

Mapping Soft Computing Concepts and Research Trends in Computer Vision through Bibliometric Analysis Using VOS Viewer and Publish or Perish

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ABSTRACT

The background of this research is the significant increase in the number of scientific publications related to the use of soft computing in computer vision in recent years. As bibliometric data becomes increasingly complex, there is a need for effective tools to map and analyze such data. This study aims to analyze and demonstrate the steps of bibliometric data analysis using VOS Viewer in a comprehensive and systematic manner. The method used in this research is to conduct bibliometric analysis to produce visualization of collaboration network maps and collaboration density maps. The analysis was carried out on a total of 200 documents obtained with predetermined topics for the period 2017-2021. Through network visualization, it can be seen that the research development map in the field of deep learning is divided into 4 clusters. Cluster One consists of 12 topics, Cluster Two consists of 12 topics, Cluster Three consists of 5 topics, and Cluster Four consists of 4 topics. The research conclusion show that VOS Viewer can be used to provide recommendations in data analysis results. This research provides a comprehensive and systematic guide for new users of VOS Viewer to conduct bibliometric data analysis and effectively present visualizations of research developments in the field of deep learning.

Keywords: Computer Vision, Soft Computing, Classification, Bibliometrics

1. INTRODUCTION

The word mapping according to KBBI is the process, method, act of making a map. Science mapping is a process, method as well as a tool for analyzing knowledge in finding images or meanings and describing them in a comprehensive form. One of the benefits of science mapping is to know the direction and development of science. Bibliometric mapping is part of bibliometrics with the help of computer applications, aiming to get a visual picture of the relationship between the units under study. Through bibliometric analysis tools such as VOS Viewer, researchers can visualize concepts and research trends in soft computing applied to computer vision [1].

Soft computing is an approach in computer science that utilizes methods based on probabilistic algorithms, fuzzy logic, neural networks, and evolutionary computation to tackle complex and ambiguous problems. These techniques allow systems to handle uncertainty, vagueness, and imperfections in the data and information received, making them suitable for applications where exact solutions are difficult or impossible to obtain [2]. On the other hand, computer vision is a field of study that focuses on developing systems that enable computers to view, understand, and analyze images and videos automatically. The processes involved in computer vision include image acquisition, image processing, pattern recognition, and visual-based decision-making [3].

Bibliometric analysis is a research method used to quantitatively and qualitatively analyze existing scientific literature, including scientific publications, citations, author collaborations, and research trends. This method allows researchers to map and understand developments, patterns, and relationships between various research topics in a particular field of science [4] [5]. By using bibliometric analysis, researchers can identify research trends, evaluate the impact of publications, and find collaborations between researchers [6]. Through this approach, the information obtained can help in formulating future research directions, identifying important contributions, and understanding the structure of knowledge networks in a research domain [7].

Research on bibliometric analysis using VOS Viewer has been widely used, some of which are Herlina [8] with her research entitled Bibliometric Analysis of Social Media Marketing Research Mapping [9] with their research entitled Review of Knowledge Domain Mapping on Indoor Navigation Through a Bibliometric Approach [10] with their research entitled Bibliometric Analysis of Research Lecturer Performance Using the VOS Viewer Application [11] with their research entitled Mapping library marketing research on google scholar using VOS Viewer.

This research will discuss bibliometric analysis using VOS Viewer to offer a comprehensive overview of the research landscape in soft computing applied to computer vision, to see the development of this from 2017-2021. The hope of this study is to provide an in-depth understanding of the latest developments in the application of soft computing to computer vision through bibliometric analysis. Thus, it is expected to identify emerging research trends, highlight potential collaborations, and provide valuable insights for the future development of intelligent systems and visual applications.

2. RESEARCH METHOD

2.1. Prepare Research Tool

In analysing bibliometric data using VOS Viewer, several applications must be prepared. The first application is to use a mapping tool, which can be obtained from the VOS Viewer application (Figure 2) which is open source. In this research, VOS

Viewer is used as a tool that can visualize the data analysed for mapping. Then the second application that needs to be prepared is the reference manager application. The reference manager application that can be used includes Publish or Perish as in Figure 3 and Mendeley as in Figure 4. This reference manager application is used to collect research data which will later be analysed bibliometric using VOS Viewer.

