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Bibliometric Analysis of Research Output on the Internet of Things in the Arab World

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ABSTRACT

Arab countries understand the importance of the Internet of things for the development of society. This entails many efforts to conduct research related to the Internet of things in the Arab countries. Analysing contributions of researchers to the Internet of things research could be useful to go further in this filed. In this study, bibliometric techniques are used to investigate publications indexed in the Scopus database with the affiliation to the Arab countries. The paper used research outputs of Arab nations as quantitative measure, while it also used citation rates and citation scores for qualitative measure. Data analysis focuses on the growth in the Internet of things research, types of publication, core journals, subject and keyword analysis, top productive authors, top productive institutes and countries, and collaborative countries with the Arab countries. Findings of the study highlighted the differences among the Arab group countries with regard to IoT research. In addition, the Arab nations appeared performing better in IoT research than the environmental and medical research.

Keywords: Internet of things; Research productivity; Arab world; Scopus database; Bibliometric techniques.

1. INTRODUCTION

The concept of the Internet of Things (IoT) is to somewhat a novel paradigm that is rapidly becoming interesting in modern wireless telecommunications. The term refers to the pervasive presence of a variety of things or objects through a unique addressing schemes to interact with each other and cooperate with their neighbours to reach common goals[1]. IoT has the ability of connecting people at any time and place to anything. It links real life and physical activities with the virtual world[2,3]. The IoT consists of objects, sensor devices, communication infrastructure, computational and processing unit that may be placed on cloud, used for decision making and action invoking system[2,4].

IoT represents the next step towards moving to the digital society and economy, where objects and people are interconnected through communication networks and report about their status and the surrounding environment[5]. According to the International Telecommunication Union (ITU), IoT can be perceived as a vision with technological and societal implications. It is a global infrastructure for the information society, enabling advanced services by interconnecting things based on existing and evolving interoperable information and communication technologies. Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of "things" to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled[6].

Many government and non-government organisations are heavily investing in IoT projects, infrastructures, and facilities to boost their services, business, and knowledge management. Based on a report by i-SCOOP[7], IoT investment will increase from USD800 billion in 2017 to nearly 1.4 Trillion in 2021. This reflects importance of IoT in the world therefore, Arab countries particularly the Gulf countries are investing a lot in this technology. The UAE is among the top leading countries of the Arab nations in relation to innovations and transformations[3,8]. For instance, Dubai has already introduced the smart city approach with the provision of smart services and has been announced to transfer the present Dubai as Smart Dubai[3]. A report by Micro Market Monitor estimated that UAE's IoT and M2M Communication market may grow from $10.02 billion in 2014 to $35.01 billion by 2019[8].

Recently, many researchers around the world have demonstrated the interest in IoT research. In 2014, Stankovic[9] discussed about research directions for the Internet of Things. He believes that in the future IoT will become more sophisticated in sensing, actuation, communication, control, and in creating knowledge from vast amounts of data. Konstantinidis[10], *et. al.* used longitudinal approach to investigate the trends of Internet of Things in Health sector using bibliometric and text mining tools. In total, 778 article were retrieved from the Web of Science database on IoT from 1998 to 2016. The publications were grouped into 30 clusters based on abstract text analysis resulting into some 8 trend of IoT in Health sector. Siow[11], *et. al.* reviewed the broad vision for the IoT in various

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Table 1. Distribution of Publications and document types matching to "Internet of Things" during 2010-2017

Publication Type	Documents	% Share	Document Type	Documents	%Share
Conference Proceedings	753	64.14	Conference Papers	840	71.55
Journals	303	25.81	Journal Articles	271	23.08
Book Series	94	8.01	Book Chapters	26	2.21
Books	23	1.96	Book Reviews	25	2.12
Trade Publications	1	0.08	Articles in Press	7	0.59
			Books	3	0.25
			Editorials	2	0.17
	1174	100		1174	100

communities. The authors examined the application of data analytics across IoT domains, and provided a categorisation of analytic approach and proposed a layered taxonomy from IoT data analytics.

