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PUBLICATION TRENDS IN GLOBAL OUTPUT OF RFID: A BIBLIOMETRIC PROFILE

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Abstract

The paper presents an analysis of 2735 global publications in RFID(Radio Frequency Identification), indexed in Web of science database during 2014-2018. The collected records were analyzed with the help of 'Histcite tool'.The present study attempted to reveal the year, country andinstitution, formwise distribution, authorship pattern, degree of collaboration, relative growth rate and doubling time of publications. The findings of this showed that degree of Collaboration was high at 2017 (0.96).The relative growth rates (RGR) has increased and the doubling time (DT) has rapidly decreased while calculated year wise i.e.2014 to 2018.

Keywords: Bibliometrics, Yearwise growth, Document type,Degree of collaboration, Authorship pattern, Radio Frequency Identification.

Introduction

The present study examines research output on radio frequency identification (RFID) during the period 2014-2018. RFID has been recognized as one of the supreme contribution of this 21st century. This technology has a rapidly growing market in the modern world .RFID is a common term used to express technologies that involve the use of data stored on small chips or tags which can communicate to a reader from a distance by means of radio transmission. It consists of the RFID tags, RFID readers, and supporting database infrastructure. Also, it is a keen short range communication technology and part of a broad category of automatic identification technologies.

RFID represents a technological advancement in automatic identification and data capture (AIDC) such as bar code, magnetic ink, optical character recognition, voice recognition, touch memory, smart cards, and biometrics.RFID is not a brand new technology and has seasoned several decades of use in military, airline, library, security, healthcare, sports, animal farms and different areas. Its function, consistency and modernization are constantly changing.It eliminates the necessity of human intervention, thus providing massive business value. It has been applied to track tools, and to trace various kinds of products.RFID systems can also be designed to enhance defense and wellbeing.It is a wireless technology used to transmit information from tags attached to an object in order to automatically identify and track the object.

It is a bibliometric study. Bibliometrics is the field of science that deals with the development and application of quantitative measures and indicators for sciences and technology, based on bibliographic information. This bibliographic information is the representation of classified knowledge as can be found in a diversity of scientific output types, such as serial literature, books, and book chapters, conference proceedings, patents, etc.

Literature Review

Literature sources are very important while writing a scientific paper as it ensures the quality of the paper.Here also, many valid and cited papers are used for getting a suitable base for this study:

Hsieh, P. N., & Chang, P. L. (2009)attempted to make a scientometric assessment of research on world-wide research productivity in production and operations management during 1956-2008. The data were obtained from Web of Science database. The countries found to have the highest outputs were the USA, the UK, Canada, the Netherlands and Taiwan.

Dongxiao, G., Isabelle, L. B. B., &Changyong, L.summarized in this paper about the temporal evolution, research themes, and emerging trends for case-based reasoning. Case-based reasoning (CBR) isan important methodology from the artificial intelligence (AI) field. Web of Science database and Histcite software are used for the analysis.

Manickaraj, J., Rajendran, P., &Elango, B. (2014) had done a scientometric study of the literature on Wireless Communication research published during the period of twelve years from 2001 to 2012, using SCOPUS database. 9587 articles were published during this study period with an average of 800 papers per year.Most of the articles are printed in English language and are by authors from the US. Researchers in the field of Wireless Communication preferred to publish their research findings in IEEE Journals. Chinese scientists engaged actively in this research field.

Singh, N. K., Dhawan, S. M., & Gupta, R. (2016)conducted abibliometric study based on"RFID Technology and Libraries". In this they analyzed that RFID did not receive much attention in the academic literature. The literature witnessed growth at a slow pace of 5.04% per year during 2002-14 due to its limited uses in libraries.Also, they indicated that though most of the studies have mainly been carried out on the theoretical aspect of RFID application, not many empirical studies have been carried out about the actual usage of this technology in libraries andChina contributed more articles than any other country.

Chao, C. C., Yang, J. M., & Jen, W. Y. (2007) discussed that in order to gain an indepthunderstaning on RFID trends and contributions , this research should include historical view and bibliometric analysis. On analysing the contributions of RFID industry and its future trends, they came to the conclusion is that it will be more useful in our daily lives in the near future.

