Research Article

Section: Literature, Linguistics & Criticism

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Social network analysis of digital volunteer on #GunungLawu hashtag of X application

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Abstract

This study aims to discover the role of disaster digital volunteers in the forest and land fires of a volcano in Indonesia named Gunung Lawu. They used the hashtag #GunungLawu through the social media Application X. This research method uses a quantitative method of crawling the hashtag data using the NodeXL Application. The population in this study was 1000 tweets using hashtag #GunungLawu from October 1, 2023, to October 25, 2023, and the sample obtained in crawling data and processing data was 834 actors (nodes). The theories used in this study are social network analysis, digital volunteer and social media. The results showed that accounts @jelajahi_idn level centrality actors have the highest level of popularity, @jelajahi_idn accounts are proximity centrality actors that have a close distance between one actor and another, @jelajahi_idn actors are intermediary centrality actors who are communication liaison actors on different communication networks, and @jelajahi_idn actors are eigenvector centrality actors who are essential in the network communication with other actors. The disaster digital volunteer proved their role could fill the information gap, which formal information from the government account or any formal information source could not be provided.

Keyword: Digital Volunteer, Gunung Lawu, Hashtag, Social Media, Social Network Analysis, X Application.

1. **Introduction**

Social network analysis is a crucial research method that allows us to identify a system's communication structure. It involves analysing relational data about communication flows, using interpersonal relationships as the unit of analysis (Erianto, 2014). This method, divided into 5 variables including degree centrality, closeness centrality, Betweenness centrality, eigenvector centrality, and clustering coefficient (Ramadhani and Arianto, 2022), has led to new findings regarding the analysis of Twitter's communication network. Specifically, it has shed light on the characteristics of centralised communication networks of @PBDjarum accounts and @lenteraanak (Miftakhul, Andre and Basuki, 2020). The application of social network analysis in disaster management, particularly in shaping and describing networks and network structures that occur on social media, is a significant development (Sari and Dwiyanti, 2018).

In this regard, it has been shown that the development of the Internet means that various phenomena can be explained through methods of analysis of communication networks (Bakry, 2020). Meanwhile, a network itself is defined as a group of actors who are related in some type of relationship with other actors (Sari and Dwiyanti, 2018). According to Mccay-peet and Quan-Haase (2020), Social media can be defined as a web-based service that allows individuals, communities, and organisations to collaborate, interact, and build communities that allow them to create, co-create, modify, share, and engage with user-generated content.

The cause of forest and land fires is defined as natural or human actions that cause the ignition and burning of forest and land fuels (Utomo et al., 2022). Forest and land fires are a crucial problem and require serious handling because these fires, in addition to causing environmental disturbances due to the smoke that arises, also result in loss of forest potential and decreased biodiversity (Munawaroh, 2021). Therefore, it is necessary to implement an effective and efficient forest fire control strategy.

Along with the times, volunteers are also allowed to come to help directly at the location. However, they can also be in the form of assistance in disseminating information on the Internet or social media. In other words, they are known as digital volunteers. A Digital Volunteer (digital volunteer) is: "*An individual that applies and leverages their technical skills in collecting, processing, and managing data to support response efforts for disasters. In most cases, he or she is not physically present at the place where the disaster has occurred*" (Robertoet al., 2017). Digital volunteers are beneficial in using social media to distribute disaster information (Fauziah and Zulkamain, 2023).

Despite its limitations, Twitter data analysis has shown promise in disaster management, particularly in hydrometeorological disasters. The findings from such analysis can help countries identify and develop strategies to accelerate vaccination rates. This is achieved by monitoring netizens' reactions and expressions on social media, particularly Twitter, using sentiment analysis (Ristya, Chien and Achmad, 2022). This potential offers a glimmer of hope in our collective efforts to manage and mitigate the impact of disasters.

Research by Parwanto and Mariyah (2018) has collected data from people's tweets in Indonesia since the beginning of 2018 and analysed the benefits of Twitter during and after disaster events. Analysis was also conducted to find out whether the volume of hashtags will spike during a disaster, who has the most Tweets, what information dissemination is most frequent in Tweets, whether Tweets Can be a reliable source of fast and efficient information in times of disaster, how-to content Tweets aforementioned.

So, this study tries to take tweet data on forest and land fires in Mount Lawu from Sunday

(10/1/2023) to Wednesday (10/25/2023). A blaze burns the forests and land of Mount Lawu in Jenawi, Karanganyar, Central Java. Mount Lawu Fire and Fire Weather, weather factors and wind direction make it difficult to fight fires not because of human activities. The impact of the fire that occurred in the Gunung Lawu forest was caused by several plants and animal feed burning down in the forest area. Even the impact of fires also causes the opening of vegetation, which can reduce water infiltration and cause flash floods or landslides if the weather is terrible. Several volunteers jumped in to help the blackout process by land, but later, the number decreased; the number of people who participated in extinguishing by land was around 70. Volunteers were reduced because the manufacture of veterans was enough, and the places reached were impossible for humans to reach.