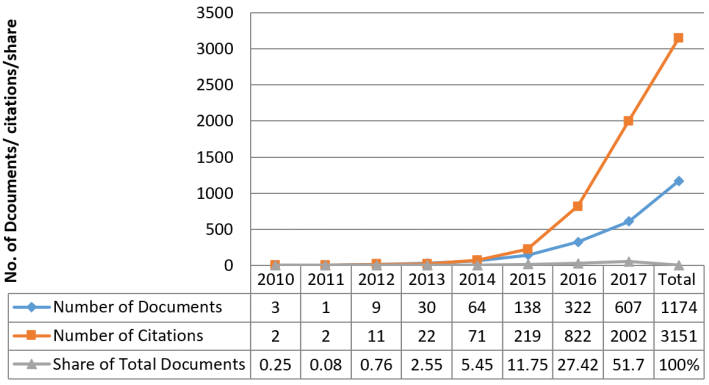
The Arab world consists of 22 countries. These countries are Algeria, Bahrain, Comoro, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Mauritania, Morocco, Oman, Palestine, Qatar, Saudi Arabia, Somalia, Syria, Sudan, Tunisia, Yamen, and UAE. Like other countries, Arab countries have hundreds of universities and research institutions[12]. As a result, thousands of researchers and scientists are recruited from all over the world and working with these universities and institutions.

Arab countries are aware of the importance of the Internet of things for the development of society. This entails many efforts to conduct research related to the Internet of things in Arab countries. Analysing contributions of researchers to the Internet of things research could be useful to go further in this field. This study is intended to investigate and analyse IoT research in the Arab world based on the research contributions indexed in the Scopus database from 2010 to 2017. Therefore, it is interesting to find out all the contributions of Arab countries to IoT research. To the best of our knowledge, this is the first bibliometric study on IoT in the Arab world. Findings of study would provide an overall progress on IoT research and progress done during 2010-2017 in the Arab world.

2. OBJECTIVES

This study intends to investigate and analyse IoT research publications in the Arab countries indexed in the Scopus database from 2010 to 2017. The paper intends to achieve the following objectives:

- To find out the research productivity output on IoT research in the Arab countries
- To identify the most productive countries in IoT research in the Arab countries
- To identify the most productive authors in IoT research in the Arab countries



	2010	2011	2012	2013	2014	2015	2016	2017	Total
Number of Documents	3	1	9	30	64	138	322	607	1174
Number of Citations	2	2	11	22	71	219	822	2002	3151
Share of Total Documents	0.25	0.08	0.76	2.55	5.45	11.75	27.42	51.7	100%

Figure 1. Arab countries research productivity output on IoT research, 2010-2017.

- To discover the most productive institutions in IoT research in the Arab countries.

3. METHODOLOGY

For this study, the researchers collected data in December 2018 from the Scopus database. In order to retrieve relevant bibliographic data form the database, we used the term "Internet of things" to search various fields including title, abstract, and keyword. This was followed by limiting the retrieved documents to the Arab countries. The search strategy matched with 1174 documents containing the term "Internet of Things" for the Arab countries. The Scopus database classifies the publications of IoT research into five categories of publications including books, book series, journals, conference proceedings, and trade publications. The retrieved documents were processed in Microsoft Excel to identify the characteristics of publications, growth pattern, subject categories, institutional productivity, author productivity and collaboration. The researchers looked into this case of counting with the help of microsoft excel to determine the frequencies, percentages, and averages.

As presented in Table 1, conference proceedings are on the top of the list with 753 documents appeared in 160 proceeding,

