Mapping the Literature on the Application of Image Processing in the Medical Field: A Scientometric Analysis

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Abstract

The application of image processing in the Medical field has witnessed remarkable growth and innovation. This scientometric analysis delves into the vast body of literature that explores this intersection, aiming to map the landscape of research and development in this crucial domain.

Our research uses scientometric approaches to analyze and synthesize a large corpus of scientific publications, including journal articles, conference papers, and patents. We investigate major trends, notable study topics, influential authors, and the growth of knowledge networks. The study was designed using a scientometric approach, with data extracted from a renowned database, Web of Sciences, from 2004 to 2023. A total of 1723 journals and conference proceedings from Web of Science database were analyzed. Trends within the field are identified, as are the dominant sub-fields and their interconnections, as well as citation patterns, key publications, key research institutions, key researchers, and key journals, along with the extent to which these interact with each other in research networks. The stages are as follows: (1) identification, keyword selection, and formation of the search strategy with the permission of a panel of computer scientists and librarians; and (2) design and construction of a flawless algorithm to validate these selected keywords in Web of Science title-abstract-keywords. (3) Processing data in certain cutting-edge bibliometric visualization tools, Biblioshiny R and VOSviewer (4) analyzing the findings for practical consequences.

This study's findings shed light on the critical significance of image processing in Medical research and clinical practice. Our study contributes to a greater understanding of the contributions and difficulties within this dynamic junction of technology and healthcare by recognizing emerging subfields, significant research, and the interplay between many disciplines. This scientometric investigation provides insights that can help researchers, policymakers, and industry experts navigate the changing landscape of Medical image processing, ultimately leading to breakthroughs that benefit both healthcare practitioners and patients.

Keywords: *image processing, scientometric, Medical research, clinical practice, Covid-19*

Introduction

Image processing has made a significant contribution to Medical diagnostics and the development of new drugs. Image processing, according to experts, will have a significant influence by giving radiologists with tools for making faster and more accurate diagnosis and prognoses, which will lead to more successful therapy. Because computers will be able to process massive volumes of patient data, big data and image processing will revolutionise the way radiologists work, allowing them to become specialists on extremely particular jobs. Artificial intelligence has already been successful in solving problems such as chronic diseases and skin cancer. Scientists currently expect artificial intelligence to play an important role in the hunt for a cure for the new corona virus, and thus in reducing the panic that has gripped the world.

Due to the Medical epidemic, the health-care system has recently faced significant hurdles in terms of supporting an ever-increasing number of patients and accompanying expenses [5][6]. As a result, the recent impact of MEDICAL necessitates a mental shift in the health-care sector. As a result, utilising modern technology such as artificial intelligence in order to build and develop intelligent and autonomous health-care solutions has become critical. When compared to other viruses, Medical is notable for its rapid transmission, which allowed it to become a worldwide pandemic in record time. The Medical and health-care systems are still researching and analysing it in order to gather more trustworthy information and gain a better understanding of this critical problem of rapid spread. As a result, accurately simulating the Medical transmission remains a top priority in the fight against this virus [7]. The detection of viral RNA from sputum or a nasopharyngeal swab using real-time reverse transcription–polymerase chain reaction (RTPCR) is currently the most widely utilised diagnosing approach. These tests, on the other hand, require human interaction, have a low positive rate at early stages of infection, and can take up to 6 hours to produce findings. Thus, fast and early diagnosis tools are needed to speed up the control of this pandemic, especially in the long run, when lockdowns are entirely lifted, testing should be conducted on a broad scale to avoid the pandemic from resuming.

Due to a lack of resources and technology in some nations, testing has been confined to patients who have symptoms, and in many cases, several symptoms. The enormous burden that the situation has placed on national health-care systems and personnel, even in the most developed countries, exacerbates the difficulty of recognising and tracking potential cases [8].

Through this research work, the detailed analysis of the papers published on the Detection of Medicalusing Image Processing techniques, which country contributing more on this content, co-occurrences of the keywords, citation, co-authorship, co-citation network analysis done on the detection of Medical using Image Processing techniques.