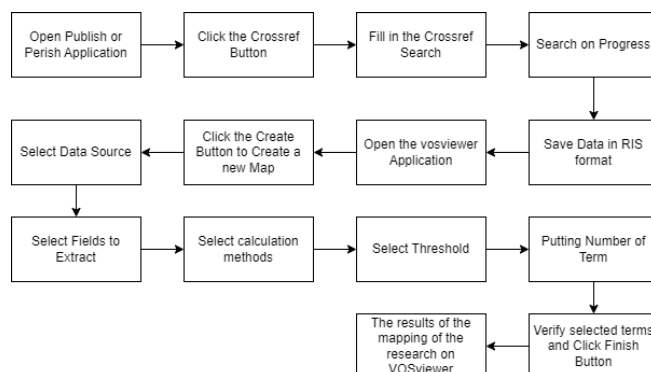


Figure 1. Flow of Research Method

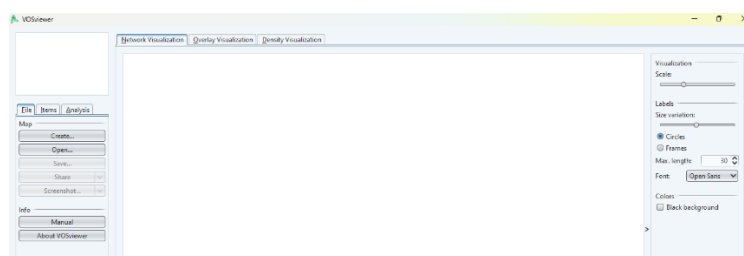


Figure 2. VOS Viewer Application

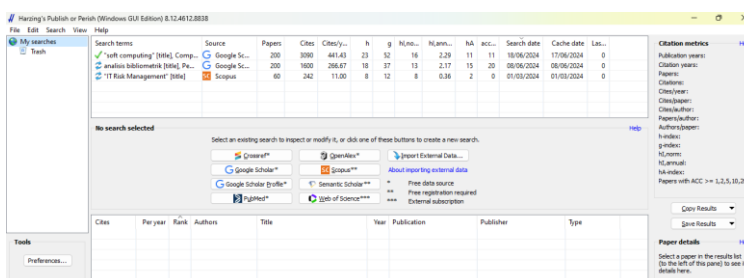


Figure 3. Publish or Perish Application

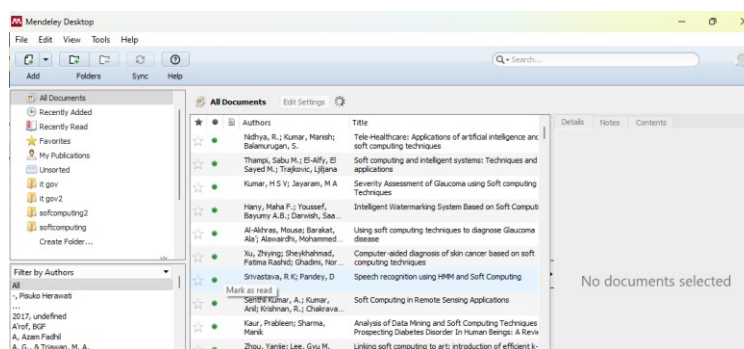


Figure 4. Mendeley Application

2.2. Data Retrieval

The data used in this research is soft computing journal publication data in the field of computer vision obtained using a reference manager application. The reference manager application used in this research is Publish or Perish. Publish or Perish is used to conduct a literature review of the selected theme. So that a database of similar research themes can be obtained.

Publish or Perish is used to find out which authors are the most cited, the oldest year and the latest year of an article, then we will get a visualization record of each research to be used. Publish or Perish provides several choices of research data sources to be used such as Crossref, Google Scholar, Google Scholar Profile, PubMed, Microsoft Academic, Scopus, and Web of Science as shown in Figure 5. In this study using data from Google Scholar.

2.3. Research Data Mapping

Data mapping in this study uses a digital mapping application, namely the VOS Viewer application. The data that has been obtained is processed in such a way as to match the desired keywords. After that the data is inputted into the VOS Viewer application which will then convert the data into an interconnected data map.

