Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

The Role of Digital Forensic Experts in Cybercrime Investigations in Indonesia Based on The Scopus Research Index

Subektiningsih[1,*], Dedy Hariyadi[2]

[1]Informatics, Universitas Amikom Yogyakarta, Yogyakarta, Indonesia
[2]Information Technology, Universitas Jenderal Achmad Yani, Yogyakarta, Indonesia
Email: [1,*]subektiningsih@amikom.ac.id, [2]dedy@unjaya.ac.id
Correspondence Author Email: subektiningsih@amikom.ac.id
Submitted: **06/12/2022**; Accepted: **30/12/2022**; Published**: 30/12/2022**

Abstract−The development of information technology, besides having a positive impact, has negative impacts, such as an increase in cybercrime. Several parties are involved in handling cybercrimes in Indonesia, including expert witnesses in digital forensics. It is hoped that cybercrimes can be uncovered through a digital forensic approach. Research related to cybercrime and Digital Forensics in Indonesia is experiencing increasing growth from 2010 to 2021. A very rapid increase was shown in 2017. Through bibliometric analysis, you can analyze expert witnesses in the field of digital forensics by region in Indonesia, such as Sumatera, Western Java, Central Java, and Eastern Java. An expert witness in digital forensics must have technical skills in operating digital forensic tools and analysis and academic skills in uncovering crimes. The results of this study are very useful for law enforcement officers or lawyers in determining expert witnesses in the field of digital forensics. List of digital forensic experts in Indonesia who have been tested from their scientific studies by conducting various paper publications. So, law enforcement can synergize with digital forensic experts to solve cybercrime. One of the roles of a digital forensic expert is as an expert witness in court. Through research, it is hoped that there will be an increase in awareness of digital forensic experts to conduct scientific publications so that it is easier to be recognized by law enforcement and academics for updating methods and techniques of cybercrime investigation.

Keywords: Bibliometrics Analysis, Cybercrime, Digital Forensics, Expert Witness, Indonesia

1. INTRODUCTION

In 2016, the existence of electronic and/or digital evidence analyzed increased from year to year [1]. Electronic and/or digital evidence supports the resolution of various incidents or crimes involving technology and computers. Because of this, cybercrime is known as a form of cybercrime due to the development of information technology [2] [3]. Cybercrime is divided into two categories, namely computer crime and computer-related crime. In general, computer crime is when the perpetrator and victim are entities of information technology products.

Meanwhile, computer-related crime is a conventional crime that utilizes information technology media [4]. In solving crime incidents, knowledge is needed. Digital forensics is a forensic science that extracts electronic and/or digital evidence to solve unusual problems, such as cybercrime, by referring to applicable provisions or laws [5]. According to ISO/IEC 27037:2012, the digital forensic process is divided into several stages, including Identification, Collection, Acquisition, and Preservation. Meanwhile, the next process in ISO/IEC 27042:2015 includes; analysis and interpretation. Based on these two standards, the digital forensic process that is carried out must be accountable to the applicable regulatory enforcement forum or court [6].

This description states that the forms of cybercrime, electronic and/or digital evidence, digital forensic stages, and courts are related. Research [7] states that digital forensic stages are applied to detect data theft at a coffee shop with electronic evidence in the form of a USB flash drive. Based on the digital forensic analysis carried out shows the potential for cybercrime to occur. Various sensitive data is found on the USB flash drive, including; data of username and password, customer credit card data, recipe data, vendor data, wholesale, and pornography content. The threat of crime is not only possible on secondary storage media but also on social media. In Indonesia, a threat that continues to increase in frequency with the growth of the internet from year to year is cyberbullying [8].

Cyberbullying crimes need to be watched out for. One of the potential reasons for increasing cyberbullying is the growth in internet use during the Covid-19 pandemic, which forced everyone to communicate via the internet [9]. Cyberbullying can occur on various platforms, such as social media, instant messaging, online games, and other media. A science-based digital forensic approach can detect communications containing cyberbullying [10] [11]. Research in [12] detects cyberbullying on the social media platform Instagram using the Naive Bayes Classifier. The stages of digital forensics in dealing with types of cybercrime can vary. This is because each incident has a unique pattern and action. Therefore, it is necessary to analyze the role of research on the digital forensic dimension in handling or investigating cybercrime in Indonesia to map digital forensic experts. This digital forensic expert plays a role in scientific studies, investigations, and evidence in court (expert witness).