Several studies have been conducted to detect the Coronavirus (Covid-19) using Chest X-Ray, CT scan by various image processing and deep learning techniques. Narin, Ali, Ceren Kaya, and Ziynet Pamuk [9] For the detection of coronavirus pneumonia-infected patients using chest X-ray radiographs, five pre-trained Convolutional Neural Network-based (CNN) models (ResNet50, ResNet101, ResNet152, InceptionV3 and Inception-ResNetV2) have been proposed. Karthik, R., R. Menaka, and M. Hariharan [10] For diagnosing infections, an unique CNN architecture may mine data patterns that catch small differences between infected and normal X-rays. Covid-19. Hasoon, Jamal N., et al [11] developed an image processing approach for MEDICALclassification and early detection utilising X-ray images. Ahuja, Sakshi, et al [12] Transfer learning from CT scan pictures reduced to three levels using stationary wavelet was used to detect the Covid-19. Ismael, Aras M., and Abdulkadir Şengür [13] Chest X-Ray images were utilised to evaluate several multiresolution methods in the detection of Covid-19. Gozes, Ophir, et al [14] built a poorly supervised deep learning framework for detecting, localising, and quantifying MEDICAL disease severity from chest CT scans. Horry, Michael J., et al [15] demonstrated how images from three of the most regularly used Medical imaging types, X-Ray, Ultrasound, and CT scan, can be used to conduct MEDICAL detection utilising transfer learning from deep learning models. Gupta, Anunay, Shreyansh Gupta, and Rahul Katarya [16] suggested a model for detecting MEDICALand pneumonia in infected people's chest X-ray pictures by identifying anomalies induced by these diseases. Rahimzadeh, Mohammad, Abolfazl Attar, and Seyed Mohammad Sakhaei [17] suggested a fully automated method for detecting MEDICALfrom a patient's chest CT scan images that is high-speed and accurate. Goel, Tripti, et al [18] The goal was to use chest X-ray images to classify COVID-19, normal, and pneumonia patients. As a result, an Optimized Convolutional Neural Network (OptCoNet) for the automatic diagnosis of MEDICALis proposed in this paper. Das, N. Narayan, et al [19] Using the extreme version of the Inception (Xception) model, researchers created an automated deep transfer learning-based technique for detecting MEDICALinfection in chest X-rays. Kassania, Sara Hosseinzadeh, et al [20] For automatic MEDICALclassification, we analysed various deep learning-based feature extraction frameworks. Karar, Mohamed Esmail, Ezz El-Din Hemdan, and Marwa A. Shouman [21] To improve the performance of these Computer Aided Diagnosis (CAD) systems for strongly suspected MEDICAL and pneumonia disorders in X-ray pictures, researchers suggested a new framework of cascaded deep learning classifiers.

Materials and Methods

The data collected from Web of Science Core collection. The keywords image processing AND Medical AND Coronavirus AND chest CT scans AND X-Ray AND lung images AND deep learning AND feature extraction AND machine learning AND artificial intelligence AND classification are used to extract the data. The methods like Citation anlaysis on countries, Co-Citation on cited sources, co-occurrences of keywords and co-authorship analysis on countries are analyzed in this research work.

Result and Discussion

Citation Analysis based on Countries

In this study, 79 countries involved for contributing articles towards the detection of Medicalusing Image processing techniques. From the 79 countries, only 34 countries are selected with the threshold like minimum number of documents of country is set as 5. Table1 depicts the Citation Analysis based on the Countries only top 20 countries have given. Figure 1 gives the graphical representation of the Citation Network visualization on Medical detection using image processing techniques. From the table 1 and figure 1, it is shown that only 3 countries like USA (108 articles), India (77 articles) and Peoples R China (100 Articles) have published more than 50 articles and USA scored more citation count of 500 than India and Peoples R China. India has more Total link strength of 188, than USA and Peoples R China.