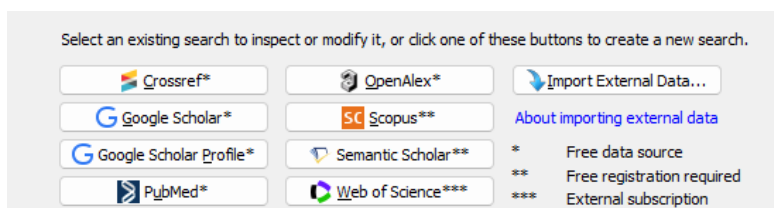


Figure 5. The options for data sources in Publish or Perish

3. RESULT AND ANALYSIS

In this section, we will discuss how to analyse the results of data mapping using VOS Viewer with data on the development of the number of Soft Computing-themed journal publications in the field of education in the Google Scholar database from 2017-2021.

3.1. Data Used

As an example of this research, the data will be retrieved through Google Scholar. This means that any article data contained in Google Scholar and in accordance with the search themes needed in this study will be backed up into a file that will be used in using VOS Viewer. The steps to get the data are as follows.

A. Open Publish or Perish Application

The first step to get data through Publish or Perish is to open the application as shown in Figure 6. Once opened, we can see the initial application window as shown in Figure 7.

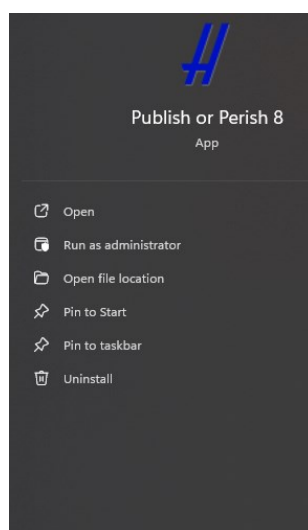


Figure 6. Open Publish or Perish

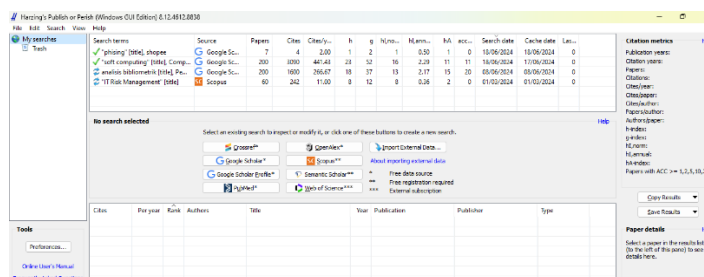


Figure 7. Welcome Screen Publish or Perish

B. Click the Google Scholar button

Figure 8 shows the location of the Google Scholar button on Publish or Perish. The step to do at this stage is to press the button.

C. Filling in the Google Scholar Search

As shown in Figure 9, there are several sections in the Google Scholar search, including authors, publication names, title words, and keywords. In this research, the theme to be searched is soft computing with 2017-2021 or research conducted 5 years ago. Then fill in the title column with "soft computing" and the keyword using "computer vision".

If the required fields in the Google Scholar search have been filled in, click the search button in the upper right corner as shown in Figure 8. After the Publish or Perish display appears in Figure 10, we just have to wait for the search process to finish.

D. Search Results

Figure 11 shows the search results of Publish or Perish. If we look at the results section on the left side of the screen, Figure 10 shows some data information from the data that has been obtained.