Table 2. Arab countries' productivity in IoT research, during 2010-2017

Country	TD (%)	TDC (%)	TDNC (no/%)	TCC (no/%)
KSA	294 (25.04)	279(94.89)	15(5.10)	USA (40/13.60)
UAE	174(14.82)	169(97.12)	5(2.87)	USA (25/14.36)
Tunisia	151(12.86)	146(96.68)	5(3.31)	France (52/34.43)
Egypt	137(11.66)	130(94.89)	7(5.10)	KSA (17/12.40)
Morocco	126(10.73)	125(99.20)	1(0.79)	France (17/13.49/)
Algeria	95(8.09)	92(96.84)	3(3.15)	France (40/42.10)
Jordan	79()6.72	74(93.67)	5(6.32)	UK (12/15.18
Qatar	65(5.53)	64(98.46)	1(1.53)	USA (17/26.15)
Lebanon	45(3.83)	42(93.33)	3(6.66)	France (11/24.44)
Iraq	44(3.74)	41(93.18)	3(6.68)	UK (13/29.54)
Oman	25(2.12)	23(92)	2(8.00)	UAE (6/24.00)
Kuwait	21(1.78)	17(80.95)	4(19.04)	USA (5/23.80)
Palestine	10(0.85)	8(80)	2(20.00)	Belgium (2/20.00)
Bahrain	7(0.59)	5(71.42)	2(28.57)	UAE(3/42.85)
Yemen	5(0.42)	5(100)	0(0)	Malaysia (4/80.00)
Sudan	4(0.34)	4(100)	0(0)	Spain (1/25.00)
Libya	3(0.25)	3(100)	0(0)	Germany, Ireland, South Korea (1/33.33)
Syria	2(0.17)	2(100)	0(0)	France, Tunisia (1/50.00)
Comoros	-	-	-	-
Djibouti	-	-	-	-
Mauritania	-	-	-	-
Somalia	-	-	-	-

*TD: Total number of Documents produced by a country, TDC= Total number of documents with collaboration, TDNC= Total number of documents without collaboration, TCC=Top collaborated country.

followed by journal articles with 303 document appeared in 130 journal. The book series occupied the third position with 94 documents appeared in 12 book series, followed by books with 23 document appeared in 16 book, and 354 document appeared in the same number of trade publications. In this regard, all the retrieved documents were further divided into seven types of documents. The top three document type are conference papers (840/71.55 %), followed by journal articles (271/23.0s8 %), and book chapters (26/2.21 %).

4. FINDINGS

4.1 Research Productivity of Arab Countries on IoT Research

Table 1 presents the growth of IoT research publications in the Arab countries from 2010 to 2017. The table shows that out of 1174 documents retrieved, the highest number of research publications (607/51.70 %) were published in 2017, followed by 2016 (322/27.42 %), and 2015 (138/11.75 %). Similarly, Fig. 1 shows the highest number of citations was received in 2017 with 2002 citations, followed by 2016 with 822 citations, and 2015 with 219 citation. The average citations per document is 2.68 from 2010-2017.

In order to compare Arab countries to the global world in IoT research productivity, we identified 29,746 IoT research documents for the global world indexed in the Scopus database. These documents are published from 127 countries during the period of 1970 to the end of year 2017. The average number of publications was 1859.12 documents per year. China topped the list in the world ranking with 6,314 documents (21.22 %), followed by USA with 4,176 (14.03 %), and India with 2,630 (8.84 %). By limiting the search option to the Arab countries, a total of 1174 document were retrieved which indicates 3.94 per cent of total research productivity at global level. Figure 2 illustrates the growth of research productivity of IoT research in the Arab world and provides comparison with global research output.

Table 2 listed the research output of Arab countries on IoT during 2010-2017. It is found that no contribution was made by four Arab countries to IoT research. The four countries are Comoros, Djibouti, Mauritania, and Somalia. The table indicates different patterns of research among these countries in terms of productivity, and collaboration with other countries. The top five countries of the Arab world based on the research output on IoT research are Saudi Arabia (294; 25.04 %), followed by UAE (174; 14.82 %), Tunisia (151; 12.86 %), Egypt (137; 11.66 %), and Morocco (126; 10.73 %).

On the other hand, results of the study indicate collaboration in IoT research between Arab nations and some of the world leading countries. The findings indicate that the majority of IoT researchers in Arab countries collaborated with researchers from France (121/10.30 %), the USA (87/7.41 %), and UK (25/2.12 %). However, the interaction between the scientists in the Arab countries is found in between Egypt and KSA, Oman and UAE, and Bahrain and UAE.

4.2 Top Ten Most Productive Academic Institutions from 2010-2017

The analysis indicates that 95 academic institutions in the Arab countries produced 1174 documents. The top ten most productive academic institutions in IoT research have contributed 434 publication, occupying 36.96 per cent of total documents produced by 95 academic institutions in the Arab world. The retrieved documents include single and multiple author papers. Three of these top ten academic intuitions are from Tunisia, two each from KSA and UAE, and one from each of the remaining countries. The three most productive academic institutions are King Saud University (KSA) with 108