Previous research analyzed digital forensic research in Indonesia using a bibliometric approach with Garba Reference Digital (Garuda), a portal for recording digital research references in Indonesia. At the time of the research, Garuda Portal was still under the management of the National Research and Innovation Agency (BRIN), currently under the management of the Ministry of Education, Culture, Research, and Technology. This research only focuses

Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

on analyzing researchers in the field of digital forensics in Indonesia [13]. Meanwhile, this paper will analyze the role of digital forensics in investigating cybercrime in Indonesia using data sources from the Scopus research index system, and a broader scope will be applied.

2. RESEARCH METHODOLOGY

2.1 Identification of Data Sources

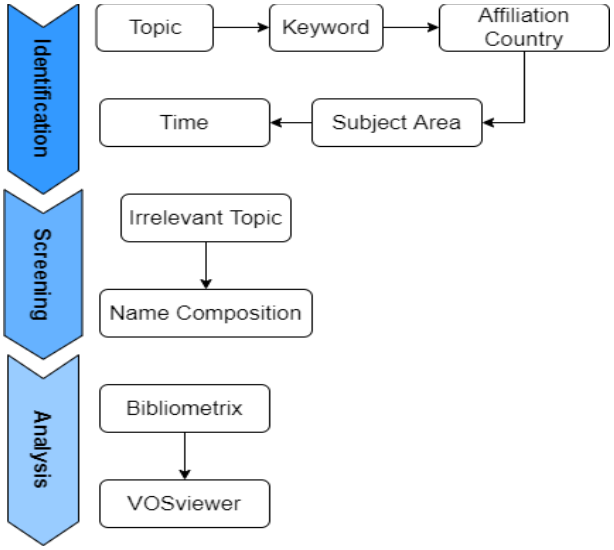
First, previous studies using the index database from the Garuda Portal still have several weaknesses. So, in this article, we use an index database from Scopus aligned with bibliometric analysis-based data management, such as VOSviewer. In addition, in conducting keyword searches, we have used mathematical logic AND-OR [14]. This article uses the mathematical logic of searching with the keywords "digital forensics" OR cybercrime. Meanwhile, in time-limited searches using AND, such as AFFILCOUNTRY,"Indonesia" AND SUBJAREA,"COMP". The search used in this article is the keyword "digital forensics", cybercrime, "forensic investigation", "computer crime", "computer-related crime", with restrictions on the country of Indonesia, research subjects in the field of engineering or computers, and a period of 2010 – 2021. So the search used is as follows (TITLE-ABS-KEY ("Digital Forensics") OR TITLE-ABS-KEY (cybercrime) OR TITLE-ABS-KEY ("forensic investigation") OR TITLE-ABS-KEY ("computer crime") OR TITLE-ABS-KEY ("computer-related crime")) AND (LIMIT-TO (AFFILCOUNTRY,"Indonesia")) AND (LIMIT-TO (SUBJAREA,"COMP") OR LIMIT-TO (SUBJAREA,"ENGI")) AND (LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2015) OR LIMIT-TO (PUBYEAR,2014) OR LIMIT-TO (PUBYEAR,2013) OR LIMIT-TO (PUBYEAR,2012) OR LIMIT-TO (PUBYEAR,2011) OR LIMIT-TO (PUBYEAR,2010)).

2.2 Screening - Data Extraction

Search results from the Scopus index database are stored in CSV format files. This is because the information exported to a CSV file has an arrangement of interrelated information, making it easier to perform analysis and visualization using VOSviewer and Bibliometric. In this article, the tools used to perform bibliometric analysis of the role of digital forensics in investigating cybercrime are VOSviewer and Bibliometrics. [15] [16].