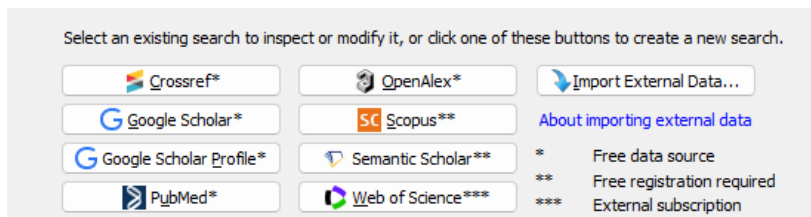


Figure 8. Google Scholar Button

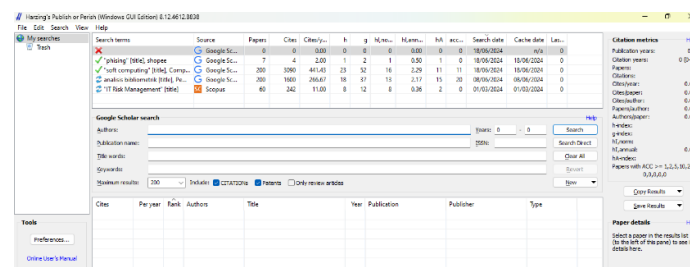


Figure 9. Google Scholar Search

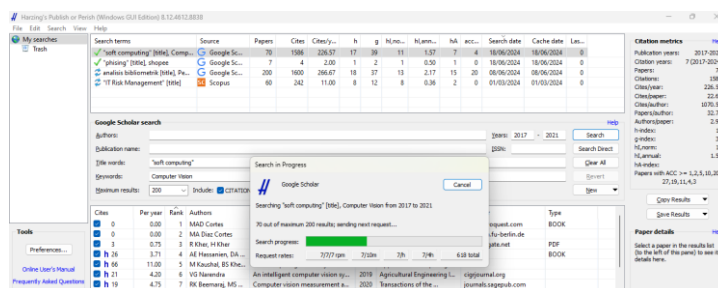


Figure 10. Article Search process in Publish or Perish

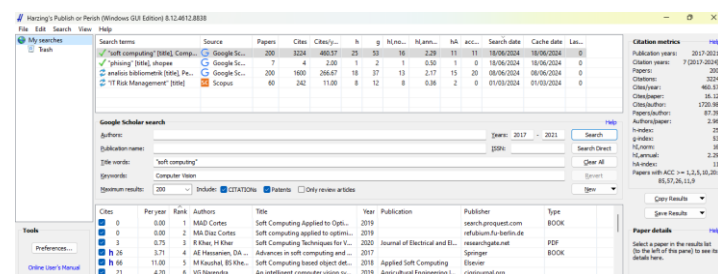


Figure 11. Search results based on Publish or Perish

E. Save Data from Publish or Perish

The next step for each saved result is to click the save results button. After that, save the results in RIS form as can be seen in Figure 12. Because the file is in RIS form which can be read by VOS Viewer.

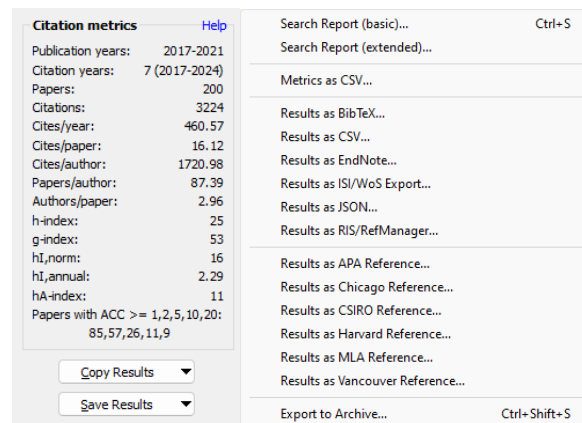


Figure 12. How to Save Publish or Perish search data

Articles found in Publish or Perish are mapped using VOS Viewer. The data displayed in Publish or Perish is in the form of metadata, not full text, including author names, titles, years, journals, and publishers of the articles found.

Table 1 shows the search data from Publish or Perish used in the VOS Viewer analysis in this study. It includes 200 articles, 3224 citations, 460,57 citations per year, 16.12 citations per article, 2.96 authors per article, an h-index of 25, a g-index of 53, an annual h-index of 2.29, and an h-annual index of 11.

Table 1. Top 10 Metadata

No	Authors	Title	Year	Author Count	Cites	Cites Per Year	Cites Per Author
1	A Konar	Artificial intelligence and soft computing: behavioral and cognitive modeling of the human brain	2018	1	721	120.20	721
2	Z Xu, FR Sheykhahmad, N Ghadimi, N Razmjoooy	Computer-aided diagnosis of skin cancer based on soft computing techniques	2020	4	210	52.50	53
3	M Mishra	Power quality disturbance detection and classification using signal processing and soft computing techniques: A comprehensive review	2019	1	160	32	160
4	H Malik, A Iqbal, AK Yadav	Soft computing in condition monitoring and diagnostics of electrical and mechanical systems	2020	3	154	38.50	51
5	R Falcone, C Lima, E Martinelli	Soft computing techniques in structural and earthquake engineering: a literature review	2020	3	142	35.50	47

3.2. Development of Publications Regarding Soft Computing in Natural Language Processing

Based on the search results in the Google Scholar database, the development of digital learning media research is shown in Table 1. The table shows that there are 200 studies on soft computing in computer vision. The number of studies on soft computing in computer vision fluctuates but tends to increase as shown in Figure 12. There was only a decrease in research interest in this theme in 2018 and 2019, namely from 40 studies throughout 2017 then dropped to 37 and 34 studies. In 2020, it increased with 49 studies.