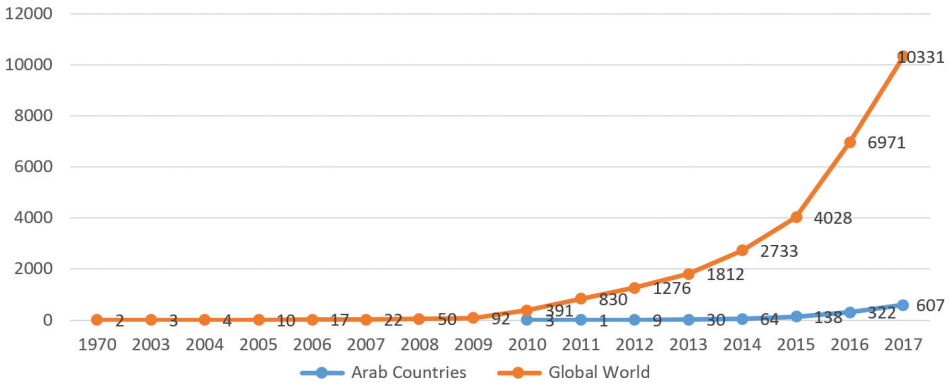


Figure 2. Productivity in IoT research: comparing Arab world to the global world.

Table 3. Top ten most productive institutions on IoT during 2010-2017

Institution	Country	Rank	TP*	SAP*	MAP*	PC (%)
King Saud University	KSA	1	108	1	107	99.07
Khalifa University of Science and Technology	UAE	2	52	2	50	96.15
Jordan University of Science and Technology	Jordan	3	45	0	45	100
Qatar University	Qatar	4	40	0	40	100
Cairo University	Egypt	5	33	1	32	96.96
United Arab Emirates University	UAE	6	30	0	30	100
King Abdullah University of Science and Technology	KSA	7	27	1	26	96.29
University of Tunis El Manar	Tunisia	8	26	0	26	100
Université des Sciences et de la Technologie Houari Boumediene	Algeria	9	25	0	25	100
Université de la Manouba	Tunisia	10	24	0	24	100
Université de Carthage	Tunisia	10	24	1	23	95.83

*TP = Total Papers, SAP= Number of Single Author Papers, MAP= Number of Multiple Authors' Papers, PC= Percentage of Collaboration among the authors from each institution.

documents, and Khalifa University of Science and Technology (UAE) with 52 documents, and Jordan University of Science and Technology (Jordan) with 45 document. With regard to the collaboration, authors of the top ten universities demonstrated 95 per cent - 100 per cent collaborations in producing these papers.

4.3 Seven Most Productive Authors on IoT in the Arab Countries, 2010-2017

The retrieved documents were analysed to determine the names of the authors and their contributors. A total of 160 unique authors contributed to IoT research in the Arab world. This indicates an average of 7.33 papers produced by a single author on IoT research in the Arab world from 2010-2017. Furthermore, of the 160 unique authors identified, seven authors were considered as top contributors produced 8 to 15 paper of IoT research from 2010 -2017. As presented in Table 5, three of the top seven authors are from Tunisia, two from each Jordan, KSA, UAE, and Algeria, and one from each Egypt, Morocco, and Qatar. Moreover, two of the five most productive authors are from Jordan University of Science and Technology, and one from each King Saud University (KSA), Center of Excellence in Information Assurance (Algeria), and Qatar University (Qatar). Similarly, the number of citations received for the documents published by the top seven author indicates that Jararweh, from Jordan University of Science and Technology, leads all the authors with 177 citation for 15 papers. He is followed by Khan from King Saud University with 171 citations for 12 document, and Al-Ayyoub from Jordan University of Science and Technology with 150 citation for 13 document.

4.4 Ten Core Journals in IoT based on their 2017 performance report

As listed in Table 1, all the IoT documents are published in conference proceedings, journals, books, book series, and trade publications. Based on the number of documents published, journals are in the second position after conference proceedings with a total of 303 document published in 130 journals. Table 5 presents the leading 18 journal published IoT research documents affiliated to the Arab countries from 2010 to 2017. With the use of journal performance report in 2017, the *IEEE Access* journal tops the list with 34 document, followed by the journal of *Computer Networks* (15 document), and *IEEE Internet of Things Journal* (15 documents).