2.2 Analysis

Analyzing digital forensics' role in handling cybercrimes in Indonesia based on the Scopus database research index requires an analysis of scientific publications on cybercrime and digital forensics. Thus, several variables must be considered when analyzing publications related to cybercrime and digital forensics. The use of bibliometric analysis tools, such as VOSviewer and Bibliometrics, can determine some of the simplest things, namely Annual Scientific Publications in the form of graphs of article growth from year to year to Networking Maps from researchers. The research flow starts from identifying the research topic until the analysis is in Figur 1.



Figur 1. Research Flowchart

3. RESULT AND DISCUSSION

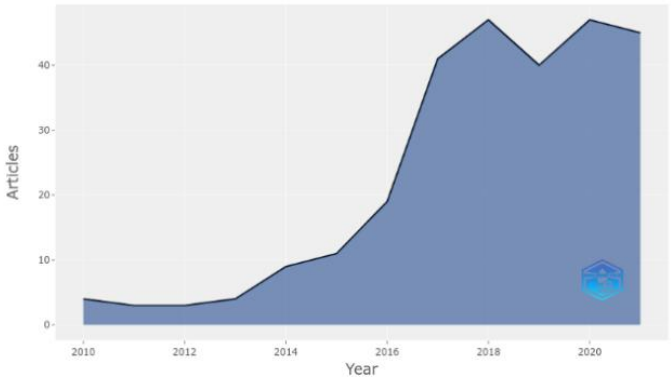
The process of identifying research sources, as shown in Fig.1, obtained 281 articles. Based on 281 articles, screening needs to be done to ensure the relevance of cybercrime and digital forensics topics. Based on the screening results,

Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

eight articles were found that were irrelevant because they were related to the issue of medical forensics. The next step is to confirm the arrangement of the author's name. In Indonesia, several people have one name arrangement, for example, Sunardi and Fazlurrahman [17]. Therefore, the arrangement of the author's name must be adjusted to the format of the first and last names. So, for authors with one name arrangement for the last name part, it is replaced with a dot (.). Based on the results of the screening, 273 articles were ready to be analyzed, 60 articles in the form of papers, one book chapter, and 212 conference papers. The articles collected are not only written by one author but are more dominant in joint publications. In the composition of article writing, there are 666 authors collaboratively and three independently.

3.1 Publication Trends

The trend of publishing papers on cybercrime and digital forensics in the 2010-2021 period shows an increase from year to year. This means that more and more researchers are evaluating and researching cybercrimes through scientific publications globally, namely by Scopus indexing. The period of 2013 – 2016 shows promising growth in scientific publications. Only starting in 2017-2021, scientific publications related to cybercrime and digital forensics experienced a very high increase, with an average of 44 articles. This trend can be regarded as the annual scientific production of cybercrime and digital forensics, see Fig. 2.



Figur 2. Annual Scientific Production

The increase in global research certainly affects other things, such as the citation of articles by other countries. This is because Scopus indexing is a worldwide indexing level that makes it easier for the popularity of articles published by researchers in Indonesia to be known abroad. The country with the highest citation of articles by Indonesian writers is the United Kingdom, with 68 citations of articles. Meanwhile, Finland's country has the lowest citation of articles by Indonesian researchers, with 7 citations. However, the average citation from Finland is higher than the USA, which is only 5.50, see Table 1.

Table 1. The Most Citation Country

Country	Total Citation	Avg. Article Citation
United Kingdom	68	34.00
Australia	59	19.67
Malaysia	47	23.50
China	19	6.33
Korea	19	9.50
Iran	15	15.00
USA	11	5.50
Finland	7	7.00

One method to determine the trend of a scientific article can be selected using the frequency of occurrence of words from a keyword and abstract. This article presents the frequency of occurrence of words in keywords or abstracts using wordcloud visualization. Especially for analyzing the occurrence of words from the abstract using bigram weighting, namely processing documents in classification with the results of two-word terms [18]. Keyword analysis and abstract use stopwords as a pre-processing stage in text mining. The stopword form is a dictionary containing words that will not be processed [19].