Table 1: Citation Analysis based on Countries

Country	Documents	Citations	Total link Strength
India	77	268	188
Saudi Arabia	50	175	98
Turkey	37	137	92
USA	108	500	85
Egypt	26	101	79
South Korea	34	171	60
Italy	23	143	57
Peoples R China	100	219	54
Canada	33	116	46
England	36	163	39
Australia	25	185	37
Germany	25	118	35
Iran	23	142	35
Brazil	15	90	34

Vietnam	5	34	33
Portugal	5	41	30
Switzerland	11	74	27
Pakistan	19	66	21
Spain	26	128	21
Denmark	6	39	17

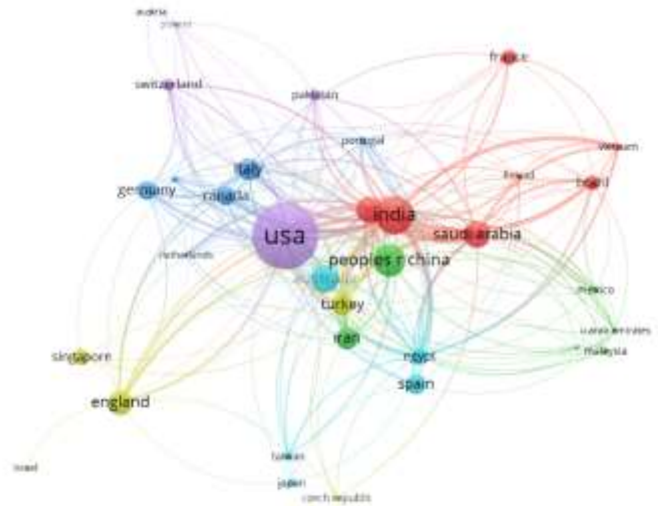

Figure 1: Citation Network Visualization based on Countries

Co-Citation Analysis based on Cited Sources

In this study, Co-Citation based on Cited sources are considered. Table 3 gives the minimum of number of citations of a source, total number of sources and number of sources selected. In this paper, the minimum number of citations of a source is set as 20, and 182 sources are considered for the analysis.

Table 3: Setting a threshold for selecting the number of sources based on minimum number of citations of a source

Total Number of Sources	Minimum of Citations of a source	Number of Sources selected
7745	5	832
	10	390
	15	240

	20	**182**
	25	137
	30	105
	40	73

Table 4 represents the top 20 sources selected based on total link strength. Figure 2 gives the Co-Citation Network Visualization based on Cited Sources. From the table 4 and figure 2, Arxiv preprint arxiv source has link strength of 16511, where the citation count is 427, but radiology has highest citation of 542, but less link strength than Arxiv preprint arxiv. Only 2 sources link strength are above 15000, whereas IEEE access has citation of 334 and link strength of 11908.

Table 4: Representation of the top 20 sources based on Total link strength

Source	Citation	Total Link Strength
Arxiv preprint arxiv	427	16511
Radiology	542	16503
Ieee Access	334	11908
Proc cvprieee	407	9932
Chaos soliton fract	134	9293
Ieee t med imaging	242	8896
Compute biol med	232	8371
Sci rep-uk	229	7602
New engl j med	237	7388
Eur radiol	194	6910
Plos one	185	6523
Lancet	215	6506
Nature	177	6027
Comput meth prog bio	123	5304
Appl intel	132	5019
Jama j-am med assoc	138	4829
Science	127	4763
Cell	111	4667
Lec notes computsc	187	4562

