A Scientometric Analysis of Beacon Technology Publications

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Abstract

Beacon technology, which uses Bluetooth Low Energy (BLE) signals, has emerged as a breakthrough option for enabling location-based applications and connecting the digital and physical worlds. Its applications include retail malls, museums, airports, and smart cities, enabling real-time communication, navigation, and customer engagement. This study uses scientometric analysis to assess global research trends in beacon technology from 2015 to 2024, utilising data from the Web of Science database (869 records). The findings show a constant increase in research production, peaking in 2024 (14.27%), with China (28.31%) and the United States (17.72%) leading the way. The most common disciplinary categories are Computer Science Information Systems (21.29%), Engineering Electrical & Electronic (32.11%), and Telecommunications (23.22%). The majority of research is disseminated through English-language journal papers (99.54%), with Sensors as the top journal (89.53%). The largest financing organisation is the National Natural Science

Keywords

Scientometric, Beacon Technology, Bluetooth Low Energy, Web of Science,

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Introduction

Bluetooth Low Energy (BLE) signals are used by beacon technology, a location-based wireless solution, to link digital and physical environments. Businesses and organisations can provide people with real-time, contextually relevant, and tailored information by using beacons that send signals to nearby smartphones or tablets. In contrast to GPS, which frequently malfunctions indoors, beacon technology provides precise proximity detection, making it ideal for settings such as shopping malls, museums, airports, and smart cities. The future of smart settings and digital services will be greatly influenced by beacon technology, which can improve customer engagement, enable direct navigation, and facilitate smooth communication. Scientometrics is the quantitative study and measurement of science, which use mathematical and statistical tools to evaluate scientific research, publications, citations, and collaborations. It provides insights into research trends, productivity, communication patterns, and the broader landscape of scientific and technological growth, which can inform science policy and research management.

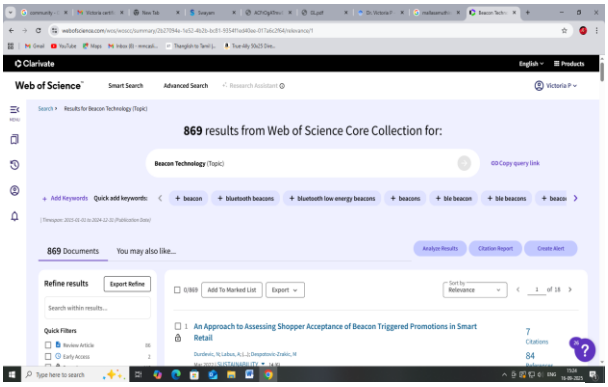
Review of Literature

Using bibliometric analysis, Pelicioni et al. (2018) assessed technical innovation trends in the aircraft industry from 2008 to 2015, revealing a predominant focus on satellite technologies and, to a lesser extent, launch vehicles. They forecast that advancements in low-cost technologies, particularly high-resolution satellite imagery for Earth observation, will shape future developments. Kukreja et al. (2023) performed a scientometric analysis of 1,154 publications from 2002 to 2022 to examine Web 3.0 research patterns, uncovering its interdisciplinary essence spanning e-commerce, healthcare, and education. Key topics included Journalism 3.0, Personal Data Stores, Decentralised File Storage, and the Metaverse, reflecting increasing scholarly interest. Alzoubi, Alshurideh, and Ghazal (2021) emphasised the requirement for accurate, cost-effective operations amidst hyper-competition, advocating the integration of Intelligent Information Systems (IIS) with Bluetooth Low Energy (BLE) beacon technology to boost retail performance through real-time transactions and improved decision-making. Pangriya, R. (2023) noted the emerging nature of beacon technology and its limited prior research, primarily centered around experimental frameworks. To fill this gap, the article provides a systematic

literature review and a SWOT analysis based on 80 academic papers, aiming to clarify and enhance understanding of beacon technology for future research.

Research Methodology

The following search string was used to retrieve the data from the Web of Science database on September 16, 2025. Beacon technology is the topic of discussion. Study range: 2015–2024. In all, 869 articles were retrieved. Bibexcel software was used to analyse the articles that were obtained. VOS Viewer software and Microsoft Excel were used for further research.