In this article, stopword is modified by adding search keywords in Scopus such as computer crime, computer-related crime, digital forensics, cybercrime, forensic investigation, and Indonesia. A keyword analysis is sourced from Keyword Plus, a combination of Author Keywords and Keyword Index. Then the study results with the presentation of wordcloud can be seen in Fig. 3. This shows that cybercrimes analyzed by researchers in Indonesia occur on the side of computer systems and networks. The intrusion detection systems method combines several machine learning and artificial intelligence approaches to carry out digital forensic investigations on the system and computer network side [20].

Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

Figur 3. Wordcloud of Keyword Plus

Analyzing Abstract is like analyzing Keyword Plus using a word's frequency of occurrence. However, the difference is that in the Abstract analysis, the Bigram weighting is added to increase the occurrence of words in the Abstract written by the researcher [21]. Fig. 4. shows things that are not much different from Keyword Plus analysis, namely, detecting cybercrimes requires a detection system and further analysis methods using machine learning and artificial intelligence approaches.

3.2 Analysis of Institutions

273 articles have been screened including 84 institutions contributing to cybercrime investigations and digital forensic analysis. Of the 84 institutions, 27 institutions come from abroad. This is because when conducting research, several researchers from Indonesia collaborated with researchers from other countries. The 57 institutions in Indonesia that are most productive in conducting scientific publications related to digital forensics in investigating cybercrime are the University of Indonesia and the Sepuluh Nopember Institute of Technology, with a total of 19 articles published. The results are shown in Table 2.

Table 2. The Most Institution

Name of Institution	Articles
Universitas Indonesia	19
Institut Teknologi Sepuluh Nopember	19
Universitas Ahmad Dahlan	18
Universitas Sriwijaya	17
Telkom University	14

3.3 Analysis of Authorship Patterns

Based on 273 articles, 468 authors contributed to cybercrime investigations with a digital forensics approach. In the Author Local Impact analysis, 5 authors are productive in conducting research with an H-Index indicator > 5; see T. Based on the 5 productive writers of researchers there are researchers from Malaysia, Abdul Hanan Abdullah. Institution from Abdul Hanan Abdullah from Universiti Teknologi Malaysia. Abdul Hanan Abdullah's involvement in research in Indonesia was due to his collaboration with Deris Stiawan from Sriwijaya University. Based on Table 3, the distribution of experts who researched cybercrime investigations and/or digital forensics in Java Island is fairly even; Kalamullah Ramli can represent the western part from the University of Indonesia and Imam Riadi from Ahmad Dahlan University can represent Central Java. In contrast, Tohari Ahmad from the Sepuluh Nopember Institute of Technology represents the eastern part of Java. Especially for the Sumatra region, Deris Stiawan from Sriwijaya University can be represented.

