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Unveiling Trends in Deepfake Research: A Global Bibliometric Perspective

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ABSTRACT

Deepfake technology leverages artificial intelligence to generate highly realistic, yet manipulated, videos that can potentially mislead or misinform the public, thereby creating ethical and social challenges. This study aims to analyse the evolution, productivity, and collaborative networks in deepfake research from 2018 to 2023, investigating the contributions of various authors, institutions, and countries to understand key trends and interdisciplinary impacts in this growing field. Using bibliometric methods, the research data was collected from Scopus database and analysed 1,548 publications across 700 sources. Tools such as RStudio and VOSviewer were employed to assess research performance and visualise co-authorship and citation networks. The analysis identifies computer science, engineering, and mathematics as leading fields, with China and the United States as primary contributors. Collaborative dynamics reveal substantial partnerships among these nations and with other active contributors like India and Singapore. Major research clusters were observed around influential journals, such as Lecture Notes in Computer Science. The study also provides an in-depth examination of citation patterns, revealing a high concentration of citations in specific journals and among leading authors. Furthermore, co-authorship networks illustrate the growing international collaborations in the field, with increasing interdisciplinary cooperation. The growth rate of deepfake research has surged, reflecting the rising importance of this topic in various domains. This study provides a comprehensive overview of the academic landscape of deepfake research, emphasising the thematic and collaborative structure. Through network visualisation and thematic analysis, the study underscores deepfake research's global and interdisciplinary nature, setting a foundation for future explorations.

Keywords: Deepfake; Bibliometric analysis; Research collaboration; Network visualisation; Multidisciplinary research; Citation impact

1. INTRODUCTION

Deepfake technology allows for AI-driven manipulation of digital media, altering faces, voices, and actions[1]. While its applications extend to entertainment and education, its misuse can lead to serious ethical issues, including misinformation and privacy violations. Since its emergence in 2018, deepfake research has rapidly expanded, addressing social, technical, and ethical implications[2]. Academic efforts primarily focus on developing detection methods to counteract malicious uses like identity theft, fraud, and fake news. Deepfake research has attracted significant global interest due to its multidisciplinary nature, spanning computer science, engineering, and social sciences. This study aims to map research trends from 2018 to 2023 using bibliometric methods to analyse productivity, collaboration networks, and influential contributors. Doing so provides insights into the academic trajectory of deepfake research and highlights areas requiring further study[3].

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2. LITERATURE REVIEW

Deepfake technology has evolved rapidly, raising concerns about misinformation, privacy, and media integrity. Previous research underscores the urgency of reliable detection tools to maintain media trust. Westerlund[4] reviewed deepfake technology's evolution and ethics, highlighting misinformation risks, privacy threats, and the need for detection methods to ensure trust. To combat deepfake threats, researchers created detection algorithms. For instance, Afchar[5], *et al.* introduced MesoNet, a compact network that effectively detects subtle facial manipulation anomalies in low-resource settings. Similarly, Chesney and Citron[6] emphasised reliable detection tools to preserve media integrity, warning of deepfakes' role in misinformation. Gil[7], *et al.* analysed algorithm advancements, highlighting deep learning's impact on detection accuracy and the need for continuous innovation to counter evolving techniques.

The ethical and privacy concerns surrounding deepfake technology have become critical areas of study**.** Studies like those by Mirsky & Lee[8] analysed the implications

of deepfakes on trust in media, stressing the need for policies and regulations to mitigate societal harm. Similarly, Domenteanu[9], *et al.* mapped ethical challenges, discussing the privacy risks associated with synthetic media and recommending interdisciplinary approaches to address these complex issues.

The development of large-scale datasets and tools has supported detection research. Li et al.[10] introduced Celeb-DF, a comprehensive dataset of manipulated videos to aid in forensic research, while Yang & Qiao[11] developed Shape Editor, a model enhancing face-swapping precision using StyleGAN. Additionally, Nirkin, Keller, and Hassner[12] contributed FSGAN, a subject-agnostic face-swapping tool allowing broader applications, which advances face manipulation research by supporting more flexible, realistic outputs.

Deepfake research overlaps with misinformation studies. Dhiman[13], *et al.* analysed deep learning in fake news detection, noting neural networks' effectiveness in identifying AI-manipulated content. Lim[14] highlighted deepfakes' role in the "infodemic," stressing their impact on consumer trust and the need for strategic countermeasures.

Bibliometric studies provide valuable insights into trends and collaboration in deepfake research. Kaushal[15], *et al.* analysed the development of deepfake technology, identifying patterns in creation and detection methods. By mapping research trends, the authors emphasised the evolving complexity of deepfake techniques and the continuous refinement of detection models. Bisht & Taneja[16] & Singh[17], *et al.* also contributed to bibliometric research, covering years of publications to identify core themes and technological advances that shape deepfake research. Raman[18], *et al.* explored the role of digital forensics in combating the malicious use of AI-manipulated media.

Despite significant progress, research gaps remain. Detection methods require real-world validation, and ethical, legal, and policy frameworks remain underdeveloped. Future scientometric studies should go beyond trend mapping to assess interdisciplinary networks, funding patterns, and societal impact. A more advanced scientometric approach can help evaluate research influence, identify collaboration gaps, and guide policy development.

3. OBJECTIVES FOR THE STUDY

The objectives of this study are as follows:

- To quantify the annual growth of deepfake research from 2018 to 2023 and identify the key factors driving the rising academic interest.
- To analyse the primary contributing disciplines-computer science, engineering, and social sciences-focusing on technical advancements and ethical challenges.
- To assess leading authors, institutions, and countries (e.g., China, the U.S., and India), emphasising collaboration patterns and international co-authorship.
- To identify top journals and conferences in deepfake research and to evaluate publication concentration using Bradford's Law.
- To examine keyword prevalence and the prominence of detection-focused studies, emphasising technical countermeasures against deepfake misuse.
- To investigate the societal impact of deepfake research within the social sciences, particularly its implications for ethics, misinformation and public trust.

4. METHODOLOGY, SCOPE & LIMITATION

The researchers collected bibliographic data on deepfake research from the Scopus database on April 12, 2024, using the keyword 'Deepfake' with the search query TITLE-ABS-KEY('Deepfake') and PUBYER > 2017 AND PUBYEAR < 2024. This search retrieved 1,548 publications spanning the years 2018 to 2023. The gathered data was analysed using a spreadsheet application to meet the study's objectives. For scientometric analysis and data visualisation, RStudio (BiblioShiny) and VOSviewer were employed to evaluate both address-based and citation-based performance metrics and citation networks Yildirim[19], *et al.* VOSviewer facilitated the creation of network-based visualisations, while RStudio provided advanced data analysis and visualisation tools. However, relying solely on Scopus may have excluded some relevant studies. Additionally, the five-year timeframe offers a limited perspective; a more extensive 10–20-year analysis could provide deeper insights into research trends and technological advancements. The bibliometric approach used in this study offers a systematic, data-driven analysis of deepfake research, identifying key contributors, collaboration networks, and emerging themes. Network visualisation and citation mapping highlight significant research trends, supporting future investigations. This methodology promotes interdisciplinary collaboration, guiding technological progress and policy development to address deepfake technology's ethical, informational, and security challenges.