Screenshot of data collected in Web of Science (1)

Objective of the Study

- To identify how the output of research on be acon technology increased between 2015 an d 2024.
- To determine the publications' document typ e distribution.
- To find out the writers and document types
- Ranking of nations and authors have contrib uted.

Data analysis and Interpretation

Table 1: Year-wise Distribution

S.No	Year	Records	Percentage
1	2024	124	14.27%
2	2023	81	9.32%
3	2022	108	12.43%
4	2021	97	11.16%
5	2020	106	12.20%
6	2019	111	12.77%
7	2018	86	9.90%
8	2017	62	7.14%
9	2016	54	6.21%
10	2015	40	4.60%
TOTAL		**869**	**100%**

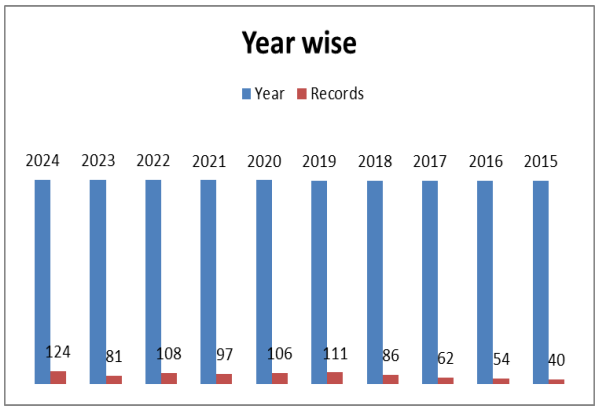


***Figure 1** Year wise Distribution*

With 869 records overall, the table shows a steady increase in research publications between 2015 and 2024. Although contributions were lower in early years like 2015 (4.60%) and 2016 (6.21%), there has been a consistent rise since 2017. 2019 (12.77%), 2020 (12.20%), 2022 (12.43%), and 2024 (14.27%) saw the highest outputs. The general trend suggests growing research interest and a steady rise in recent years, notwithstanding a slight fall in 2023 (9.32%).

Table 2: Prolific Authors (Top 15)

S.No	Prolific Authors	Records	Percentage
1	Al-deek H	5	0.58%
2	Alves H	4	0.46%
3	Bo Y	4	0.46%
4	Caballero-gil C	4	0.46%
5	Caballero-gil P	4	0.46%
6	Chen C	5	0.58%
7	Cheng L	4	0.46%
8	Guo Y	4	0.46%
9	Han GJ	4	0.46%
10	He Y	4	0.46%
11	Kim S	5	0.58%
12	Kohrt BA	4	0.46%
13	Kolpashchikov DM	4	0.46%
14	Lee J	4	0.46%
15	Li L	5	0.58%

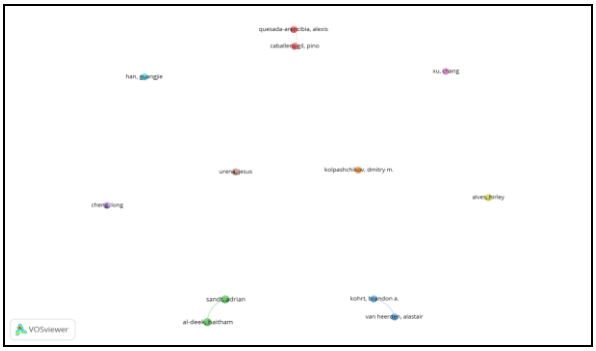


Figure 2 Vos viewer Prolific Authors

The table shows the contributions of prolific authors in the field, displaying that a small number of researchers have published multiple records. Al-deek H, Chen C, Kim S, and Li L are the most productive, accounting for 5 records apiece (0.58%). Several others, including Alves H, Bo Y, Caballero-gil C, Caballero-gil P, Cheng L, Guo Y, Han GJ, He Y, Kohrt BA, Kolpashchikov DM, and Lee J, contributed four records (0.46%). This distribution shows that, while there are a few key contributors, research output is distributed rather evenly among several writers, showing collaboration and general interest in the topic.