Table 2. Research on Soft Computing in Computer Vision

Years of Publication	Number of Publication
2017	40
2018	37
2019	34
2020	49
2021	40
Total	200

**Figure 13.** Graph of Research

3.3. Bibliometric Mapping Research Regarding Soft Computing in Natural Language Processing

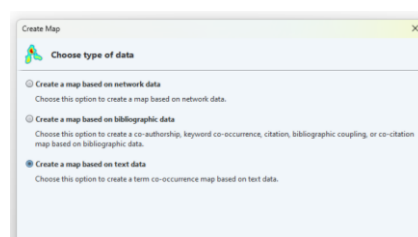
From the search results through the Google Scholar database, 200 research documents related to soft computing research on computer vision were obtained. Then the document is exported to RIS format. Entered and analysed with VOS Viewer. There are several steps in mapping research using VOS Viewer, which are as follows.

A. Open the VOS Viewer Application

The first step that must be done is to open the VOS Viewer application that has been installed. After opening it, the initial VOS Viewer window will appear as shown in Figure 1.

B. Click the Create Button to Start Creating a New Map

After opening VOS Viewer, click create to start creating a new mapping. As shown in Figure 14, there are three data type options, namely making maps based on network data, bibliographic data, and text data. In this study, the map was created based on text data, because in this study the research mapping was carried out based on the research title. After that, click the next button.

**Figure 14.** Create a Map in VOS Viewer

C. Select Data Source

Figure 15 shows the next step in creating a research map, there are 4 data source options, namely reading data from VOS Viewer files, bibliographic database files, reference manager files, and downloading data via API. In the previous data retrieval stage, we used the Publish or Perish application which is one of the reference manager applications, and the type of data we previously saved was RIS. So, in this section we select read data from reference manager files, then click Next.

In the section shown in Figure 15, select the RIS section and enter the file that has been obtained through Publish or Perish, by pressing the three-dot button. Then click the next button to proceed to the next stage.

D. Select Fields to Extract

This page displays 3 types of data options that can be extracted, namely title and abstract columns, title columns, and abstract columns. In this study, title and abstract data from the articles that have been collected are used. Thus, VOS Viewer maps each keyword taken from the titles and abstracts of the articles that have been collected. When finished, the next step is to click the next button.

E. Select Calculation Method

Figure 18 shows the calculation method selection. There are two methods: binary counting and full counting. Binary counting displays data in the form of 0 or 1 values, meaning that if the same word appears repeatedly in the title, it is counted as one. While

the full count method means that in this method the total number that appears is still counted as many times as it appears.

F. Select Threshold

Figure 19 shows the Select Threshold page. This page is used to set the minimum number of words that appear in order to be presented in a folder. In this research, the number of words that appear at least three times, so the corresponding keywords and the number of occurrences of 3 times or more are included in the mapping. Then the number of words found is 33, and for the section shown in Figure 20, we maximize the data display by 33.

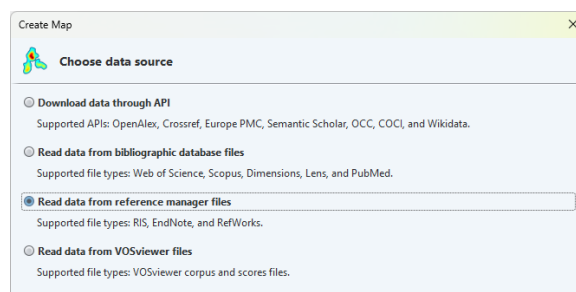


Figure 15. Selection of data sources on VOS Viewer

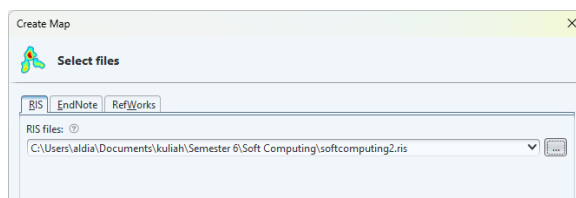


Figure 16. Selection of the file to be used as the source of mapping data in VOS Viewer