Objectives

The objective of the study is to perform a bibliometric, analyze the global research output in RFID during 2014-2018, with a following aspect of the study:

- To find out the year wise growth of distribution
- To calculate the document type distribution
- To identify the authorship pattern and degree of collaboration
- To determine the journal wise analysis of documents
- To examine the Highly productive institutes
- To analyze the country wise and cited reference wise distribution

Methodology

Data were downloaded for a period of 5 years (2014-2018) from the Web of science database using the search term 'Radio Frequency Identification' in topic field. A total of 2735 publications received by these publications were transferred to Histcite tool, Excel application and analyzed the data as per objectives of the study.

Data analysis

Table 1:Year-wise publications

SL.No	Publication Year	No:of publications	Percentage	TLCS	TGCS
1	2014	511	18.7	888	7326
2	2015	533	19.5	584	4495
3	2016	494	18.1	342	2628
4	2017	605	22.1	179	1650
5	2018	592	21.6	30	321

Interpretataion:

The Table shows the year wise publication of records during the year 2014 to 2018. The year 2014 contains 511 records with an average of 18.7 percentage. The year 2015 contains 533 records with an average of 19.5 percentage. Then 2016 contains 494 records with an average of 18.1percentage, and 2017 contains 605 records with an average of 22.1 percentage. Also, year of 2018 contains 592 records with an average of 21.6 percentage. According to the year wise publication of records; the year 2017 contains more records of 605 with 22.1 percentage.

Graph 1:Year-wise publications

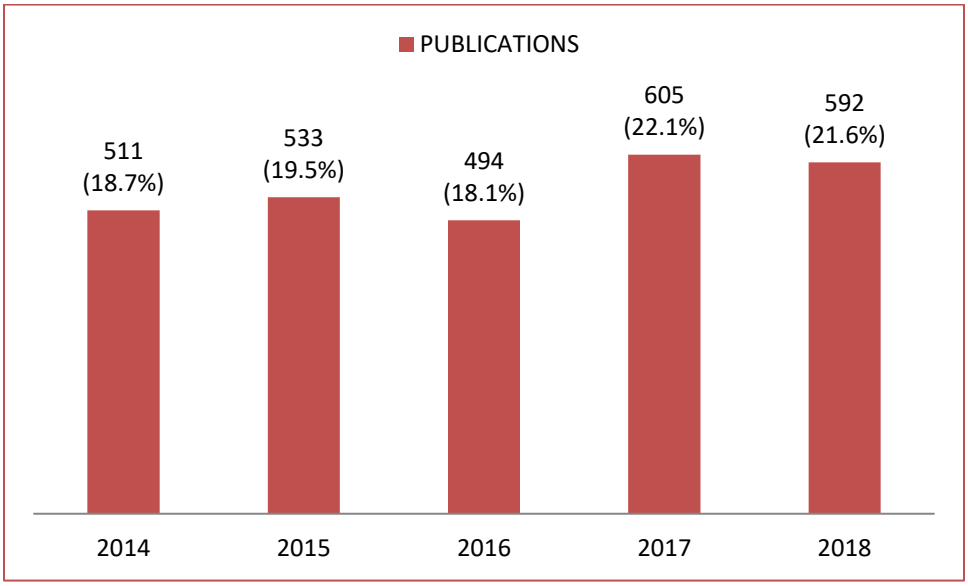


Table 2:Authorship pattern of publications

SL: No	No: of authors	No: of publications	Percentage
1	Single author	135	4.93
2	Two authors	442	16.16
3	Three authors	625	22.85
4	Four authors	591	21.60
5	Five authors	412	15.06
6	More than five	530	19.37

	authors		
Total		2735	100

Interpretation:

From the above analysis, the authorship pattern of year wise publications from 2014 to 2018 can be observed. From this, overall single authored articles published was 4.93%. 16.16% of authors contributed at two authors groups. 22.85% and 21.60%, 15.06% of authors contributed at three, four and five authored group respectively. Above five authored group have 19.37%. Among these, above three authored group output is leading (22.85%), followed by four authored collaboration (21.60%). Single authored group of authored collaboration is very low.