Meanwhile, by based on the number of citations, the *IEEE Communications Surveys and Tutorials* journal occupied the first position with 1525 citation for five document, indicating an average of 305 citation for each paper. The *Journal of Network and Computer Applications* takes the second position with 492 citation for eight documents with an average of 61.5 citations per paper, while *IEEE Access* journal comes in the third position with 431 citation for 34 paper, registering an average 12.67 citation per paper. On the other hand, by analysing the citation scores of the top 18 journal, the *IEEE Communications Surveys and Tutorials* leads the list with 26.26 scores (SJR = 3.661, SNIP = 11.681), followed by *IEEE Communications Magazine* with 11.06 scores (SJR = 2.297, SNIP = 5.631), and *IEEE Internet of Things Journal* with 10.53 scores (SJR = 1.341, SNIP = 4.296).

Table 4. Seven most productive authors of IoT research in the Arab countries, 2010 -2017

Author	Affiliation	City , Country	Rank	TP*	TC*	ACP*
Jararweh, Y.	Jordan University of Science and Technology	Irbid, Jordan	1	15	177	11.80
Al-Ayyoub, M.	Jordan University of Science and Technology	Irbid, Jordan	2	13	150	11.53
Khan, M.K.	King Saud University	Riyadh, KSA	3	12	171	14.25
Tandjaoui, D.	Centre de Recherche sur l'Information Scientifique et Technique (CERIST)	Algiers, Algeria	3	12	72	6.00
Meddeb, A.	Université de Sousse, National School of Engineering of Sousse	Sousse, Tunisia	4	11	43	3.90
Bouras, A.	Qatar University, Department of Computer Science	Doha, Qatar	4	11	30	2.72
Challal, Y.	École nationale supérieure d'Informatique,	Algiers, Algeria	5	10	84	8.40
Gadallah, Y.	American University in Cairo, Department of Electronics and Communication Engineering	Cairo, Egypt	5	10	49	4.90
Alouini, M.S.	King Abdullah University of Science and Technology, Electrical and Mathematical Sciences and Engineering Division	Jeddah, KSA	6	9	54	6.00
Ghazal, M.	Abu Dhabi University, Department of Electrical & Computer Engineering	Abu Dhabi, UAE	6	9	11	1.22
Saleem, K.	King Saud University, Center of Excellence in Information Assurance (CoEIA),	Riyadh, Saudi Arabia	7	8	131	16.37
Hamdi, M.	Université de Carthage, Digital Security Research Unit	Tunis, Tunisia	7	8	34	4.25
Yeun, C.Y.	Khalifa University of Science and Technology, Department of Electrical & Computer Engineering,	Abu Dhabi, UAE	7	8	34	4.25
Zouinkhi, A.	Université de Gabès, Research Laboratory Modeling,	Tunisia	7	8	18	2.25
Ezzati, A.	University Hassan 1,	Settat, Morocco	7	8	9	1.12
			Total	177	1067	98.96

*TP = Total Papers, TC= Total Citations, ACP=Average Citation Per Paper

4.5 Subject and Keyword Frequencies

Table 6 contains subject area frequencies related to IoT documents indexed in the Scopus database. Based on the Scopus outputs, computer science occupied the highest subject areas for IoT documents (50.92 %), followed by engineering (20.98 %), and Mathematics (7.06 %). In addition to the subject areas, Scopus uses at least 160 keywords for indexing IoT documents. The keywords appeared 6645 times with 1174 IoT documents affiliated to the Arab countries. Figure 3 illustrates the top 12 keyword indexed in the Scopus database. According to the findings, the keyword "Internet of Things" tops the list with 24.58%, followed by the "Internet" (4 %), and "cloud computing" (2.70 %).

5. DISCUSSIONS

The main objective of this study was to investigate and analyse IoT research productivity in the Arab world based on the literature indexed in Scopus database. The paper has reported the research productivity output on IoT in the Arab countries, their institutions, and contributors. Findings of the study showed that IoT research productivity has grown rapidly in the Arab world from 2010 to 2017. As noticed, the researchers from the Arab world had started IoT research in 2010, since then their productivity has gone up and reached up to 600 documents in 2017. In fact, the productivity on IoT has significantly increased in the last three years, i.e. in 2015, 2016, and 2017 which contributes to 90.88 per cent of the total outputs by the researchers in the Arab countries.