2. Objectives of the Study

The purpose of this study is to discover a *novelty* that is an originality in research in the field of digital communication in the field of disaster information management studies, including:

1. To discover the role of digital volunteers in disseminating disaster information using *the hashtag* #GunungLawu, which helps speed up the dissemination of disaster information.

2. To find a communication network between digital volunteers in disseminating disaster information that can utilise the wealth of data on social media X.

3. To uncover the application of social network analysis in application x to the role of digital volunteers in disseminating disaster information that can be an input for the future of disaster information management in Indonesia.

3. Literature Review

Social Network Analysis

This emphasis on data on actors and relationships will provide an overview of the formation process of communication phenomena or events and decisive actors in the communication structure (Erianto, 2014). Communication structure is the arrangement of different elements in a patterned communication flow in a system. One of the goals of communication research using social network analysis is to identify these communication structures and, thus, to understand the big picture of human interaction in the Rogers and Kincaid systems (2015).

Social network analysis has two data analyses, namely whole network data analysis (complete network) and ego-centred network data analysis (ego networks) (Erianto, 2014). Eriyanto (2014: 14) states that communication networks offer several advantages. Communication networks describe processes so that they can explain the process of forming communication phenomena or events.

Network science focuses on studying network patterns that develop due to relationships between one person and another in society; as social creatures, humans cannot live alone. A person needs to contact or establish a relationship with another party for the specific purpose of affirming. A person participates in social relationships because of certain motives, such as Borrowing books, finding job information, adding friends, or simply strengthening social relationships that have been established before.

In communication network analysis, researchers can understand groups and how they are divided into sub-subgroups. Finally, researchers can examine how groups are interconnected in a global network. Analysing a network down to its parts is helpful, but network analysis can be much more

helpful. For example, by identifying its parts, network analysis can look at the quality of those parts or explain the functions the same links in a network or influence can fulfil.

Digital Volunteer

Especially for digital volunteers, the things that make them loyal in disseminating information even though they do not meet each other are the desire to use and improve technical knowledge, especially in ICT (Information Communication Technology) (Roberto et al., 2017). Volunteers become loyal to their community because several things influence them, such as ideology, personal satisfaction, community, and human values.

Volunteers are different from paid employees because they usually accept assignments without expecting monetary compensation (Connolly dan Jones, 2015). Dealing with the negative impacts caused by natural disasters is not easy and requires the cooperation of many close parties, such as a volunteer. The author aims to examine the urgency of altruism and the resilience of digital volunteers in natural disaster management. The result of this study is digital volunteers, who volunteer their time, energy, and money to help others affected by natural disasters. They look at the tragic reality of natural disasters that claim many lives.

Research by Arthur et al. (2014) indicates that a person is volunteering for a variety of different reasons, including opportunities to make new friends, build and strengthen social networks, gain skills, knowledge, and experience or share and develop skills and knowledge that benefit community members, volunteers, and other professionals. When facing problems in the field, a volunteer must develop effective ways of dealing with them (Grace et al., 2021).

Social Media

Social media is one of the most widely used communication tools in society today. Currently, social media, especially App X, is considered to play a role as a real-time communication tool in the emergency response process and has the potential to be a source of information for related parties to identify emergency events.

App X is a social media platform that users can use to send and read text-based messages called tweets (Layalia et al., 2021). In this study, the wheel communication pattern formed is asymmetrical. This pattern arises because network connections in Application X occur not only between actors who follow each other.

Features of App X, such as the user's ability to follow or be followed by others without reciprocity and the user's ability to view content Tweets that other users post without following them, affect the resulting communication patterns. Asymmetric relationships occur in one direction, where the communicating party has a role but no role (Erianto, 2014). In this study's context, some actors have informative roles, and some do not.

According to Paul Bradshaw, news online is characterised by a fundamental or concise nature, adaptability, ease of navigation, interactivity, community, and conversation. In the context of this study, other actors who have relationships with news actors can be called audiences because these actors are the ones who select the messages conveyed by news actors. It also fits the definition of an audience as a person who chooses media products based on conscious choice (Nasrallah, 2019).

When writing the name of Mount Lawu, various links will appear with the character, both those who

use hashtags (#GunungLawu) and those who do not (Gununglawu). The username or account address is marked with the "@" symbol so that the name that appears is @Gununglawu.

The search facility is not only used to find other accounts but also to search for topics that are currently being discussed. In Application X, hashtags (#) are keywords in written tweets. Anyone interested in the hashtag can join in by tweeting a tweet related to the topic on the hashtag. The more often the hashtag is used, the greater the chance of the topic becoming trending or most discussed.