Nat communication	81	3562

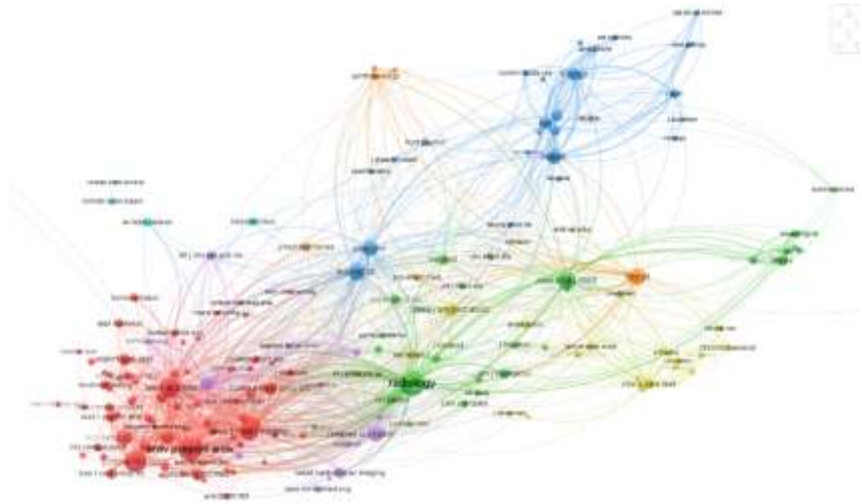

Figure 2: Co-Citation Network Visualization based on Cited Sources

Co-Occurrencesof Keywords

In this study, Co-occurrences of keywords on all keywords used in the publication are considered. Table 5 depicts the total number of keywords, minimum number of occurrences of a keyword, and number of keywords obtained with the minimum of number of occurrences. From the table 5, 84 keywords are selected by setting the threshold as minimum number of occurrences of a keyword as 5.

Table 5: Threshold table for selecting the number of keywords based on minimum number of occurrences of a keyword

Total Number of Keywords	Minimum number of occurrences of a Keyword	Number of Keywords selected
2156	**5**	**83**
	6	60
	7	50
	8	40
	9	34
	10	29
	11	27

	12	24
	13	23
	14	21
	15	20

Table 6 gives the Co-Occurrences of a top 20 keyword and total link strengths is represented. Figure 3 depicts the co-occurrence of keyword network visualization. From the table 6 and figure 3, Medicalkeyword has 248 occurrences with total link strength of 673, Deep Learning has 105 occurrences with total link strength of 364. Other keywords are occurred below 100 only. Only those keywords are co-occurred many times in the publication.

Table 6: Co-Occurrence of a Keyword

Keyword	Occurrences	Total Link Strength
Covid-19	248	673
Deep learning	105	364
Classification	57	224
Coronavirus	47	162
Machine learning	34	161
Pneumonia	36	157
Sars-cov-2	52	147
Artificial intelligence	30	132
Diagnosis	26	117
Feature extraction	22	111
Transfer learning	24	96
Convolutional neural network	24	89
Computed tomography	18	88
Segmentation	24	81
Ct	19	79
X-ray	17	77
Cnn	20	70
Image processing	22	70
Chest x-ray	12	66

Model	16	57

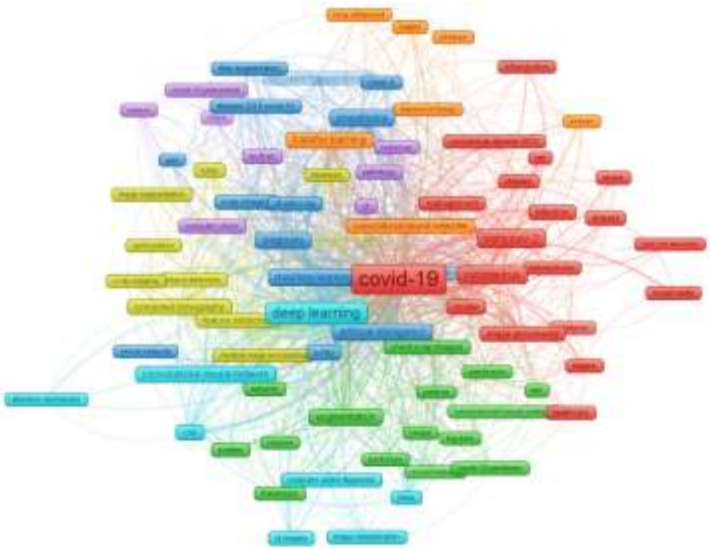

Figure 3:Co-Occurrences of a Keywork Network Visualization

Co-Authorship Network Analysis based on Countries

In this study, Co-authorship based on countries is considered. Table 7 depicts the threshold table for getting the number of countries to be selected based on the minimum number of documents of a country and minimum number of citations of a country on the total number of countries. From the table 7, when the minimum number of documents of a country and minimum number of citations of a country is 5, the number of countries met the threshold is 34 out of 79 countries.