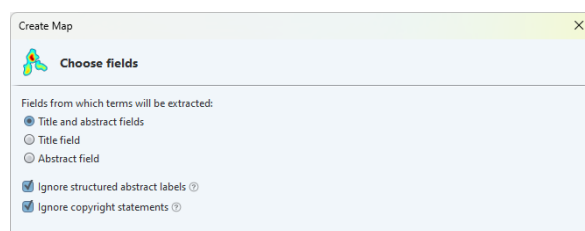


Figure 17. Selection of the type of data to be extracted into a map on VOS Viewer

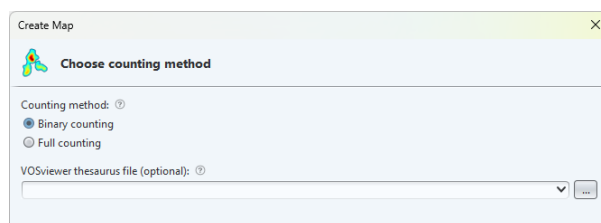


Figure 18. Choosing the counting method in VOS Viewer

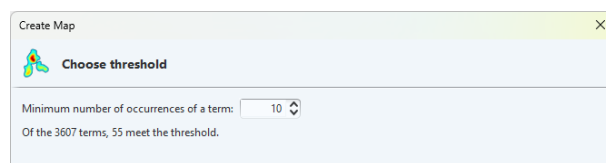


Figure 19. Choosing the threshold section on VOS Viewer

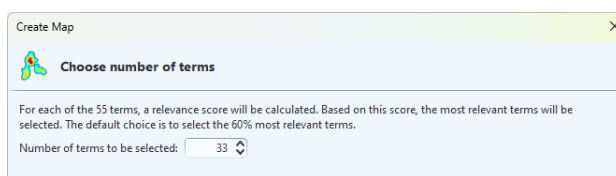


Figure 20. Putting the number of terms

G. Verify Selected Terms and Click the Finish Button

In Figure 21, we select the words used and appear on the research mapping created, then click the finish button. After that, we can see the results of the research theme mapping on digital learning media shown in Figure 22.

Create Map

Verify selected terms

Selected	Term	Occurrences	Relevance
☒	book	10	3.13
☒	proceeding	10	2.93
☒	accuracy	17	2.28
☒	advance	16	2.12
☒	feature	20	1.82
☒	classification	25	1.32
☒	soft	11	1.30
☒	object	12	1.27
☒	field	30	1.26
☒	image	48	1.23
☒	type	18	1.08
☒	implementation	13	1.06
☒	performance	16	1.03
☒	disease	17	0.85
☒	quality	16	0.83
☒	detection	21	0.72
☒	soft computing	116	0.70
☒	human	10	0.69
☒	development	30	0.68
☒	machine learning	19	0.63
☒	number	15	0.62