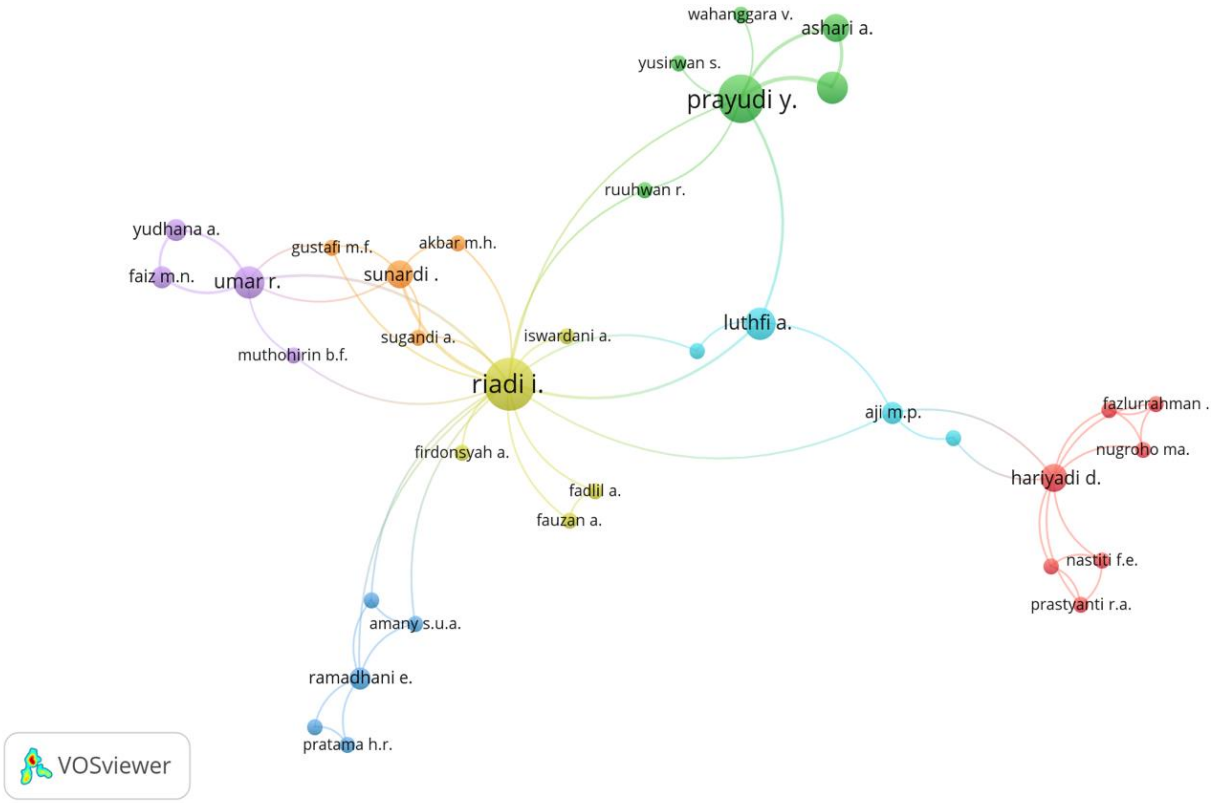
Table 3. The Most Authors

Author	Institution	H-Index	Total Citation	Total Link Strenght
Deris Stiawan	Universitas Sriwijaya	6	99	49
Abdul Hanan Abdullah	Universiti Teknologi Malaysia	5	47	22
Tohari Ahmad	Institut Teknologi Sepuluh Nopember	5	52	24
Kalamullah Ramli	Universitas Indonesia	5	54	8
Imam Riadi	Universitas Ahmad Dahlan	5	43	22

Imam Riadi dominates the network in conducting research with a Total Link Strength of 22 from the emergence of 1 article document and links with other researchers. Imam Riadi's research network is vital due to the collaboration in writing articles related to cybercrime and digital forensics, see Fig. 5. Although listed as a lecturer at Ahmad Dahlan University, Imam Riadi also teaches and conducts research with master's students at the Islamic University of

Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

Indonesia with a concentration on Digital Forensics. Although the network of researchers from Imam Riadi is less productive than the 5 writers, he has the potential as a digital forensic expert.



Figur 4. Network Visualization of Researcher

Cybercrime still needs to be watched out for. Therefore, we need experts who can uncover it with a digital forensics approach. Although it is still a new branch of forensic science, based on the Scopus research index, digital forensics has a role in uncovering cybercrimes that are increasing yearly. Cybercrime is growing because the impact of technological developments needs to be considered from several angles before, during, and after the incident. The bibliometric analysis approach in analyzing the role of digital forensics in handling cybercrime is beneficial for law enforcement officials in collaboration with digital forensic experts in Indonesia.

In the 2010-2021 period, many articles written by digital forensics experts were cited by researchers from abroad. This shows that theoretically and practically, the development of forensic science in Indonesia has become a global concern. The distribution of digital forensic experts in Indonesia is quite good based on institutions and researchers. Even though researchers in Yogyakarta have yet to look productive, every institution still has much potential for networking and collaboration. This is shown by the research network conducted by Imam Riadi from Ahmad Dahlan University.