5. ANALYSIS & INTERPRETATION

5.1 Publication Performance Analysis

Fig. 1, generated using the AI text-to-visual platform napkin.ai, summarises the performance of deepfake research from 2018 to 2023. The field has experienced remarkable growth, beginning with just 3 publications in 2018 and rising sharply to 543 in 2023. Significant increases in publication output were observed in 2020 (144) and 2021 (326), followed by continued steep growth in 2022 (510) and 2023 (543). With a total of 1,548 publications across 700 sources, the research output reflects an impressive annual growth rate of 182.84 %. The average age of documents is relatively low, at 2.1 years, reflecting the recency and dynamism of this domain. These publications are well-cited, averaging 9.262 citations per document and referencing over 46,000 sources. Collaboration is a prominent feature, with 3,378 authors contributing to the field, of which only 101

are single-authored publications. The average number of co-authors per document is 3.71, and international co-authorships account for 18.86 % of collaborations. A variety of document types exist, with conference papers (838) and journal articles (528) leading the output. The citation distribution analysis indicates that highly cited papers are predominantly found in key venues such as IEEE and Lecture Notes in Computer Science. The top 10 % of papers contribute to nearly 50 % of the total citations, underscoring the strong influence of leading works in shaping the domain. This research encompasses a wide range of topics, as evidenced by the large number of keywords used in publications, with 4,899 Keywords Plus and 2,658 Author's Keywords.

5.2 Publication of Research Areas

Deepfake research spans multiple disciplines, with a strong emphasis on Computer Science, which leads with 1,306 publications, as shown in Table 1. Engineering follows with 567 papers, while Mathematics contributes 272 studies, underscoring deepfake technology's technical and algorithmic aspects. Social Sciences and Decision Sciences also show notable engagement with 189 and 176 papers, respectively, reflecting interest in deepfakes' societal and decision-making impacts. Other significant fields include Physics and Astronomy (143), Medicine (89), and Arts and Humanities (77). Less explored areas such as Neuroscience, Economics, and Environmental Science exhibit modest contributions.

5.3 Most Productive Journals

Table 2 shows the most productive journals in deepfake research. The analysis of top journals in deepfake research shows that Lecture Notes in Computer Science, including its subseries, leads with 70 publications. ACM International Conference Proceedings follows with 49, highlighting the importance of conferences. Other key journals include Lecture Notes in Networks and Systems (26), IEEE Access (25), and Multimedia Tools and Applications (22). Notable venues like ICASSP Proceedings (21) and IEEE Transactions on Information Forensics and Security (14) emphasise signal processing, multimedia, and cybersecurity in deepfake research.

Bradford's Law analysis in Fig. 2 of deepfake research journals reveals that most publications are concentrated in a few key sources Vickery[20]. Zone 1, the most productive, is led by Lecture Notes in Computer Science (70 publications), followed by ACM International Conference Proceeding Series (49) and Lecture Notes in Networks and Systems (26). Other core journals include IEEE Access and Multimedia Tools and Applications, highlighting their crucial role in disseminating deepfake research.

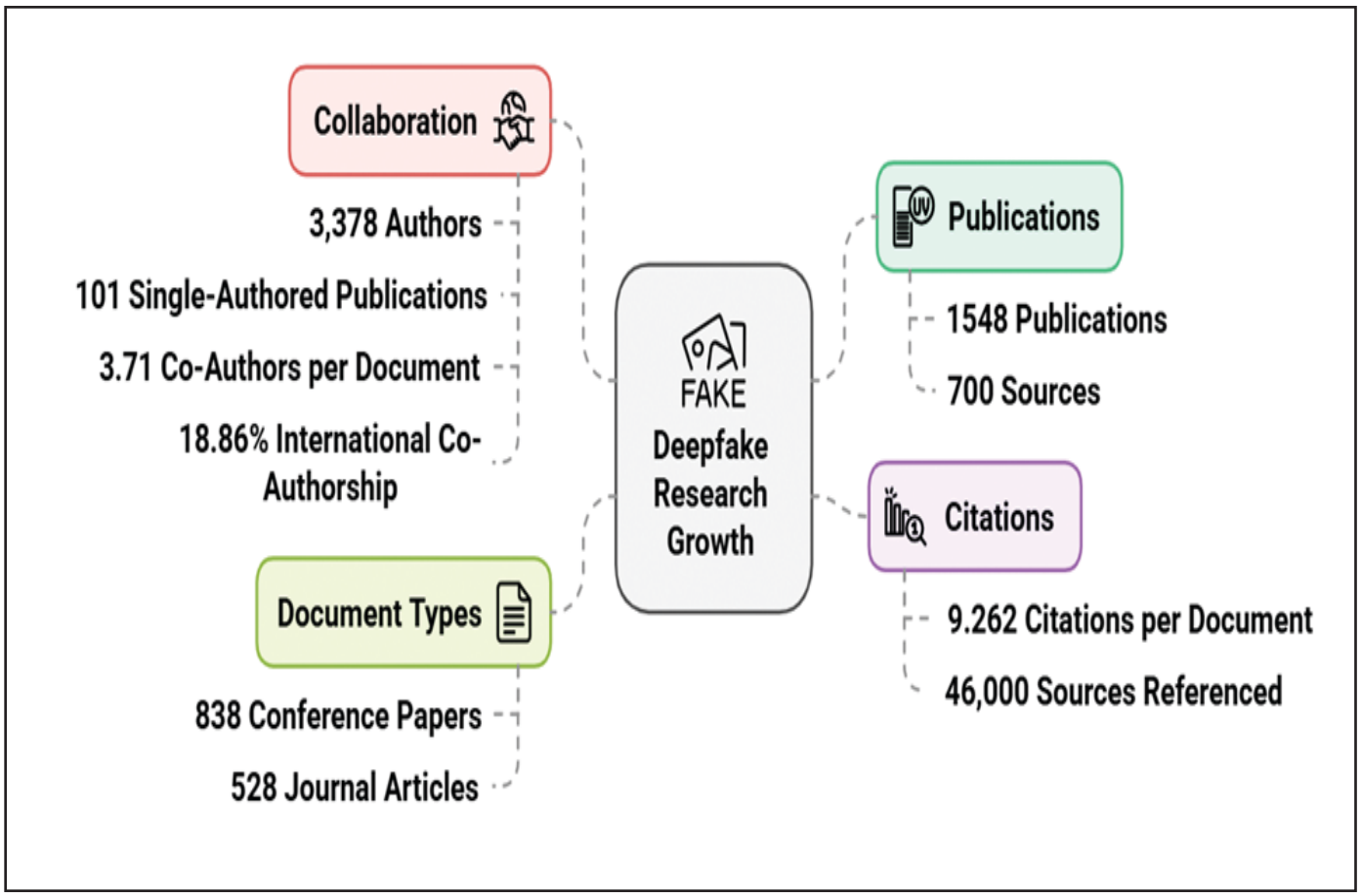

Figure 1. Publication performance analysis

Table 1. Publication subject areas

S. No.	Subject area	No. of publication
1	Computer Science	1306
2	Engineering	567
3	Mathematics	272
4	Social Sciences	189
5	Decision Sciences	176
6	Physics and Astronomy	143
7	Medicine	89
8	Arts and Humanities	77
9	Materials science	70
10	Business, management and accounting	41
11	Energy	39
12	Psychology	32
13	Chemistry	18
14	Chemical engineering	16
15	Biochemistry, genetics and molecular biology	15
16	Multidisciplinary	15
17	Neuroscience	14
18	Economics, econometrics and finance	12
19	Environmental science	10
20	Agricultural and biological sciences	5