Graph 2:Authorship pattern of publications

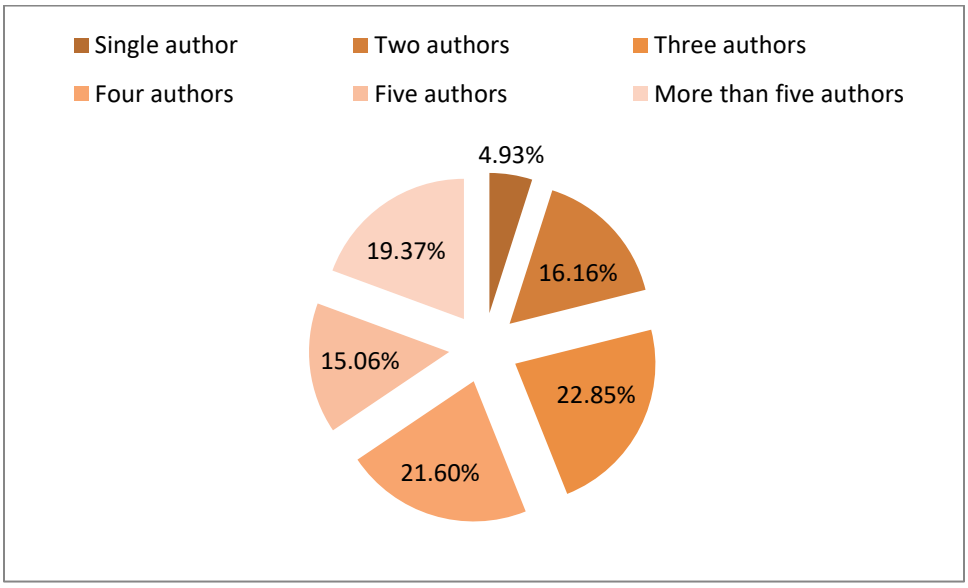


Figure 1:Network visualization of Co-authorship with prolific author

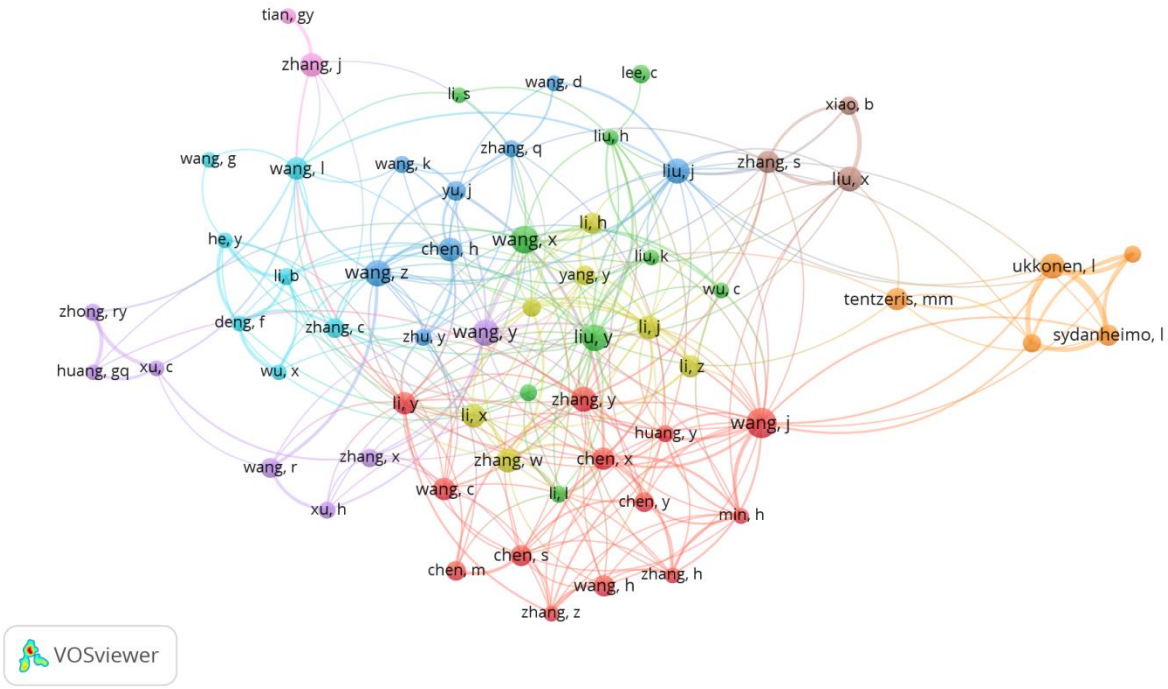


Table 3: Single Vs Multi-Authors

Sl.No:	Authorship pattern	Publication	Percentage
1	Single author	135	4.93%
2	Multiple author	2600	95.06%
Total		2735	100%

Interpretation:

The table indicates the result related to the contribution by single author and multiple authors. According to the table wise distribution of this authorship pattern, it is observed that the multiple authors have contributed more than single authors. The multiple authors have published 2600 records with an average of 95.06 percentage, but the single author only contributed in 135 works with an average of 4.93 percentage.

Graph 3: Single Vs Multi-Authors

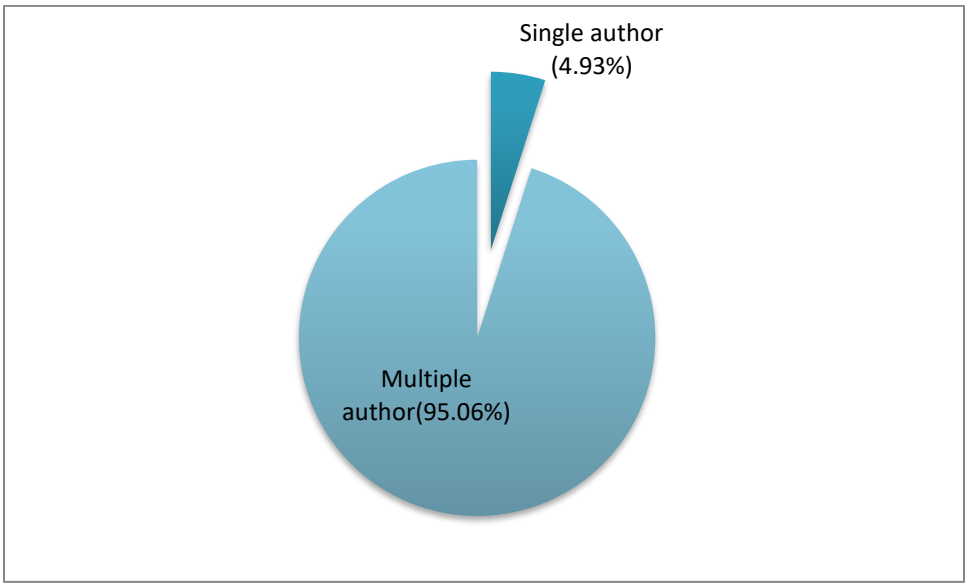


Table 4:Degree of Collaboration

Years	Single Author(Ns)	Multiple Author(Nm)	Total Authors(Ns+Nm)	Degree Of Collaboration
2014	33	479	512	0.93
2015	29	504	533	0.94
2016	25	469	494	0.94
2017	22	583	605	0.96
2018	26	565	591	0.95
Total	135	2600	2735	0.94

Interpretation:

The table shows the details of the degree of collaboration which indicate a development in single and multiple authors during 2014 – 2018. The degree of collaboration ranges from 0.93, then increases to 0.94 in two years and again increases to 0.96.It then suddenly decreases to 0.95. Therefore average degree of collaboration is 0.94.

The DC is calculated by using the formula,

$DC=\frac{NM}{NS+NM}$

DC = Degree of Collaboration in a discipline

NM = Number of Multi-Authored papers

NS = Number of Single Authored papers

$DC=\frac{2600}{135+2600}$

Thus the degree of collaboration in this study is 0.95.