4. CONCLUSION

Expert Witnesses can be digital forensic practitioners with competency certification, an academic whose scientific focus is proven by publications, or even both. Mapping of experts in the field of digital forensics in Indonesia in handling cybercrimes using a bibliometric analysis approach. Based on this research, we obtained a list of digital forensic experts in Indonesia who have been tested from their scientific studies by conducting many paper publications. Law enforcers can work with digital forensic experts to solve various cybercrime crimes. These digital forensic experts are spread across various institutions and regions, including; Universitas Sriwijaya (Sumatra), Universitas Indonesia (western part of Java), Universitas Ahmad Dahlan (central part of Java), Institut Teknologi Sepuluh Nopember (eastern part of Java). Central Java region has great potential because it has a fairly strong network of researchers. Meanwhile, there are still limited digital forensic experts in Kalimantan, Sulawesi, Bali - Nusa Tenggara, Maluku - Ambon, and Papua. Through this research, there will be an increase in the awareness of digital forensic experts to carry out scientific publications so that they are more easily recognized by law enforcement and academics. Become a trigger for other digital forensic experts, so there is an even distribution of digital forensic experts in various regions in Indonesia. The existence of publications from digital forensic experts is also expected to have a positive impact on updating cybercrime investigation methods and techniques.

Building of Informatics, Technology and Science (BITS)
Volume 4, No 3, Desember 2022 Page: 1665−1670
ISSN 2684-8910 (media cetak)
ISSN 2685-3310 (media online)
DOI 10.47065/bits.v4i3.2638

REFERENCES

[1] D. Hariyadi, W. W. Winarno, and A. Luthfi, "Analisis Dugaan Saksi dengan Barang Bukti Digital Blackberry Messenger Menggunakan Metode Term Frequency dan Analisis Triadic," Universitas Islam Indonesia, 2016.

[2] Raodia, "Pengaruh Perkembangan Teknologi Terhadap Terjadinya Kejahatan Mayantara (Cybercrime)," *Jurisprud. Jur. Ilmu Huk. Fak. Syariah dan Huk.*, vol. 6, no. 2, p. 39, 2019, doi: 10.24252/jurisprudentie.v6i2.11399.

[3] V. Kalra and R. Aggarwal, "Importance of Text Data Preprocessing & Implementation in RapidMiner," *Proc. First Int. Conf. Inf. Technol. Knowl. Manag.*, vol. 14, pp. 71–75, 2018, doi: 10.15439/2017km46.

[4] M. N. Al-Azhar, *Digital Forensic: Panduan Praktis Investigasi Komputer*. Jakarta: Salemba Infotek, 2012.

[5] D. Hariyadi, H. Wijayanto, and I. D. Sari, "ANALISIS BARANG BUKTI DIGITAL APLIKASI PAZIIM PADA PONSEL CERDAS ANDROID DENGAN PENDEKATAN LOGICAL ACQUISITION," *Cybersecurity dan Forensik Digit.*, vol. 2, no. 2, pp. 1–5, 2019.

[6] D. Hariyadi, F. E. Nastiti, and F. N. Aini, "Framework for Acquisition of CCTV Evidence Based on ACPO and SNI ISO / IEC 27037 : 2014," 2018.

[7] D. Septianto, Lukas, and B. Mahawan, "USB Flash Drives Forensic Analysis to Detect Crown Jewel Data Breach in PT. XYZ (Coffee Shop Retail - Case Study)," in *2021 9th International Conference on Information and Communication Technology (ICoICT)*, Aug. 2021, pp. 286–290, doi: 10.1109/ICoICT52021.2021.9527419.

[8] D. Hariyadi, D. P. I. Kusuma, N. H. Maulida, and M. Ma'rifat, "Evaluasi Potensi Celah Keamanan SQL Injection Menggunakan Nearest Neighbor pada Security-Software Development Life Cycle," *J. Repos.*, vol. 2, no. 9, pp. 1273–1280, 2020, doi: 10.22219/repositor.v2i9.999.

[9] Pusat Operasi Keamanan Siber Nasional Badan Siber dan Sandi Negara, "Laporan Tahunan Monitoring Keamanan Siber," Jakarta, 2021.