Table 2. Most productive journals

S. No.	Journal title	No. of publication
1	Lecture notes in computer science including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics	70
2	ACM international conference proceeding series	49
3	Lecture notes in networks and systems	26
4	IEEE access	25
5	Multimedia tools and applications	22
6	ICASSP IEEE International conference on acoustics speech and signal processing proceedings	21
7	Proceedings of the annual conference of the international speech communication association interspeech	21
8	Ceur workshop proceedings	20
9	Communications in computer and information science	20
10	Ieee transactions on circuits and systems for video technology	17
11	Proceedings of spie the international society for optical engineering	17
12	Ieee computer society conference on computer vision and pattern recognition workshops	16
13	Proceedings of the ieee computer society conference on computer vision and pattern recognition	15
14	Ieee transactions on information forensics and security	14
15	Proceedings ieee international conference on multimedia and expo	14
16	Proceedings international conference on image processing icip	14
17	Applied sciences switzerland	12
18	Ddam 2022 proceedings of the 1st international workshop on deepfake detection for audio multimedia	9
19	Journal of image and graphics	9
20	Journal of imaging	9

5.4 Performance of Institutions

The analysis of institutional performance in deepfake research, as shown in Table 3, reveals that the Chinese Academy of Sciences leads with 56 publications, highlighting its dominant role in the field. The University of Chinese Academy of Sciences follows with 43 publications, further emphasising China's significant contribution. Other key institutions include the Institute of Information Engineering (30) and the Ministry of Education of China (28). Outside China, Nanyang Technological University in Singapore has contributed 28 papers, with universities like Sun Yat-Sen University (26), Wuhan University (24), and Sungkyunkwan University (23) also actively engaged.

5.5 Performance of Countries

Table 4 presents a comprehensive analysis of global contributions to deepfake research, highlighting the top 20 publishing countries. China leads significantly with 385 publications, followed by the United States (258) and India (223), reflecting their dominant roles in AI and digital media research. European nations such as Italy, France, Germany, and the United Kingdom also show notable engagement, indicating a widespread concern over deepfake implications. Countries like Saudi Arabia, Japan, and South Korea demonstrate growing interest, with over 30 contributions each. Meanwhile, emerging economies including Pakistan, Malaysia, and Iraq are making strides, showcasing a global diffusion of research

Table 3. Performance of institutions

S. No.	Affiliation	No. of publication
1	Chinese academy of sciences	56
2	University of chinese academy of sciences	43
3	Institute of information engineering	30
4	Ministry of education of the people's republic of china	28
5	Nanyang technological university	28
6	Sun yat-sen university	26
7	University of science and technology of china	24
8	Wuhan university	24
9	Sungkyunkwan university	23
10	Institute of automation chinese academy of sciences	19

Table 4. Performance of countries

S. No.	Country name	No. of publication
1	China	385
2	United States	258
3	India	223
4	Italy	65
5	South Korea	61
6	Australia	59
7	United Kingdom	57
8	Pakistan	47
9	Singapore	47
10	Canada	38
11	France	38
12	Germany	36
13	Saudi Arabia	34
14	Japan	32
15	Russian Federation	30
16	Spain	30
17	Malaysia	28
18	Turkey	24
19	Taiwan	23
20	Iraq	21

Table 5. Authors' productivity

No. of articles	No. of authors	Frequency
1	2495	0.739
2	444	0.131
3	185	0.055
4	73	0.022
5	53	0.016
6	31	0.009
7	29	0.009
8	18	0.005
9	7	0.002
>=10	4	0.001

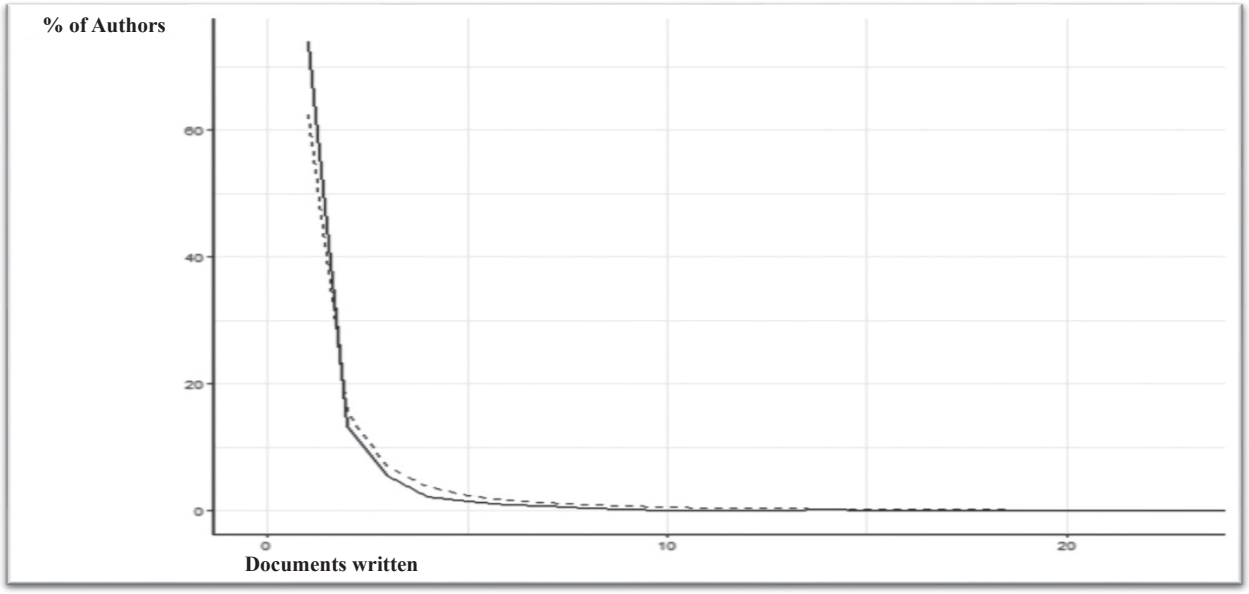

Figure 3. Analysis of author productivity according to lotka's law.

efforts. The diversity of contributors underscores the multidisciplinary and international relevance of deepfake studies. This widespread engagement is crucial for developing comprehensive countermeasures and ethical frameworks, ensuring that technological advancements are met with global awareness and collaboration. The table reflects both the intensity and geographic breadth of deepfake-related scholarly activities.

5.6 Performance of Authors

Lotka's Law analysis in Table 5 of deepfake research shows that most authors publish only once García-Villar & García-Santos[21]. Of 2,495 authors, 73.86 % contributed a single article, while 13.14 % published two. As publications increase, author numbers decline-5.48 % authored three papers, and only 1.57 % produced five. This pattern aligns with Lotka's Law, indicating that a small group of prolific researchers dominates output, while the majority contribute minimally, highlighting the field's reliance on a core of highly productive scholars, as shown in Fig. 3.

5.7 Co-authorship Network Analysis

5.7.1 Co-authorship Author Network Visualisation

The co-authorship network analysis in deepfake research, shown in Fig. 4(A), highlights influential authors based on total link strength and citation counts Newman[22]. Of the 4,038 authors, 108 met the criteria of at least five publications and a maximum of 25 co-authors per article. The largest connected group contains 27 authors. Siwei Lyu, a key figure, leads with 1,714 citations and a link strength 34. Yuezun Li (1,569 citations, 29 link strength) and Wenbo Zhou (294 citations, 34 link strength) also significantly contribute. Authors like Weiming Zhang and Nenghai Yu are highly collaborative, while others, including Sebastiano Battiato, demonstrate strong ties despite fewer citations. The co-authorship trends reveal that cross-border collaborations have increased, with a notable rise in joint publications between China, the United States, and India. The formation of collaborative research groups has significantly influenced the number of citations these works receive, indicating that partnerships enhance research impact.