Table 5:Relative Growth Rate (RGR) & Doubling Time (DT)

Year	No.of Publications	Cumulative Total Of Publications	W1	W2	R(A) =W2 -W1	Mean R(A)	Doubling Time(DT)	Mean(DT)
2014	512	512		6.23		1.15		0.65
2015	533	1045	6.27	6.95	0.68		1.01	
2016	494	1539	6.20	7.33	1.13		0.61	
2017	605	2144	6.40	7.67	1.27		0.54	
2018	591	2735	6.38	7.91	1.53		0.45	
Total	2735							

Interpretation:

The Relative Growth Rate and Doubling Time of a record during the year 2014 to 2018 can be clearly defined. According to the result arrived from the table, the Relative Growth Rateincreased year by year. In the year 2015the relative growth rate was 0.68. It increased to 1.13 in the year of 2016.Then it further increased to 1.27 in 2017 and 1.53 in 2018. The Doubling time decreased one year to next year. In 2015,doubling time value is 1.01. It decreased to 0.61 in the year of 2016. Then it decreased to 0.54 in 2017 and 0.45 in 2018. Thus the mean

value of Relative Growth Rate is 1.15 during the year 2014 to 2018. The Doubling Time mean value is 0.65 during the year 2014 to 2018.

Table 6: Highly productive countries (Top Ten)

SL.No:	Country	Total Publications	Percentage	TLCS	TGCS
1	Peoples R China	631	23.1	650	5489
2	USA	427	15.6	341	4575
3	Unknown	245	9.0	10	33
4	UK	171	6.3	207	2413
5	Taiwan	157	5.7	150	695
6	France	145	5.3	104	860
7	Italy	141	5.2	217	1473
8	South Korea	138	5.0	74	542
9	Germany	135	4.9	62	915
10	Australia	127	4.6	106	1022

Interpretation:

According to the tabulated country wise distribution, Peoples R of China is the leading country to publishing records related to the topic RFID. They are publishing 631 records with 23.1 percentage. According to the percentage wise distribution, countries during the period of 2014 to 2018, USA (15.6%), United Kingdom (6.3%) and Taiwan (5.7%). France (5.3%) etc.

Graph 4: Highly productive countries

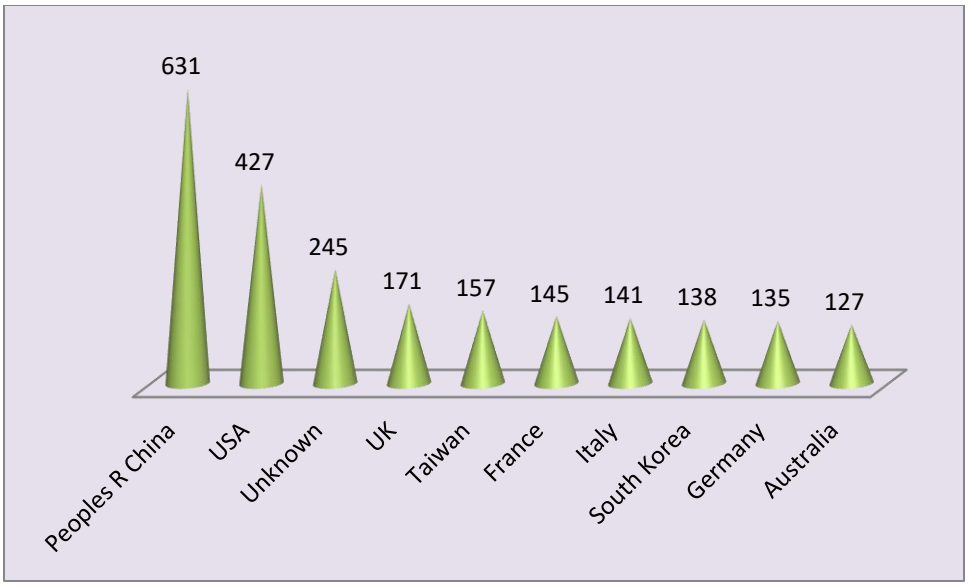


Table.7: Forms of publications

Sl.No:	Forms of publications	No:of publications	Percentage	TLCS	TGCS
1	Article	2355	86.1	1951	14718
2	Unknown	236	8.6	9	
3	Article; Proceedings Paper	66	2.4	19	256
4	Review	61	2.2	43	1441
5	Meeting Abstract	7	0.3	0	0
6	Editorial Material	6	0.2	1	1
7	Correction	3	0.1	0	4
8	Letter	1	0.0	0	0

Interpretation:

The table shows the forms of publications published during 2014-2018. This analysis points that the article type document have the highest score, i.e. 86.1%. The other types of documents only score below 3%.This study has once more proved that articles are the most preferred form to distribute their research results.