Overall, 3.94 per cent of Arab world's contribution to IoT research in the global level not surprising. According to UNESCO report, the researchers in the Arab world do not publish in refereed journals listed by the Web of Science or Scopus, and many Arab universities are not considered as research universities[13]. However, the findings of this study

Table 5. Ten core journals in IoT based on 2017 performance report

Journal	Rank	TP	TC	ACPP	Citation Score	SJR	SNIP
IEEE Access	1	34	431	12.67	4.49	0.548	1.758
Computer Networks	2	15	412	27.46	3.33	0.5	1.551
IEEE Internet of Things Journal	3	14	90	6.42	10.53	1.341	4.296
Sensors Switzerland	3	14	213	15.21	3.23	0.584	1.55
IEEE Communications Magazine	4	10	240	24	11.06	2.297	5.631
Adhoc Networks	5	9	99	11	3.56	: 0.53	1.809
Cluster Computing	5	9	21	2.33	2.04	0.374	1.115
Journal of Network And Computer Applications	6	8	492	61.50	5.13	0.784	2.401
Journal of Theoretical and Applied Information Technology	7	7	4	0.57	0.42	0.161	0.42
IEEE Sensors Journal	8	6	161	26.83	3.29	0.619	1.555
IEEE Communications Surveys And Tutorials	9	5	1525	305	26.26	3.661	11.681
IEEE Wireless Communications	9	5	225	45	9.3	1.878	3.66
Computer Communications	10	4	83	20.75	3.47	0.459	1.712
Computers and Electrical Engineering	10	4	63	15.75	2.16	0.401	1.142
Future Generation Computer Systems	10	4	113	28.25	4.76	0.844	2.472
International Journal Of Applied Engineering Research	10	4	2	0.5	0.13	0.199	0.484
Journal of Ambient Intelligence and Humanized Computing	10	4	97	24.25	1.69	0.352	0.894
Wireless Networks	10	4	415	103.75	2.03	0.336	1.021

TP = Total papers, TC= Total Citations, ACPP = Average citation per paper, SJR = SCImago Journal Rank, SNIP = Source Normalized Impact per Paper

Table 6. IoT Subject area

Subject Area	Rank	TP	% Share
Computer Science	1	995	50.92
Engineering	2	410	20.98
Mathematics	3	138	7.06
Decision Sciences	4	76	3.88
Physics and Astronomy	5	73	3.73
Social Sciences	6	62	3.17
Materials Science	7	56	2.86
Business, Management and Accounting	8	33	1.68
Medicine	9	23	1.17
Energy	9	23	1.17
Chemistry	10	18	0.92
Biochemistry, Genetics and Molecular Biology	11	15	0.76

Subject Area	Rank	TP	% Share
Health Professions	12	7	0.35
Environmental Science	12	7	0.35
Economics, Econometrics and Finance	13	4	0.20
Earth and Planetary Sciences	14	3	0.15
Chemical Engineering	14	3	0.15
Neuroscience	15	2	0.10
Multidisciplinary	15	2	0.10
Arts and Humanities	15	2	0.10
Psychology	16	1	0.05
Agricultural and Biological Sciences	16	1	0.05
	Total	1954	100

TP = total papers

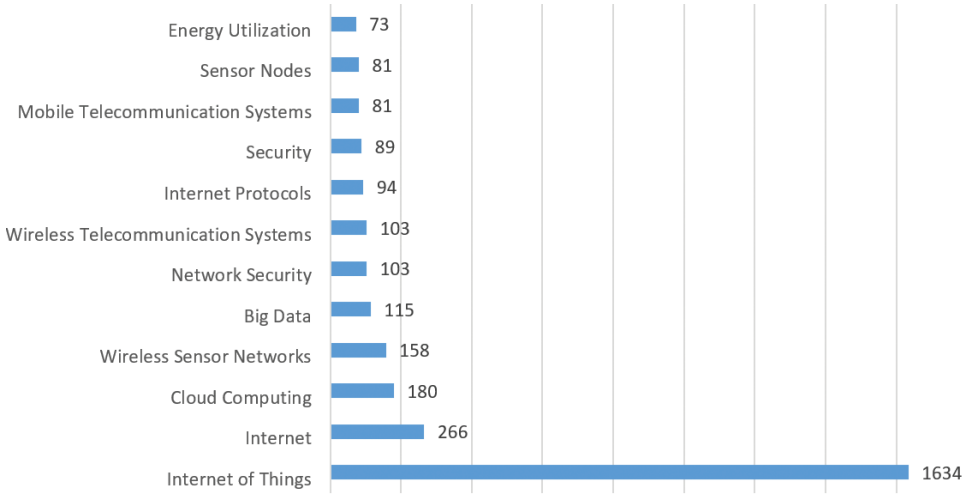


Figure 3. Top twelve keywords of IoT documents along with their frequency in the Scopus database.