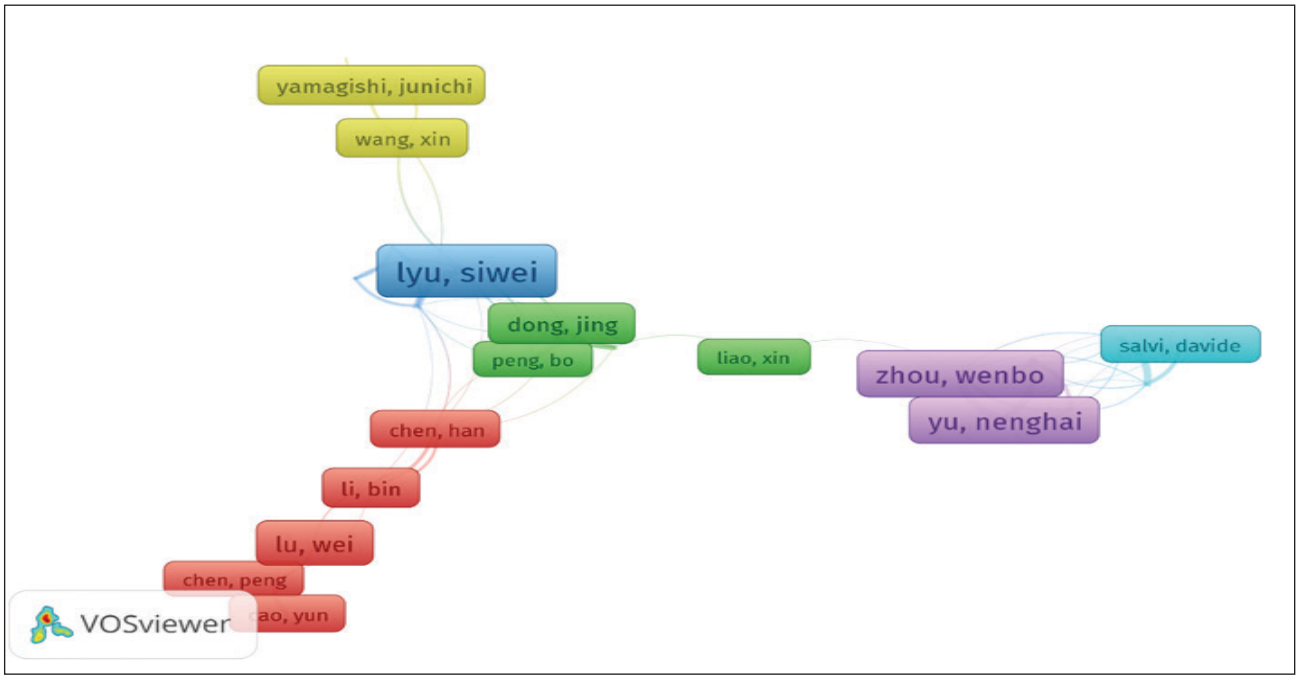

Figure 4(A). Co-authorship network visualisation.

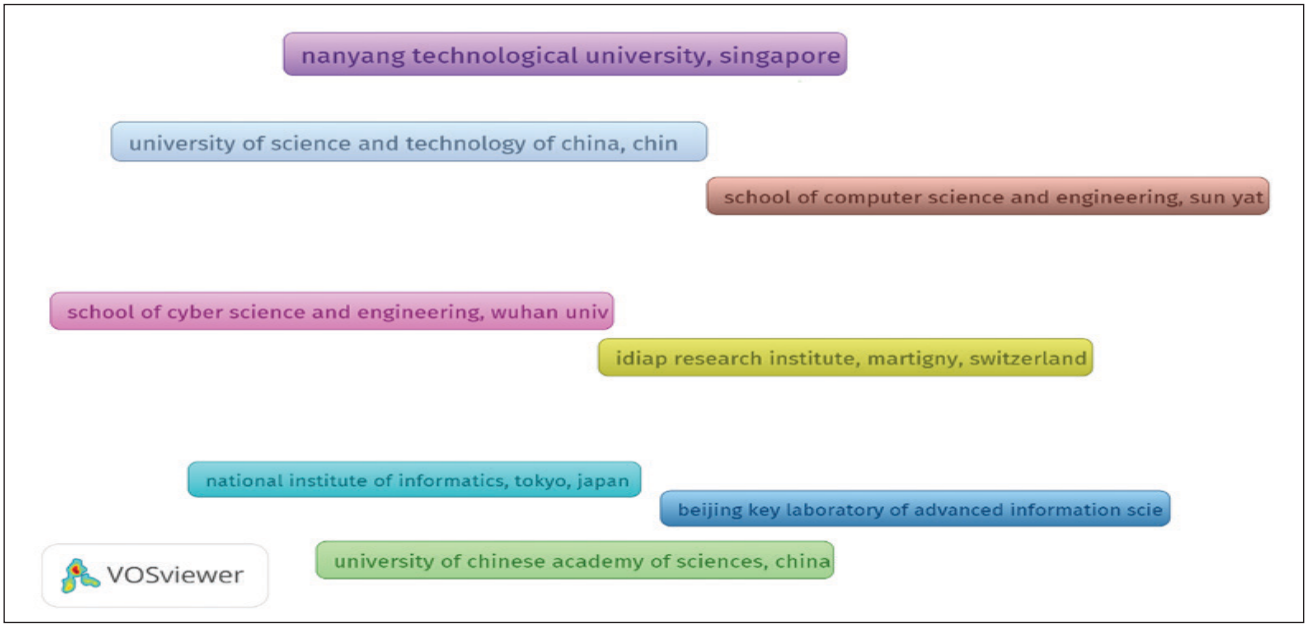

Figure 4(B). Co-authorship organisation visualisation.

5.7.2 Co-authorship Oganisation Visualisation

The co-authorship network analysis in deepfake research, presented in Fig. 4(B), identifies diverse collaboration patterns across 2,595 organisations, with 14 organisations meeting the criteria of at least five publications and up to 25 co-authors per paper. The analysis reveals that organisations with high link strengths, such as the Institute of Information Engineering and the School of Cyber Security, and the Chinese Academy of Sciences, show moderate collaboration. In contrast, institutions like the National Institute of Informatics and Nanyang Technological University exhibit high citations but limited co-authorship connections.

5.7.3 Co-authorship Countries Network Visualisation

The co-authorship country network for deepfake research, shown in Fig. 4(C), reveals global collaboration patterns among 130 countries, with 43 countries meeting the criteria of at least five publications and a maximum of 25 co-authors. The United States and China dominate with the highest citations (5,152 and 3,562) and link strengths (134 and 130), indicating strong international ties. India, Singapore, the UK, Japan, France, Italy, Canada, and Pakistan reflect emerging and established research hubs, showcasing varying levels of citation impact and collaboration strength. The study also finds that countries with strong institutional support, such as China and the