Graph.5: Forms of publications

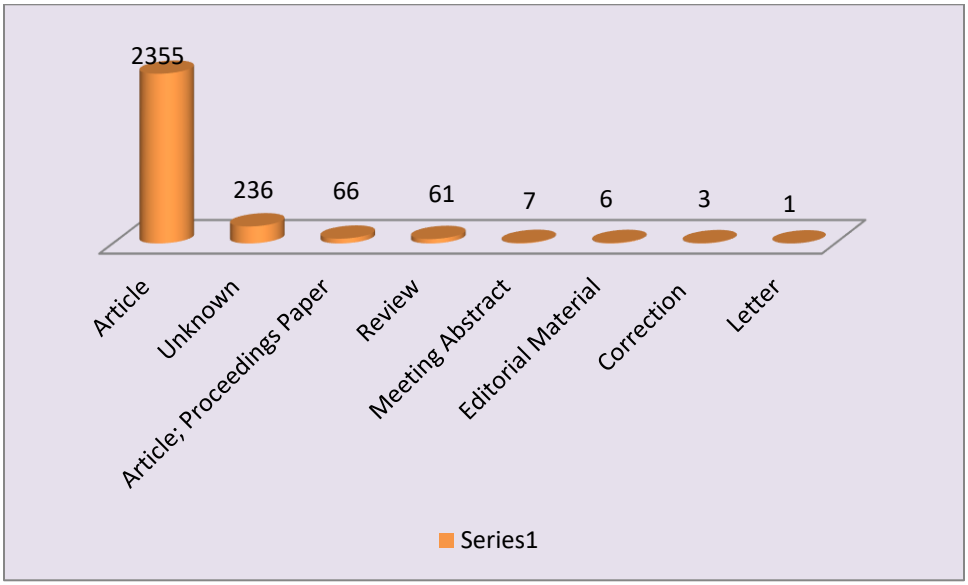


Table 8: Source title of publications

Sl. No:	Source title	No: of publications	Percentage	TLCS	TGCS
1	Sensors	81	3.0	30	415
2	IEEE Transactions On Antennas And Propagation	77	2.8	144	561
3	IEEE	73	2.7	188	760

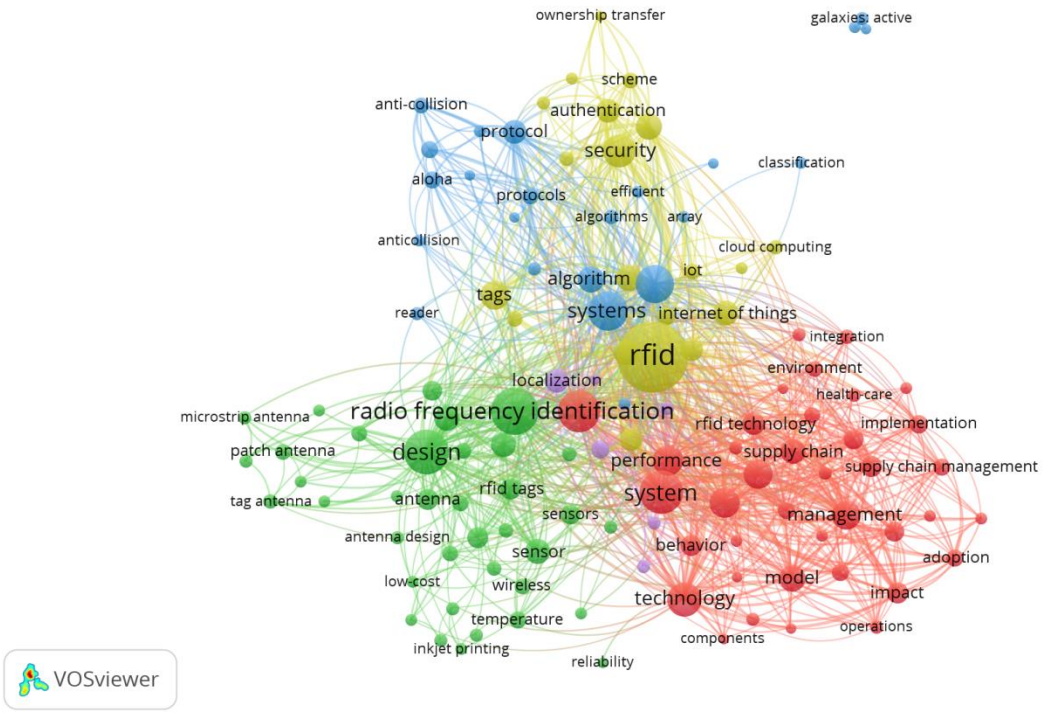
	Sensors Journal				
4	IEEE Antennas And Wireless Propagation Letters	62	2.3	79	395
5	Wireless Personal Communications	53	1.9	37	112
6	Microwave And Optical Technology Letters	47	1.7	13	61
7	IEEE Access	44	1.6	9	253
8	IEEE Transactions On Microwave Theory And Techniques	38	1.4	34	160
9	IET Microwaves Antennas & Propagation	35	1.3	19	76
10	International Journal Of Distributed	34	1.2	0	69