Table 3: Document Types Wise Distribution

S.No	Document Types	Records	Percentage
1	Article	778	89.53%
2	Book Chapters	2	0.23%
3	Data Paper	1	0.12%
4	Early Access	2	0.23%
5	Editorial Material	2	0.23%
6	Letter	1	0.12%
7	Meeting Abstract	2	0.23%
8	Proceeding Paper	8	0.92%
9	Retracted Publication	1	0.12%
10	Review Article	86	9.90%

The data reveals that research articles account for the vast majority of contributions (778 records, 89.53%), emphasizing their importance as the dominant channel of scholarly communication. Review articles also contribute significantly with 86 records (9.90%), showing efforts to summarize and assess prior research. Other document kinds include proceeding papers (0.92%), book chapters (0.23%), editorials (0.23%), and meeting abstracts (0.23%), with data papers, letters, and retracted publications accounting for only 0.12% each. This distribution clearly indicates that the area relies primarily on original research articles, with a lower share of reviews and other contributions in various formats.

Table 4: Language-Wise Distribution

S.No	Language	Records	Percentage
1	Chinese	3	0.35%
2	English	865	99.54%
3	German	1	0.12%
Total		**869**	**100%**

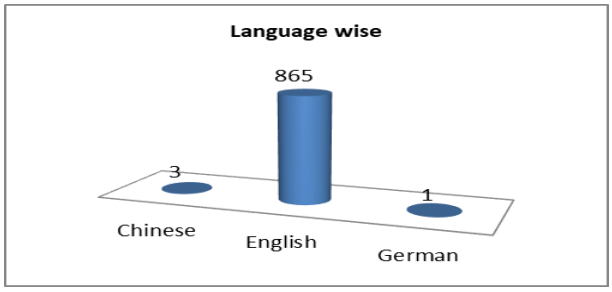


Figure 3 *Language wise*

The language distribution indicates a great dominance of English, with 865 records (99.54%), making it the primary medium of scholarly communication in the field. A small number of articles are in Chinese (3 records, 0.35%) and German (1 record, 0.12%), showing that contributions in other languages are quite limited. This pattern reflects the global propensity for publishing in English to increase visibility, accessibility, and academic impact.

Table 5: Countries-wise Distribution

S.No	Countries	Records	Percentage
1	Peoples R China	246	28.31%
2	Usa	154	17.72%
3	South Korea	84	9.67%
4	Spain	64	7.37%
5	India	49	5.64%
6	Italy	42	4.83%
7	England	36	4.14%
8	Canada	33	3.80%
9	Australia	30	3.45%
10	Taiwan	30	3.45%

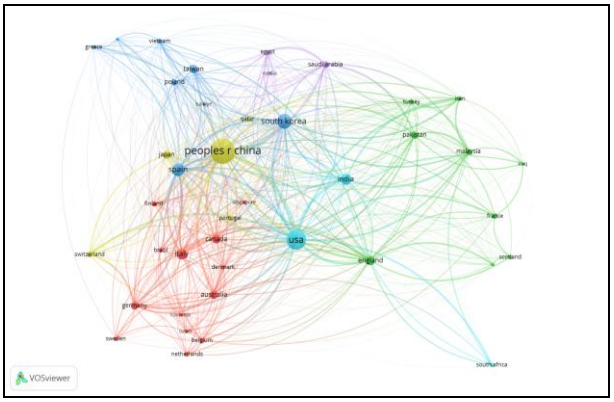


Figure 4:*Countries Wise Distribution*

With 246 records (28.31%), the People's Republic of China leads the country-wise distribution, demonstrating its significant contribution to the field of study. With 154 recordings (17.72%), the USA comes in second, followed by South Korea (9.67%), Spain (7.37%), and India (5.64%), all of which exhibit noteworthy engagement. Moderate contributions are made by Canada (3.80%), Australia (3.45%), Taiwan (3.45%), and European nations such as Italy (4.83%) and England (4.14%). This distribution shows a globally varied but regionally concentrated research output, with significant contributions from the USA and parts of Europe in addition to the domination of Asian nations, particularly China and South Korea.