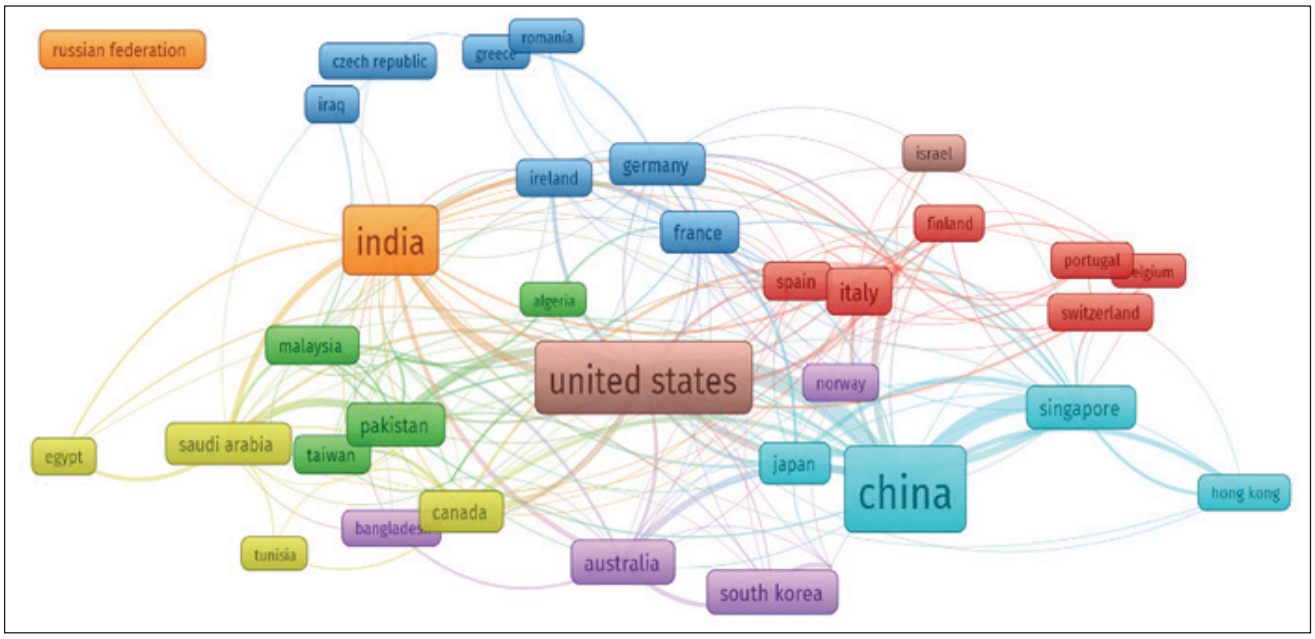

Figure 4(C). Co-authorship countries network visualisation

USA, tend to have more prolific research output and higher citation rates. Additionally, developing nations like India and Pakistan are increasingly contributing to deepfake research, highlighting the global expansion of the field.

5.8 Keyword Analysis and Keyword Occurrence Mapping

Keyword analysis in deepfake research, as shown in Table 6, strongly emphasises advanced technologies and detection methods. The terms "Deepfake" (564 occurrences) and "Deep Learning" (513) are most prominent, reflecting their centrality. Detection techniques are a key theme, with terms like "Fake Detection" (366) and "Deepfake Detection" (306) signalling significant research interest. Other key terms include "Face Recognition" (221), "Computer Vision" (212), "Generative Adversarial Networks" (152), and "Convolutional Neural Networks" (177), emphasising the role of machine learning in deepfake identification.

Table 6. Distribution of core keywords

S. No.	Keywords	No.
1	Deepfake	564
2	Deep Learning	513
3	Fake Detection	366
4	Deepfake Detection	306
5	Face Recognition	221
6	Computer Vision	212
7	Convolutional Neural Networks	177
8	Deepfakes	176
9	Digital Forensics	169
10	Detection Methods	154
11	Feature Extraction	153
12	Generative Adversarial Networks	152
13	Learning Systems	131
14	Artificial Intelligence	125
15	Convolutional Neural Network	122
16	Convolution	111
17	Deep Neural Networks	107
18	Video Detection	107
19	Performance	88
20	Social Media	82

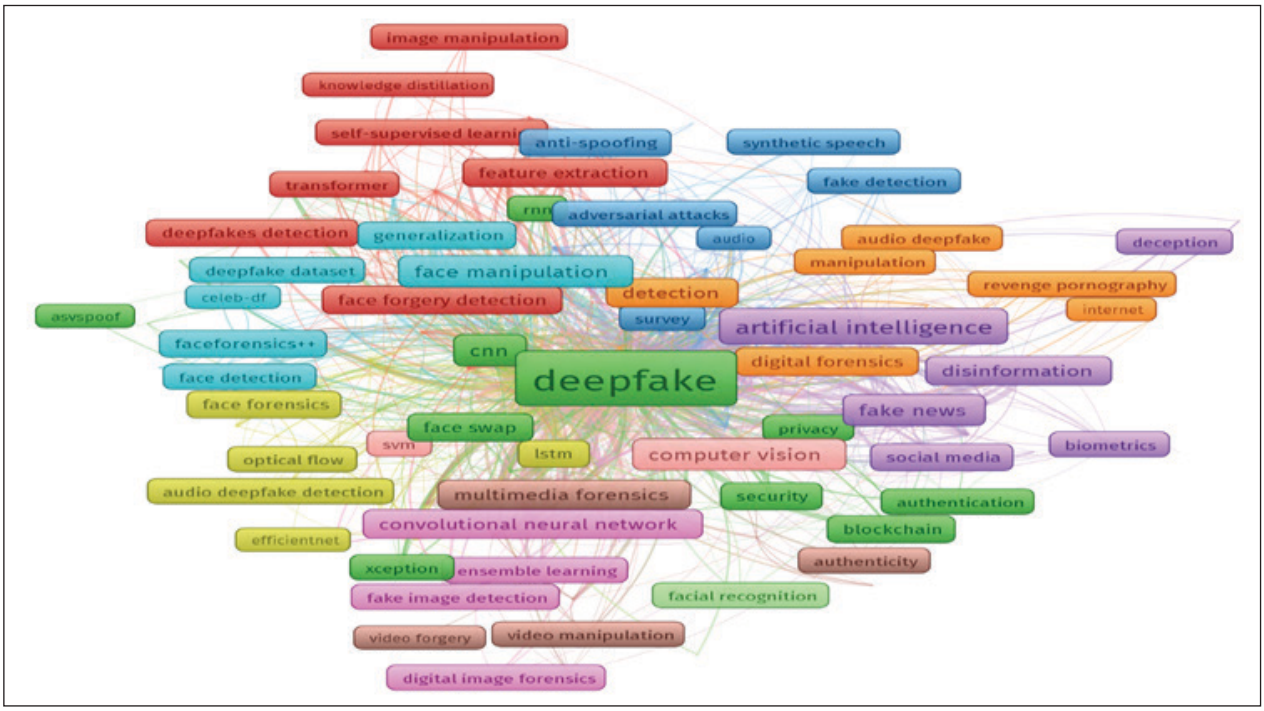

Figure 5(A). Author keywords network visualisation.

5.8.1 Author Keywords Network Visualisation

The authorkeyword network visualisation Sood, Kumar & Saini[23] in Fig. 5(A) reveals key thematic areas in deepfake research, based on keyword frequency and link strength. Out of 2,662 keywords, 157 met the threshold of at least five occurrences. "Deepfake" is the most prominent term, appearing 432 times with a link strength of 813, followed by "deep learning" (255 occurrences, 702 link strength) and "deepfake detection" (310 occurrences, 501 link strength). Additionally, AI-related terms and technical domains such as GANs and face manipulation emphasise the interdisciplinary nature of deepfake research.

5.8.2 Index Keywords Network Visualisation

The index keyword network visualisation in Fig. 5(B) reveals major themes in deepfake research by analysing keyword frequency and link strength. Among 4,901 keywords, 496 met the occurrence threshold. "Deep learning" is the most dominant term, appearing 442 times with a link strength of 3,825, followed by "deepfake" (415 occurrences, 3,422 link strength) and "fake detection" (366 occurrences, 3,356 link strength). Additionally, keywords such as "face recognition" (2,049) and "computer vision" (1,582) emphasise facial manipulation, while terms like "digital forensics" and "feature extraction" reflect authentication efforts.