Table 7: Threshold table to select number of countries for co-authorship analysis based on countries

Total Number of Countries	Threshold Parameters		Number of Countries met the Threshold
	Minimum number of documents of a country	Minimum number of citations of a country	
79	5	0	34
	5	5	34
	6	5	30

	6	6	30
	7	6	25
	7	7	25
	8	7	23
	8	8	22
	9	8	21
	9	9	21
	10	9	20
	10	10	20

Table 8 gives the Co-Authorship based on countries which contains number of documents by the countries, citations and total link strength. Figure 4 depicts the co-authorship network visualization based on countries. From the table 8 and figure 4, the authors/researchers from countries like USA, People R China and India are jointly authored for many publications on Medical detection using image processing, deep learning techniques since those countries have more than 100 total link strength. USA have co-authorship total link strength of 158, Peoples R china have co-authorship link strength of 107, where as India has link strength of 104. Other countries like Saudi Arabia, Canada, Germany, Australia, England, South Korea, Italy have co-authorship link strength are from above 50 to 100.

Table 8: Co-Authorship of Top 20 countries

Country	Documents	Citations	Total link Strength
USA	108	500	158
Peoples R China	100	219	107
India	77	268	104
Saudi Arabia	50	175	93
Canada	33	116	80
Germany	25	118	71
Australia	25	185	70

England	36	163	70
South Korea	34	171	65
Italy	23	143	61
Pakistan	19	66	50
Switzerland	11	74	46
Egypt	26	101	45
France	13	95	45
Spain	26	128	42
Brazil	15	90	40
Japan	10	42	38
Singapore	9	100	38
Denmark	6	39	35
Iran	23	142	34

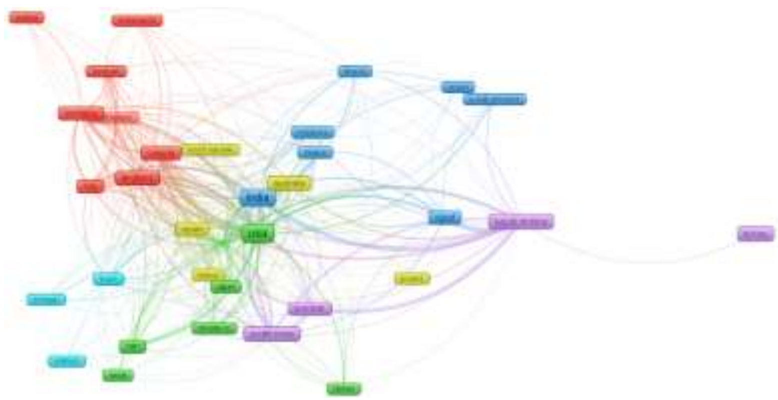

Figure 4: Co-Authorship Network Visualization based on Countries

Conclusion & Recommendations

Through this article we have made an attempt to limit the impact of the MEDICAL epidemic since it began. Around the world, the search for effective therapies, vaccinations, and societal management methods has escalated. Image Processing technologies have surely played a significant impact, providing academics with fresh insights and techniques.

The United States, China, and India, as mentioned in this article, have the highest output in this regard. It's worth noting that practically all of the top ten countries with the highest scientific output on the topic of COVID-19/image processing have a lot of fund, demonstrating the importance of funding and economic support for research. On the other hand, we have demonstrated that, in an increasingly globalised society, there is a high level of cross-national collaboration. There was a lot of cooperation between surrounding and geographically close countries, in addition to collaborations between the US and China. This suggests that the ease of physical transportation and cultural similarities between countries on the same continent may lead to increased collaboration. The MEDICAL pandemic has expanded the use of teleworking, but it's unclear whether distant cooperation will change this view in the next years. The use of Web of Science, help us in comparing the results. Despite the fact that the samples were of varying sizes, equivalent classifications were identified. This suggests that the WoS sample, despite being smaller, is still representative of MEDICAL research in image processing technologies. This report outlined the research that was carried out over the course of several years. In respect to the use of image processing systems, a period of around a year and a half MEDICALpandemic data was analysed. We plan to do so in the future in order to expand our understanding of this fascinating issue, we will continue our research using bibliographic analysis a better understanding of researcher interactions, the progression of scientific knowledge manufacturing, as well as current research trends.

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