‘Machine Learning’ appears at least in 5 papers from 2018 to 2020. In the year 2019, 5 papers with the keyword ‘Twitter’ occur alongside with ‘extremism’ and ‘online radicalization’.

Documents by subject area

Scopus

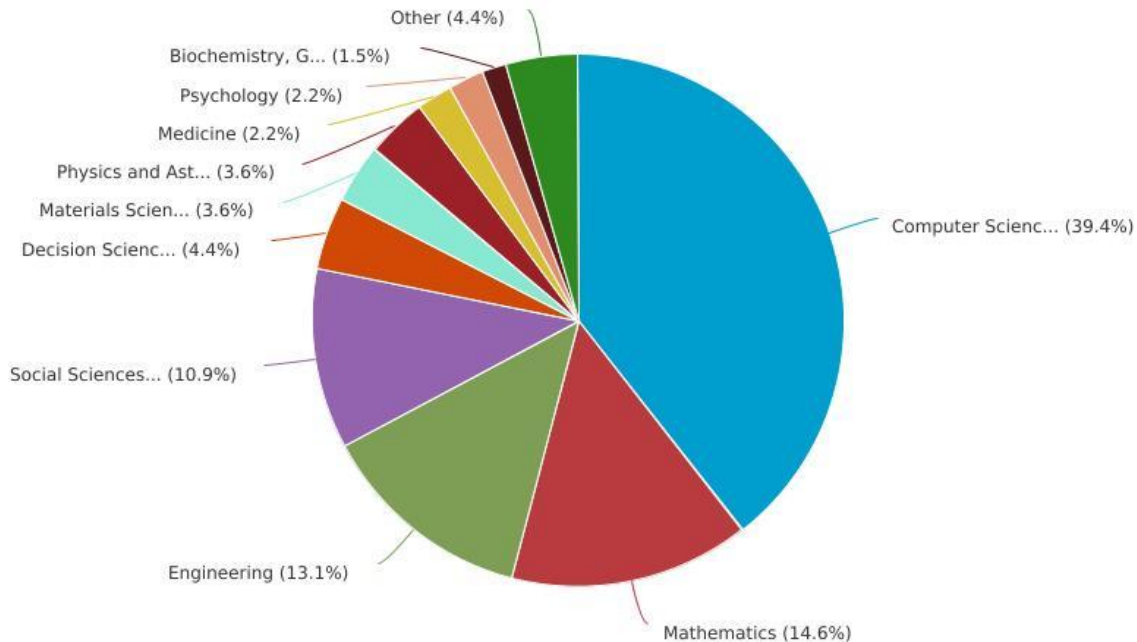


Figure 17. Document by Subject Area (Accessed 16 September 2020)

Figure 1,7 shows all 66 documents retrieved, 39 % belong to the ‘Computer Science’ subject area. Then followed by ‘Mathematics’ and ‘Engineering’ subject areas.

4. Observations

The extremist detection is a multidisciplinary research area. Linguistic analysis, Behavioural analysis, and Psychological analysis are targeted by researchers with Machine Learning for extremist detection. Machine Learning techniques dominate the existing research in extremism detection. Natural language processing is used with Machine Learning to enhance the research quality. Conferences are preferred publication strategy by the researchers working in extremism detection. The United States leads in extremism detection research. Out of 107 papers retrieved by Query 1, 28 documents are published in the United States, while 13 in the United Kingdom and India has nine publications. ‘Twitter’, ‘machine learning’, ‘social media’, ‘natural language processing’, and ‘radicalization’ frequently appear together. Researchers focus on the Twitter micro-blogging platform as the extremist organization primarily uses it as a propaganda tool. The analysis shows most of the published papers are affiliated to Indraprastha Institute of Technology Delhi. The citation analysis shows that published research focuses on a particular ideology.

5. Limitations of Current Work

There are different research databases like Web of Science, PubMed, etc. But for this Bibliometric study, only the SCOPUS database is considered. Peer-reviewed published articles carry more weightage than the independent institutional research. Therefore, reports and whitepapers provided by the governments and the independent institutes are not considered in this Bibliometric analysis. The Bibliometric study is limited to English language only.

6. Conclusion

This paper presents Bibliometric study of extremism detection. In this study, SCOPUS database is used to retrieve the published research. This study was useful in identifying important authors, keywords and journals in extremism detection research. This study notes that selected researchers are working on online extremism detection using Machine Learning techniques. After analyzing the top-cited documents and their title, it is observed that extremism research focuses on a particular ideology. Thus, online extremist detection research becomes biased. This needs more insights into the algorithms and the identification of extreme ideas from social media, irrespective of ideology. The researchers' focus on Twitter essentially means Twitter is frequently used by the extremists to spread their propaganda. Therefore, focused research on social media, considering multiple ideologies with some context, is necessary for the extremism detection research.

7. Acknowledgement

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