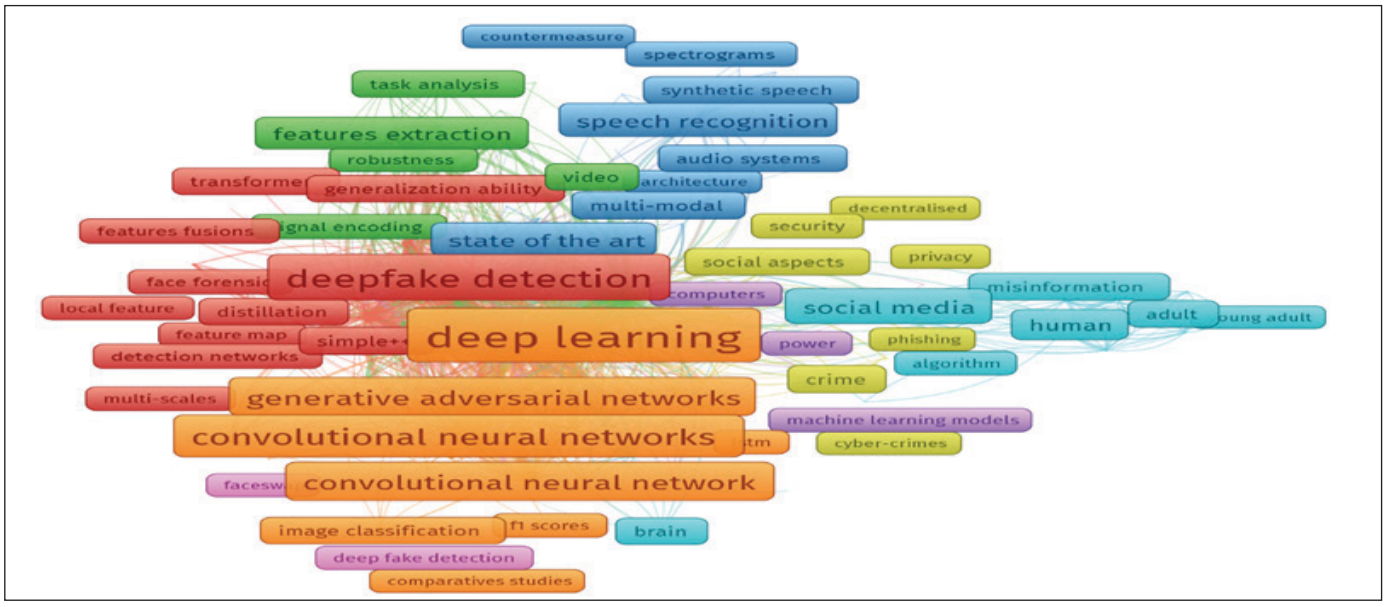

Figure 5(B). Index keywords network visualisation.

5.9 Highly Cited Publications and Co-Citation Analysis

The analysis of highly cited deepfake research, as presented in Table 7, highlights key contributions to detection techniques. Afchar *et al.*'s MesoNet (2018) leads with 749 citations, introducing a compact forgery detection network. Guera and Delp's (2018) RNN-based approach follows with 557 citations, focusing on sequential data analysis. Yang, *et al.* identified deepfakes through head pose inconsistencies, earning 554 citations. Other influential works, such as Celeb-DF by Li, *et al.* and Westerlund's (2019) review with 320 citations, showcase the diverse challenges in deepfake research. Co-citation analysis reveals that highly cited papers tend to cluster around specific research areas, particularly detection methodologies and forensic analysis. The citation patterns also indicate a growing shift toward ethical discussions, regulatory frameworks, and adversarial deepfake generation techniques.

5.9.1 Citation Documents Network Visualisation

The citation document network visualisation in Fig. 6(A) highlights significant connections in deepfake research based on citation counts and link strength. Among 1,548 documents, 452 with at least five citations were analysed, forming a core group of 196. Tolosana (2020) leads in influence (318 citations, link strength 155), while Westerlund (2019) has 320 citations but fewer connections (link strength 68). Li (2020e) has the most citations (516) but limited influence (link strength 36), highlighting diverse collaboration patterns.

5.9.2 Citation Sources Network Visualisation

Figure 6(B) presents a citation source network visualisation of deepfake research, highlighting key publications based on citation counts and link strength. Among 700 sources, 57 met the five-document threshold, forming a connected group of 45. The IEEE Computer

Table 7. Highly cited publications

S. No.	Authors	Title	Year	Source title	Cited by
1	Afchar D.; Nozick V.; Yamagishi J.; Echizen I.	MesoNet: A compact facial video forgery detection network	2018	10th IEEE International Workshop on Information Forensics and Security, WIFS 2018	749
2	Guera D.; Delp E.J.	Deepfake Video Detection Using Recurrent Neural Networks	2018	Proceedings of AVSS 2018 - 2018 15th IEEE International Conference on Advanced Video and Signal-Based Surveillance	557
3	Yang X.; Li Y.; Lyu S.	Exposing Deep Fakes Using Inconsistent Head Poses	2019	ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings	554
4	Li Y.; Yang X.; Sun P.; Qi H.; Lyu S.	Celeb-DF: A Large-Scale Challenging Dataset for DeepFake Forensics	2020	Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition	516
5	Li Y.; Chang M.-C.; Lyu S.	In Ictu Oculi: Exposing AI created fake videos by detecting eye blinking	2018	10th IEEE International Workshop on Information Forensics and Security, WIFS 2018	441
6	Li L.; Bao J.; Zhang T.; Yang H.; Chen D.; Wen F.; Guo B.	Face X-ray for more general face forgery detection	2020	Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition	397
7	Westerlund M.	The emergence of deepfake technology: A review	2019	Technology Innovation Management Review	320
8	Tolosana R.; Vera-Rodriguez R.; Fierrez J.; Morales A.; Ortega-Garcia J.	Deepfakes and beyond: A Survey of face manipulation and fake detection	2020	Information Fusion	318
9	Zhao H.; Zhou W.; Chen D.; Wei T.; Zhang W.; Yu N.	Multi-attentional Deepfake Detection	2021	Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition	258
10	Mirsky Y.; Lee W.	The Creation and Detection of Deepfakes	2021	ACM Computing Surveys	235