< Back Next > Finish Cancel

Figure 21. Verification of word selection on VOS Viewer

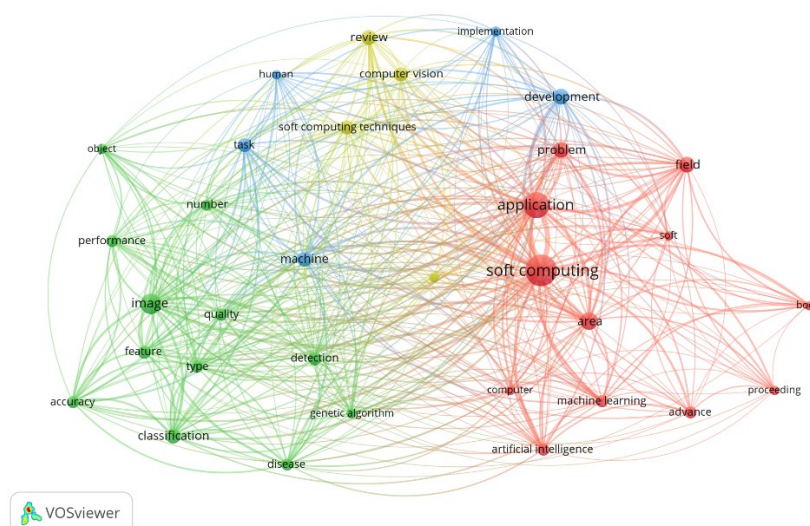


Figure 22. The results of the mapping of the research on VOS Viewer

The results of the network visualization of the research development co-word map regarding digital learning media are divided into 4 clusters as shown in Figure 23 below. Cluster 1. Application of Soft Computing in the Field of Artificial Intelligence and Machine Learning: Advances, Problems, and Proceedings. The red color consists of 12 items including: soft computing, application, soft, problem, field, book, computer, artificial intelligence, machine learning, advance, area, and proceedings. This keyword has been used and discussed in the research; Application Research of Soft Computing Based on Machine Learning Production Scheduling [12]; Soft Computing Applications for Optimum Rock Fragmentation: An Advanced Overview [13]; Soft Computing in Remote Sensing Applications [14]; The problems of routing and traffic rate control and the potential for soft computing. 1 & 2 [15]; Soft Computing based Medical Image Mining: A Survey [16]; Hybrid soft computing for image segmentation [17]; A Framework for Quality Evaluation of Edible Nuts Using Computer Vision and Soft Computing Techniques [18]; Cloud and Edge Computing Security Using Artificial Intelligence and Soft Computing Techniques [19]; Advances in Soft Computing and Machine Learning in Image Processing [20]; Advances in Harmony Search, Soft Computing and Applications [21]; Soft Computing in Robotics: A Decade Perspective [22]; Proceedings of the 18th Online World Conference on Soft Computing in Industrial Applications (WSC18) [23].

Cluster 2. Titled Performance and Detection of Genetic Algorithm for Object Classification: An Analysis of Image Quality, Accuracy, and Disease Detection Based on Features and Types. The green color consists of 12 items, namely: number, performance, object, feature, quality, classification, accuracy, genetic algorithm, detection, disease, type, and image. This keyword has been used and discussed in a study entitled; A Frame Work for Detection of the Degree of Skin Disease Using Different Soft Computing Model [24]; Performance of predicting surface quality model using soft computing, a comparative study of results [25];

A multi-objective evolutionary algorithm-based soft computing model for educational data mining: A distance learning experience [26]; Research on local feature indexing of multimedia video based on intelligent soft computing [27]; Comparison between soft computing methods for tomato quality grading using machine vision [28]; A Soft Computing Model of Soft Biometric Traits for Gender and Ethnicity Classification [29]; A soft computing approach to violence detection in social media for smart cities [30]; An Emerging Approach to Intelligent Techniques Soft Computing and Its Application [31]; Classification of dermoscopic images using soft computing techniques [32]; Soft Computing Techniques for Medical Diagnosis, Prognosis and Treatment [33]; Content-Based Image Retrieval Techniques for Mammographic Images Using Soft Computing Techniques [34].

Cluster 3. Entitled Task Implementation and Development of Human-Machine Interaction. The blue color consists of 5 items, namely: task, human, implementation, machine, and development. This keyword has been used and discussed in research entitled; Soft computing approaches for image segmentation: a survey [35]; Clustering of various parameters to catalog human bone disorders through soft computing simulation [36]; Implementation of violence detection system using soft computing approach [37]; A dual approach for machine-awareness in indoor environment combining pseudo-3D imaging and soft-computing techniques [38]; Design and Development of Safe Intelligent Moving Machine SIMM Using Soft Computing Techniques [39].

Cluster 4. Entitled Review of Soft Computing Techniques and Artificial Neural Networks in Computer Vision. The yellow color consists of 4 items, namely: artificial neural network, computer vision, review, and soft computing techniques. This keyword has been used and discussed in research entitled; Introducing the Visual Imaging Feature to the Text Analysis: High Efficient Soft Computing Models with Bayesian Network [40]; [41] Fuzzy classification for strawberry diseases-infection using machine vision and soft-computing techniques [41]; A comprehensive review and analysis of supervised-learning and soft computing techniques for stress diagnosis in humans [42]; Performance analysis of soft computing techniques for the automatic classification of fruits dataset [43].