Table 6: Institutions Wise Distributions

S.NO	Institutions	Records	Percentage
1	Chinese Academy Of Sciences	35	4.03%
2	Beihang University	10	1.15%
3	Harbin Institute Of Technology	8	0.92%
4	Egyptian Knowledge Bank Ekb	7	0.81%
5	Central South University	6	0.69%
6	Centre National De La Recherche Scientifique Cnrs	6	0.69%
7	China University Of Mining Technology	6	0.69%
8	Consiglio Nazionale Delle Ricerche Cnr	6	0.69%
9	Hunan University	6	0.69%
10	King Saud University	6	0.69%

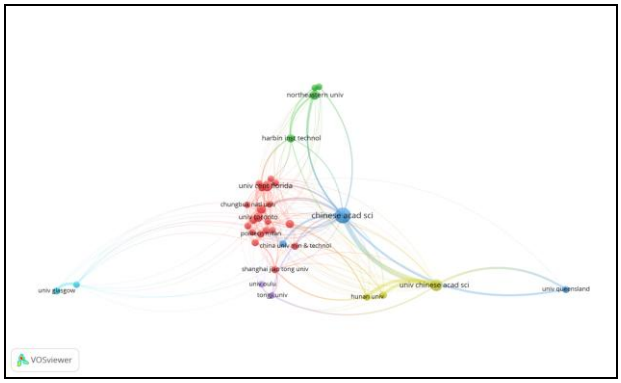


Figure 5: *Institutions Wise Distributions*

According to the institutional distribution, the Chinese Academy of Sciences is the largest contributor with 35 records (4.03%), underscoring its critical role in advancing research in this field. It is followed by Beihang University (1.15%) and the Harbin Institute of Technology (0.92%), demonstrating that other prominent Chinese institutions have made significant contributions. The Egyptian Knowledge Bank (0.81%), Centre National de la Recherche Scientifique (CNRS, France) (0.69%), Consiglio Nazionale delle Ricerche (CNR, Italy) (0.69%), and King Saud University (Saudi Arabia) (0.69%) all contribute to the total. Overall, the data indicate that China leads institutional research production, with select institutions from Europe and the Middle East also making significant contributions, revealing a worldwide collaborative research ecosystem.

Table 7: Web of Science Categories

S.No	Web Of Science Categories	Records	Percentage
1	Engineering Electrical Electroniccate	279	32.11%
2	Telecommunications	200	23.02%
3	Computer Science Information Systems	185	21.29%
4	Chemistry Analytical	132	15.19%
5	Instruments Instrumentation	103	
6	Physics Applied	63	7.25%
7	Chemistry Multidisciplinary	56	6.44%
8	Nano science Nanotechnology	51	5.87%
9	Materials Science Multidisciplinary	49	5.64%
10	Biotechnology Applied Microbiology	29	3.34%

The table reveals that research is concentrated in Engineering, Electrical and Electronic (32.11%),

Telecommunications (23.02%), and Computer Science and Information Systems (21.29%), indicating a considerable emphasis on technologically oriented subjects. Other areas, such as Chemistry, Physics, Nanoscience, and Materials Science, make moderate contributions, while Biotechnology makes a lower contribution, reflecting an interdisciplinary but technology-focused research trend.

Table 8: Funding Agencies

S.No	Funding Agencies	Records	Percentage
1	National Natural Science Foundation Of China Nsfc	157	18.07%
2	National Science Foundation Nsf	31	3.57%
3	European Union Eu	30	3.45%
4	Spanish Government	28	3.22%
5	National Research Foundation Of Korea	27	3.11%
6	United States Department Of Health Human Services	26	2.99%
7	National Institutes Of Health Nih Usa	25	2.88%
8	Fundamental Research Funds For The Central Universities	24	2.76%
9	National Key Research Development Program Of China	17	1.96%
10	Ministry Of Education, Culture, Sports, Science, And Technology, Japan Mext	13	1.50%