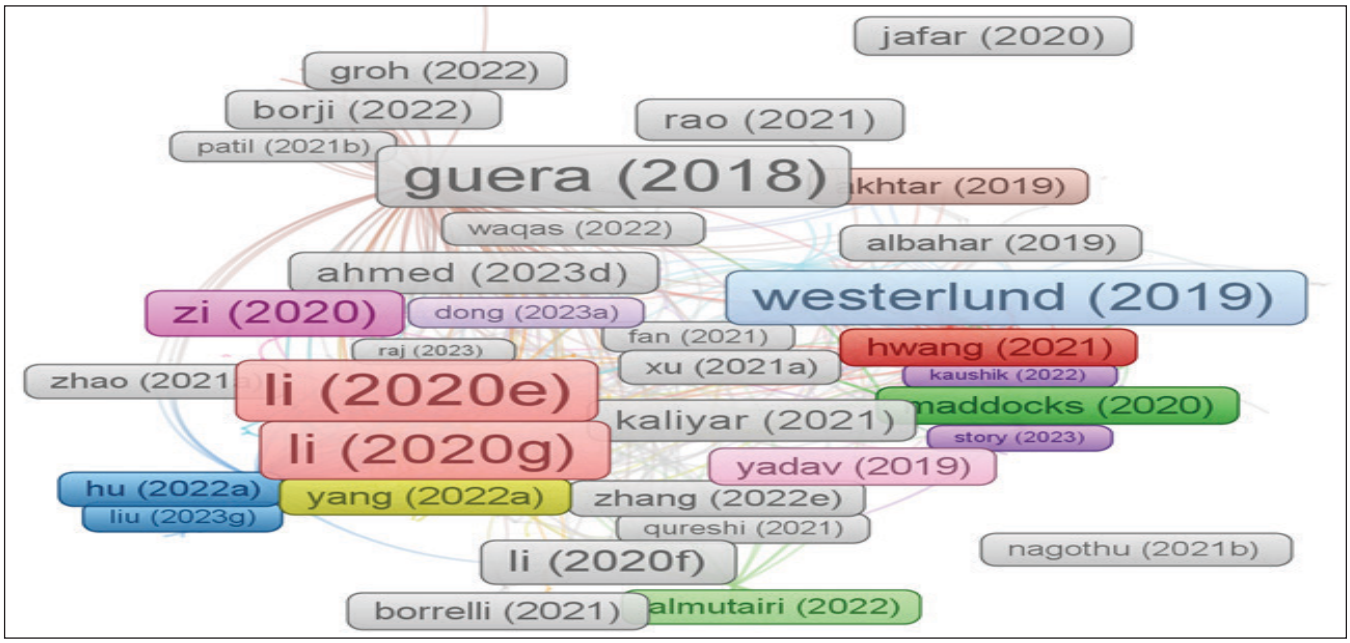

Figure 6(A). Citation document network visualisation.

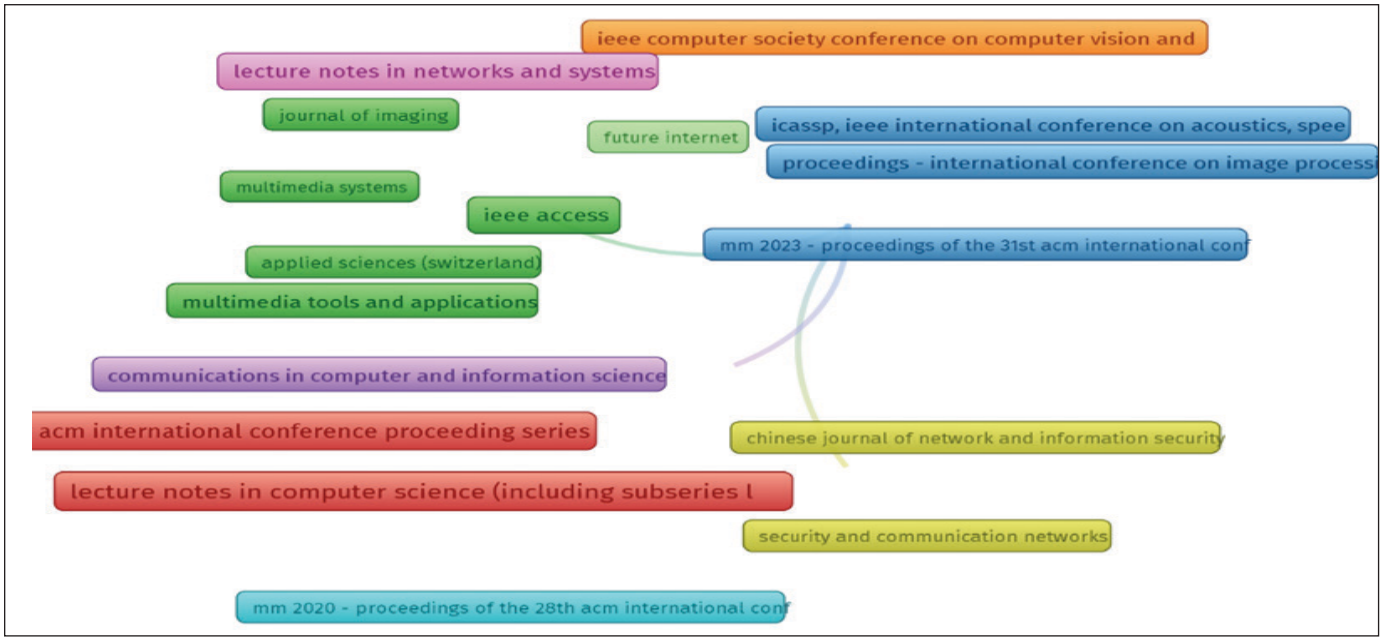

Figure 6(B). Citation sources network visualisation.

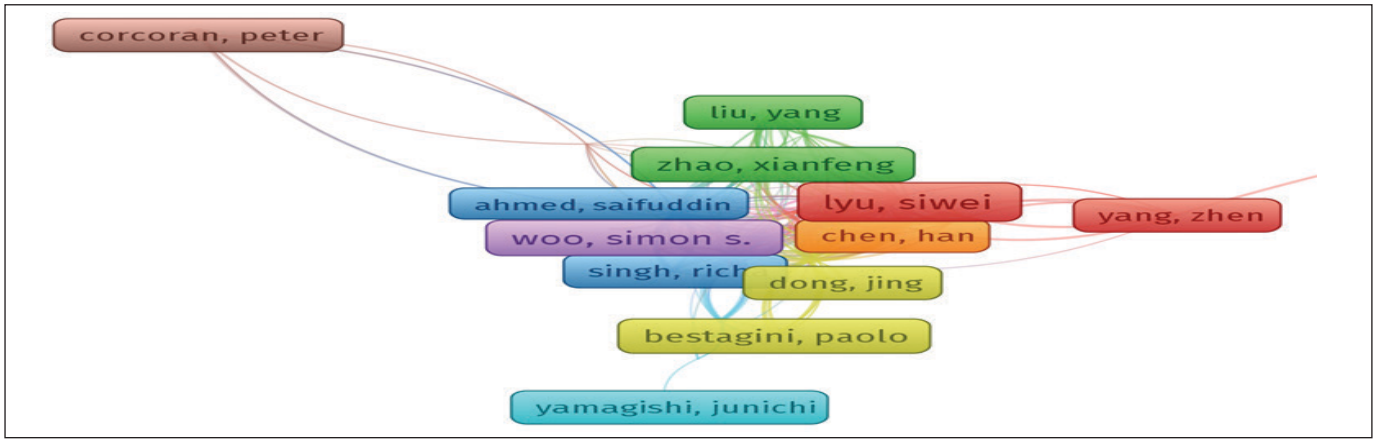

Figure 6(C). Citation author network visualisation.