	Sensor Networks				

Interpretation:

The table shows that the "Sensors" is one of the most preferred journal of the authors for publishing their contributions. There have been 81(3%) papers published; 30 TLCS, 415 TGCS, followed by IEEE Transactions on Antennas and Propagation in second place and IEEE Sensors Journalin third place, followed by other journals.

Figure2: Network visualization of Co-occurance with prolific keywords



Interpretation:

This figure shows the network visualization of the most prolific keywords used for this work. It was determined that 'rfid' is the most prolific one and the rest comes only after this.

FINDINGS

- The year wise output of publications of RFID was studied.We could clearly see that during the period 2014 – 2018, a total number 2735 records were published in Web of Science online database at World Level. The highest publication is 605 in 2017 with first rank, the second rank is 2018 in 592 records, the third rank is 2015 in 533 records and the lowest record is 494 in 2016.
- The study concludes that out of 2735 articles, single author contributed only 135 (4.93%) articles while the rest 2600(95.06 %) of the articles were contributed by multi-authors.
- The study details the degree of collaboration which indicates a trend in single and multipleauthorship during 2008 – 2017 as shown in the Table. The degree of collaboration ranges from 0.93 to 0.95 and the average degree of collaboration is 0.94.In the present study, the value of DC is 0.95. As the result, the degree of collaboration in the study RFID is 0.95 which shows the collaborations of multiple authors.
- Relative Growth Rate and Doubling time shows the highest value and lowest value. The highest relative growth was 1.53 in the year of 2018. And the lowest relative growth was 0.68 in the year of 2015. The highest doubling time was 1.01 in the year of 2015. And lowest doubling time was 0.45 in the year of 2018.
- The country “Peoples RChina” was observed in 631 records, securing the first position, followed by the “USA” in 427 records, which attained the second position.
- The Journal “SENSORS” was observed to appear in 81 records gaining first position, followed by the “IEEE Transactions on Antennas and Propagation” in 77 records securing second position, followed by the “IEEE Sensors Journal” 73 records which attained third position among Journals.

CONCLUSION

The aim of this study is to report the information flow in both recognition and marketing applications by using RFID technology. It is very helpful to improve the efficiency of enterprises. For this purpose, enterprises must integrate education and teamwork consistency with innovative technologies to adjust to the changing needs of the industry. It provides a great advantage in terms of human and machine-based decision-making capabilities. This will solve time-consumption for entering data, the problem in identifying items, human mistakes etc. Radio-frequency identification (RFID) is rapidly emerging as the replacement for the barcode. Several studies have beendone in this field, but metric related studies are minimum. This indicates the relevance of this quantitative study. Finally, it describes that this technology promises to change the world and has the capacity of making individual and work lives atmosphere more suitable.

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