According to the data, the National Natural Science Foundation of China (NSFC) is the dominating funding organization, supporting the most articles (157; 18.07%). Other major contributors are the National Science Foundation (NSF, USA) (31; 3.57%), the European Union (EU) (30; 3.45%), and the Spanish government (28; 3.22%). In contrast, the Ministry of Education, Culture, Sports, Science, and Technology of Japan (MEXT) supplied the smallest amount of funds (13; 1.50%). Overall, the trend demonstrates China's dominant role in research financing, with major contributions from the United States, Europe, and Korea, as well as lesser but significant support from other international organizations. Overall, the trend demonstrates China's dominant role in research financing, followed by significant contributions from the United States, Europe, and Korea, with minor but significant support from other international organizations.

Table 9: Journal Wise Distribution

S.No	Publications	Records	Percentage
1	Sensors	66	7.60%
2	Ieee Access	38	4.37%
3	Electronics	19	2.19%
4	Wireless Personal Communications	17	1.96%
5	Ieee Internet of Things Journal	16	1.84%
6	Applied Sciences Basel	14	1.61%
7	Biosensors Bioelectronics	14	1.61%
8	Ieee Transactions on Vehicular Technology	10	1.15%
9	Transportation Research Record	10	1.15%
10	Analytical Chemistry	9	1.04%

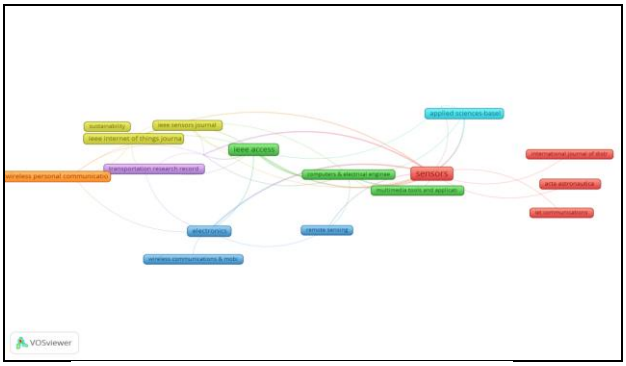


Figure 6: *Publication Wise Distributions*

According to the data, Sensors published the most records (66; 7.60%), making it the leading source of research in this field. Analytical Chemistry, on the other hand, contributed the least (9; 1.04%), trailing only Transportation Research Record and IEEE Transactions on Vehicular Technology (10 each; 1.15%). Overall, the trend implies a concentration of publications in sensor-related and open-access journals, with minor but significant contributions in the transportation and analytical fields.

Findings and Conclusion

The analysis suggests that research output is predominantly concentrated in Engineering, Electrical, Electronic (32.11%), followed by Telecommunications (23.02%) and Computer Science, Information Systems (21.29%), underscoring the dominance of technology-driven disciplines. Year-by-year distribution shows consistent growth, with the highest number of publications in 2024 (14.27%) and the lowest in 2015 (4.60%), suggesting an increasing trend in academic contributions in recent years. Articles (89.53%) account for the vast majority of document categories, whereas data papers, letters, and retracted publications (0.12% each) are the least common. Publications are virtually entirely in English (99.54%), reinforcing their prominence as the global medium of academic communication. The most prolific authors are Al-deek H, Chen C, Kim S, and Li L, each with five articles. The Chinese Academy of Sciences (4.03%) is the leading contributor, with Hunan University and King Saud University each accounting for 0.69%. China (28.31%) dominates global research output, followed by the United States (17.72%) and South Korea (9.67%). Australia and Taiwan, on the other hand, provide the smallest contributions of the top 10 countries (3.45% apiece).

According to funding analysis, the National Natural Science Foundation of China (18.07%) is the largest sponsor, while Japan's MEXT (1.50%) offers the least support in this dataset. The most popular journals are Sensors (7.60%), IEEE Access (4.37%), and Electronics (2.19%), with Analytical Chemistry (1.04%) having the smallest percentage. The majority of the findings show that Chinese institutions, researchers, and funding agencies have a significant impact on the research landscape, with a focus on engineering, computer science, and telecommunications, aided by international collaboration and interdisciplinary applications.

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