[10] S. T. Laxmi, R. Rismala, and H. Nurrahmi, "Cyberbullying Detection on Indonesian Twitter using Doc2Vec and Convolutional Neural Network," in *2021 9th International Conference on Information and Communication Technology (ICoICT)*, Aug. 2021, pp. 82–86, doi: 10.1109/ICoICT52021.2021.9527420.

[11] S. W. Prasetyaningtyas and A. Prayogo, "The Effect of Cyberbullying in Multi-Player Online Gaming Environments: Gamer Perceptions," in *2021 International Conference on Informatics, Multimedia, Cyber and Information System (ICIMCIS)*, Oct. 2021, pp. 244–249, doi: 10.1109/ICIMCIS53775.2021.9699130.

[12] P. P. Adikara, S. Adinugroho, and S. Insani, "Detection of cyber harassment (cyberbullying) on Instagram using naïve bayes classifier with bag of words and lexicon based features," in *Proceedings of the 5th International Conference on Sustainable Information Engineering and Technology*, Nov. 2020, pp. 64–68, doi: 10.1145/3427423.3427436.

[13] M. Kusuma, D. Hariyadi, Fazlurrahman, and M. A. Nugroho, "The Bibliometric Analysis the Digital Forensics Researcher in Indonesia Based on Garba Rujukan Digital: 2008–2020," in *2021 IEEE Mysore Sub Section International Conference (MysuruCon)*, Oct. 2021, pp. 13–17, doi: 10.1109/MysuruCon52639.2021.9641641.

[14] F. H. Arifah, A. E. Nugroho, A. Rohman, and W. Sujarwo, "A bibliometric analysis of preclinical trials of Andrographis paniculata (Burm.f.) Nees in diabetes mellitus," *South African J. Bot.*, Dec. 2021, doi: 10.1016/j.sajb.2021.12.011.

[15] A. A. Zahra *et al.*, "Bibliometric Analysis of Trends in Theory-related Policy Publications," *Emerg. Sci. J.*, vol. 5, no. 1, pp. 96–110, Feb. 2021, doi: 10.28991/esj-2021-01261.

[16] M. Aria, M. Misuraca, and M. Spano, "Mapping the Evolution of Social Research and Data Science on 30 Years of Social Indicators Research," *Soc. Indic. Res.*, vol. 149, no. 3, pp. 803–831, Jun. 2020, doi: 10.1007/s11205-020-02281-3.

[17] E. K. Aribowo and N. Herawati, "Trends in Naming System on Javanese Society: A Shift From Javanese to Arabic," *Ling. Cult.*, vol. 10, no. 2, p. 117, Nov. 2016, doi: 10.21512/lc.v10i2.1730.

[18] R. Ramadhan, Y. A. Sari, and P. P. Adikara, "Perbandingan Pembobotan Term Frequency-Inverse Document Frequency dan Term Frequency-Relevance Frequency terhadap Fitur N-Gram pada Analisis Sentimen," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 5, no. 11, pp. 5075–5079, 2021, [Online]. Available: http://j-ptiik.ub.ac.id.

[19] C. B. Aslan, S. Li, F. V. Celebi, and H. Tian, "The World of Defacers: Looking Through the Lens of Their Activities on Twitter," *IEEE Access*, vol. 8, pp. 204132–204143, 2020, doi: 10.1109/ACCESS.2020.3037015.

[20] Amarudin, R. Ferdiana, and Widyawan, "A Systematic Literature Review of Intrusion Detection System for Network Security: Research Trends, Datasets and Methods," in *2020 4th International Conference on Informatics and Computational Sciences (ICICoS)*, Nov. 2020, pp. 1–6, doi: 10.1109/ICICoS51170.2020.9299068.

[21] S. G. Kanakaraddi, A. K. Chikaraddi, K. C. Gull, and P. S. Hiremath, "Comparison Study of Sentiment Analysis of Tweets using Various Machine Learning Algorithms," *Proc. 5th Int. Conf. Inven. Comput. Technol. ICICT 2020*, pp. 287–292, 2020, doi: 10.1109/ICICT48043.2020.9112546.