confirmed that the Arab world contributions to IoT research is higher than that of their contributions to the environmental and medical research[14,15] but lower than their contributions to leishmaniasis research[16]. A report by Wasim Maziak[14] found that Arab countries contributed to less than 0.5 per cent of the papers appeared in 200 leading medical journals. Similarly, a research by Zyoud[15] and his colleagues found that Arab world contributed to 1.25 per cent of world productivity in environmental research, while Al Jabi[16] reported 5.65 per cent of Arab contributions to leishmaniansis research at the global level.

As reported by similar studies[15-17], findings of the study indicated different patterns of IoT research productivity in the Arab world. The large number of IoT publications is from Saudi Arabia, followed by UAE, and Tunisia. In addition, results of the study indicated that the majority of IoT researchers in the Arab world collaborated not only with other researchers within the Arab countries but also with researchers from around the world such as France, the USA, and UK. The results are in line with the previous studies[18-20]. Similarly, authors of the top ten universities demonstrated having 95 per cent collaborations with other scholars and scientists with locally and internationally. Certainly, this kind of collaboration would have positive impact on the quantity and quality of IoT research in the Arab world.

The results of study identified 95 academic institutions in the Arab countries contributed to IoT research. This number is not significant as it represents only 33.92 per cent of 280 academic institutions with the membership of the Association of Arab Universities[12]. The top ten most productive academic institutions in IoT research have contributed 434 publications indicating 36.96 per cent of total documents produced by academic institutions in the Arab world. The top three productive academic institutions are King Saud University (KSA), Khalifa University of Science and Technology (UAE), and Jordan University of Science and Technology (Jordan). Meanwhile, authors from Jordan achieved outstanding performance in their contributions to IoT research. The top two most productive authors are from Jordan University of Science and Technology. This result reflects a positive impact of the Jordanian research institutions on IoT research in the Arab world.

The results of the study found that IEEE society's dominates the publication of IoT documents. The IEEE society took the first and third positions with regard to the number of papers published, and in the number of citations received. Similarly, for the citation scores IEEE publications occupied the first three positions of the top 20 journal. The publications are *IEEE Communications Surveys and Tutorials*, followed by *IEEE Communications Magazine*, and *IEEE Internet of Things Journal*. Off course, IEEE is one the leading publishers in the world being top professional society and non-profit body bringing out a wide range of quality publications, helps in the exchange of technical knowledge and information among technology professionals (IEEE, 2018). Therefore, researchers and scholars of the Arab world should aim to publish in IEEE publications for getting proper recognition and worldwide visibility.

Findings of the study identified "computer science" as the largely accepted subject area for IoT researcher look into, followed by engineering, and Mathematics. In addition to these subject areas, Scopus uses at least 160 keyword for indexing IoT documents. The keywords appeared 6,645 times in 1,174 IoT documents affiliated to the Arab countries. According to the findings, the keyword "Internet of Things" top the list, followed by the "Internet", and "cloud computing" (2.70 %). This indicates that these are the three keywords to be used in indexing and identifying IoT literature in online databases and particularly Scopus database.

6. CONCLUSIONS

IoT research productivity witnessed a significant growth in the Arab world in 2015, 2016, and 2017, and the level of productivity reached 3.94 per cent as compared to global productivity level during this period. However, that is better than their contribution to environmental and medical research. Although the achievements of the Arab world in IoT research are not dreadful, there is a need to enhance research productivity in this area. This can be done through more research projects, collaboration and networking between academic institutions in the Arab region along with their counterparts from the world. With an increasing interest in smart services and artificial intelligence, Arab governments as well as the stakeholders and decision makers of academic institutions are encouraging the researchers and providing all kinds of support for doing IoT research so that intellectual productivity and developments would takes place in the Arab world.

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