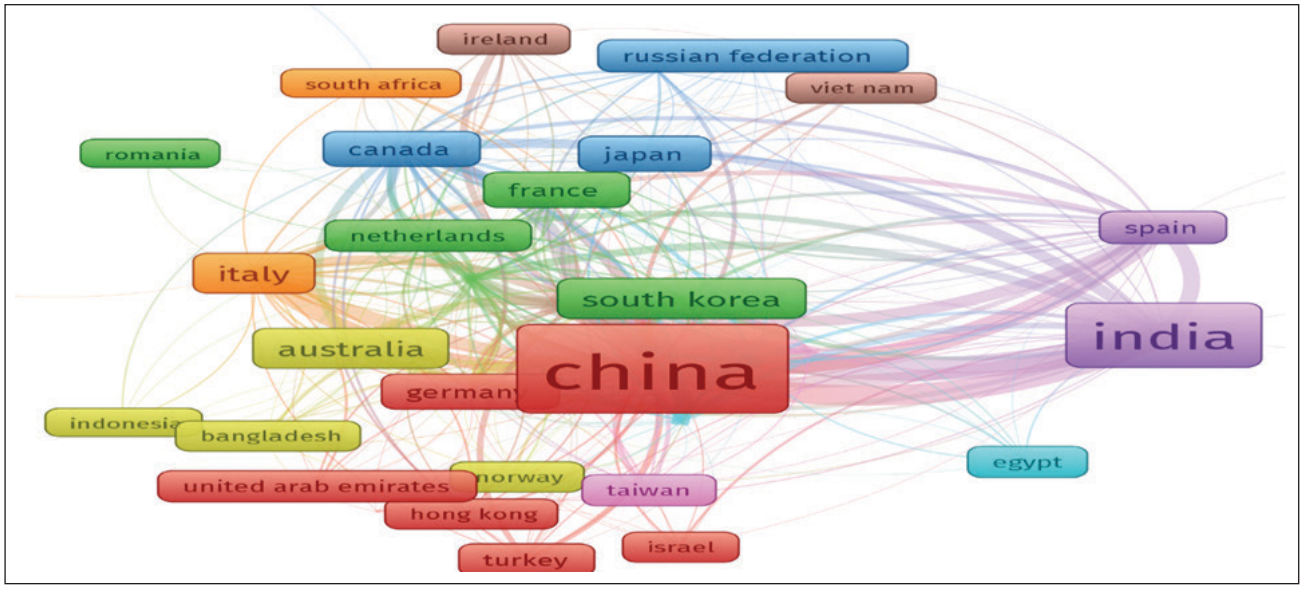

Figure 6(D). Citation country network visualisation.

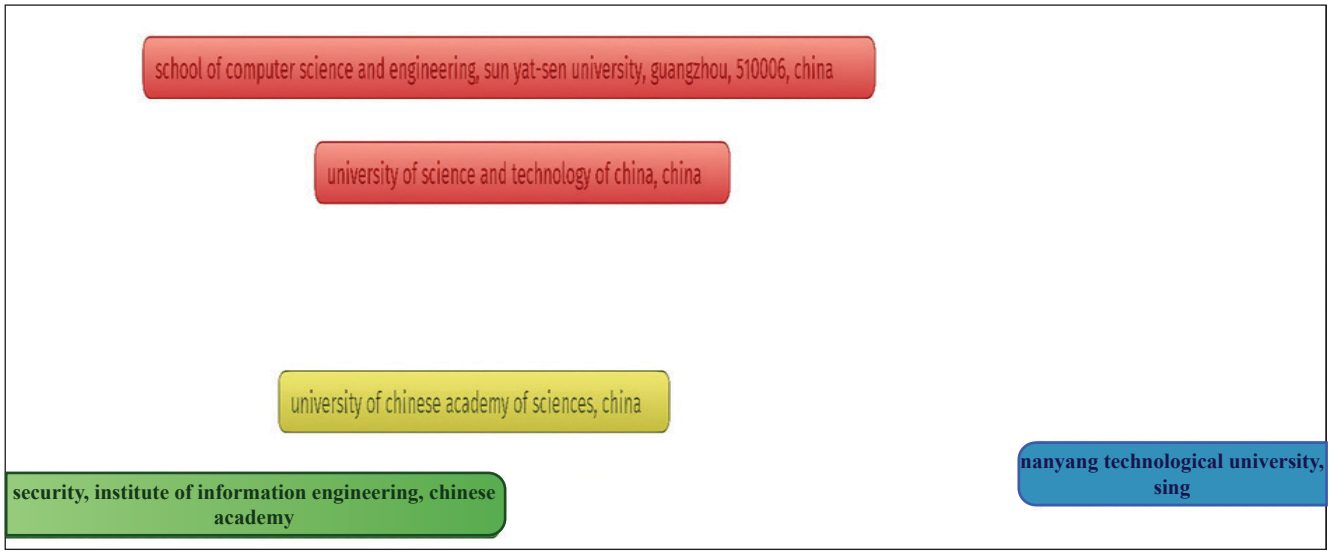

Figure 6(E). Citation organisation network visualisation.

Society Conference on Computer Vision and Pattern Recognition leads with 1,430 citations and a link strength of 78, followed by IEEE Access (356 citations, link strength 45). Other influential sources, including IEEE Transactions on Information Forensics and Security, emphasise citation frequency's role in advancing deepfake research.

5.9.3 Citation Author Network Visualisation

The citation author network visualisation in Fig. 6(C) of deepfake research, identifying key contributors through citation counts and link strength. Among 4,038 authors, 108 with at least five documents were analysed, forming a connected group of 97. Julian Fierrez and Ruben Tolosana lead with five documents, 379 citations, and a link strength of 75. Other influential authors include Zhou Wenbo, Zhang Weiming, and Yu Nenghai, highlighting a diverse network of central and peripheral contributors.

5.9.4 Citation Country Network Visualisation

Fig. 6(D) presents a citation country network visualisation of deepfake research, showcasing global collaboration and influence. Among 130 countries, 43 met the threshold of five publications, forming a connected network. China leads with 398 documents, 3,562 citations, and a link strength of 675, followed by the U.S. with 259 documents, 5,152 citations, and a link strength of 648. India (225 documents, 896 citations) exhibits a growing research impact, while Canada, Spain, and Italy further strengthen international collaboration.

5.9.5 Citation Organisation Network Visualisation

The citation network visualisation in Fig. 6(E) of deepfake research, showcasing key institutional contributions and collaborations Koondhar[24], *et al.* Among 2,595 organisations, only 14 had at least five publications, with 10 forming the largest connected group. The University of Science and Technology of China leads with 8 papers (288 citations, link strength 7), followed by the University of Chinese Academy of Sciences (6 papers, 584 citations). The National Institute of Informatics (Japan) stands out with 758 citations but no collaborations.

6. RESULTS

The key findings of this study are as follows:

- Deepfake research has grown at an annual rate of 182.84 %, culminating in 1,548 publications.
- The field is highly interdisciplinary, with computer science leading, followed by engineering and social sciences.
- China, USA, and the India are the top contributors, with strong international collaborations.
- Leading authors like Siwei Lyu and Yuezun Li have significantly influenced the research landscape.
- Journals like Lecture Notes in Computer Science and IEEE conferences are primary publication venues.
- Frequent research themes include "Deepfake Detection" and "Face Recognition," indicating a strong focus on security and ethics.

These findings highlight deepfake research as a rapidly growing, multidisciplinary field driven by global collaboration, influential scholars, and a strong focus on detection, security, and ethical considerations.

7. DISCUSSION AND CONCLUSION

This study highlights the rapid expansion of deepfake research and its interdisciplinary nature (Boyack, K. W. & Klavans, R.)[25]. While computer science and engineering dominate, the role of social sciences in addressing misinformation, ethics, and regulation is increasing. The global contributions from China, the USA, and India demonstrate worldwide efforts to understand and counteract deepfake threats. Future research should focus on developing more sophisticated detection mechanisms, including explainable AI (XAI) and blockchain-based authentication. Additionally, real-time detection models will be critical as deepfake generation techniques continue to advance.

As deepfake technology evolves, challenges such as adversarial attacks, privacy violations, and large-scale misinformation campaigns will intensify. The increasing realism of synthetic media poses risks to journalism, politics, and cybersecurity, requiring proactive responses from researchers and policymakers. Governments and international organisations should implement standardised policies, such as deepfake disclosure laws and digital content authentication standards.

In conclusion, while significant strides have been made, ongoing interdisciplinary collaboration remains essential. Future research must prioritise ethical frameworks, real-world applications, and regulatory measures to ensure that deepfake technology is managed responsibly, minimising its potential for harm.

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