The cluster density display is characterized by items that are indicated to be similar to the visible items. The item dots are coloured depending on the item density at that time. This can identify that the colour of the dots is still dependent on the items associated with other items. The Density Co-Word Map is useful to get an overview of the bibliometric map structure by showing which items are considered important to analyse [44]. Based on the research results shown in Figure 23, it can be interpreted that the most frequently used keywords in a publication represent the density map visualization of co-word development research on soft computing in computer vision.

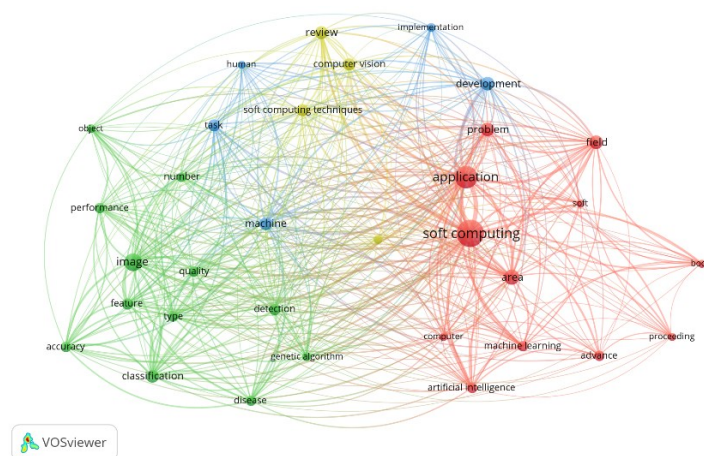


Figure 23. Co-word map network visualization

Figure 24 shows the density which is the result of analysis using all soft computing articles in computer vision from 2017-2021. The density map means that the more yellow the colour with the largest diameter of the circle, the denser the keyword means the more often it appears and if the colour fades to blend with the green background, the less often it appears. Density Map is a tool designed to display the density of genomic features along chromosomes, offering customizable color scales for optimal data representation.

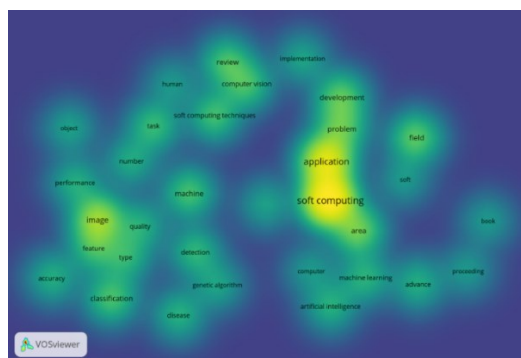


Figure 24. Co-Word Map Density Visualization

4. CONCLUSION

Based on the results and discussion above, it can be concluded that VOS Viewer can be used as a mapping tool to analyse data bibliometric. In this study, the data used in data analysis with VOS Viewer is Soft Computing research on Computer Vision taken from the Google Scholar database. The number of publications obtained and related to this theme amounted to 200 documents with a range of years 2017-2021. Changes in the number of publications in this period experienced fluctuating changes but tended to increase rapidly from 2020 to 2021. Through network visualization, it can be seen that the Soft Computing research development map on Computer Vision is divided into 4 clusters. Cluster 1 consists of 12 topics, cluster 2 consists of 12 topics, cluster 3 consists of 5 topics, and cluster 4 consists of 4 topics.

This confirms that among these clusters, Cluster One with 12 topics, is the largest and most significant cluster in terms of research activity. This cluster is titled "Application of Soft Computing in the Field of Artificial Intelligence and Machine Learning: Advances, Problems, and Proceedings" and includes topics such as soft computing, application, soft, problem, field, book, computer, artificial intelligence, machine learning, advance, area, and proceedings. The prominence of this cluster indicates a high level of interest and ongoing research efforts in these areas. Given the rapid advancements and the critical importance of these topics in the field of Natural Language Processing, it is evident that this cluster holds significant potential for future research. Continued exploration and innovation within this cluster are likely to yield valuable insights and advancements, making it a highly promising area for ongoing and future studies.

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