In general, media can be divided into 3, namely print, electronic, and new media (new media) (Humaizi and Siti, 2019). Several studies try to understand information distribution patterns and find key players in information distribution on social media, one of which is Application X, by using social network analysis methods so that mitigation actions can be taken (Anwar et al., 2018).

Hashtag #GunungLawu

The hashtag feature also acts as an identity and sign of unique information that becomes the medium and characteristic of messages conveyed via Twitter (Ikhsan, 2022). Mount Lawu is a mountain located on the border of Central Java and East Java. In more detail, Mount Lawu has three sides to the slope: the western slope is under the administration of Karanganyar Regency, Central Java, and the northern slope is under the administration of Ngawi Regency, East Java.

Ground efforts were carried out again on the slopes created by about 150 joint personnel for the blackout. If found, fire spots can be extinguished. In addition, air blackouts with "water bombing" are also still carried out alternately in the three regions.

Dissemination of forest and land fire information (karthula) through social media Application X, but the name of Application X has been changed to X. Application X's logo change is also intended to support the business the company will develop. Note that, in October 2022, Musk said that buying App X was a step to speed up the creation of X. Elon Musk has also changed the name of the X App company. Previously, the app company App X was named App X Inc. After that, Musk changed its name to X Corp in October 2022. The move to rename the X Application company to X Corp is likely because Elon Musk wants to merge the social media platform into the supper app he will develop.

From disseminating news about Mount Lawu forest and land fires, the hashtag (#) became one of the trending lists on social media Application X on (01/10/2023). The mountain, located on the border of Central Java and East Java, is one of the climbers' favourite mountains. In addition to the natural beauty factor, ease of access is another reason.

4. Methods and Data
Method

A suitable method is needed to run smoothly and correctly; the important thing is that researchers can understand the problems to be studied. Therefore, researchers adopt quantitative research methods. As stated (Sugiyono, 2020), the quantitative research method is based on the philosophy of positivism used to study specific populations or samples and utilise research tools to analyse the data. According to Rahmi et al. (2023), the population is the entire research object, including humans, animals, objects, events, symptoms, and test scores used as data sources with specific characteristics in ongoing research. Analysis of the text in the comment column using NodeXL software is good quantitatively. To obtain data related to social media users and their networks, the researchers used social media data download technology through NodeXL software.

Data

This research is a network or relationship formed between users on a social media platform (Application X) due to discussing a particular problem. Conversations between social media users can range from thousands to millions of people, which will be a problem in sampling. Sampling always starts with the population, for which our findings will be generalised. The population must be determined precisely because the population is the basis for sampling. Incorrect population determination will result in sampling that does not reflect the population to be studied. Demographic determination in social media analysis is based on participants using social media to discuss specific issues. In the study, we wanted to understand social media users' response (engagement) to the discussion of forest and land fires (karhutla) on Mount Lawu.

As a study, we only want to talk to social media users about forest and land fires (karhutla) on Mount Lawu in the period from (01/10/2023) to (25/10/2023). Software-wise, researchers only need to perform a filter by taking social media user data from the start date (01/10/2023) to the date (25/10/2023). So, the population of this study is tweeted with hashtag #GunungLawu from 01/10/2023 to 25/10/2023, with a limit of 2,000 tweets on NodeXL. While the sample is 834 tweets that have been filtered using NodeXL.

5. Empirical results and discussion

Vertex/actor

Network visualisation was carried out using NodeXL software with an area of 1,000 data for the social media platform application x after being crawled to 834 data. In this study, 834 actors were formed with the number of interactions spreading the Gunung Lawu hashtag in the social media application x. Several concepts in NodeXL need to be understood. For example, the vertex represents an organisation, group, or individual in a network. Vertex is the name associated with a communication network.

Edges

Edges indicate interactions that occur between actors, with higher edge values indicating the number of conversations on social media Twitter that discuss "#gununglawu" messages. NodeXL obtains edge results for the keyword "#gununglawu" as many as 1136 edges. Edges the number of vertex pairs that are repeated on the edges worksheet.

Network Type

Egocentric networks: talk about networks that involve users (egos) and other users who act as "alters". Full network: contains all the people or entities of interest and their connections. Network analysis determines the actors who use #gununglawu hashtags to play a role in communication networks for the spread of forest and land fires (khutba). The analysis of communication networks found that communication networks formed in business activities are ego networks and human-centred networks. The number of bonds (links) formed is 225 bonds, where the bonds are formed between different actors. From the results of communication network mapping, the density of alter to change actors does not reach 1, which means far from the network density. Based on the research collected, the dataset has a type of network, namely ego- --networks of actors related to disseminating forest and land fire information in Gunung Lawu. It can be seen that the central figures, namely the figures of jelajahi_idn, jateng_twit, and convomfs, are the central figures and the activities of the Mount Lawu care movement. The sociogram shown in the figure shows that the ego network of the #gununglawu hashtag is much

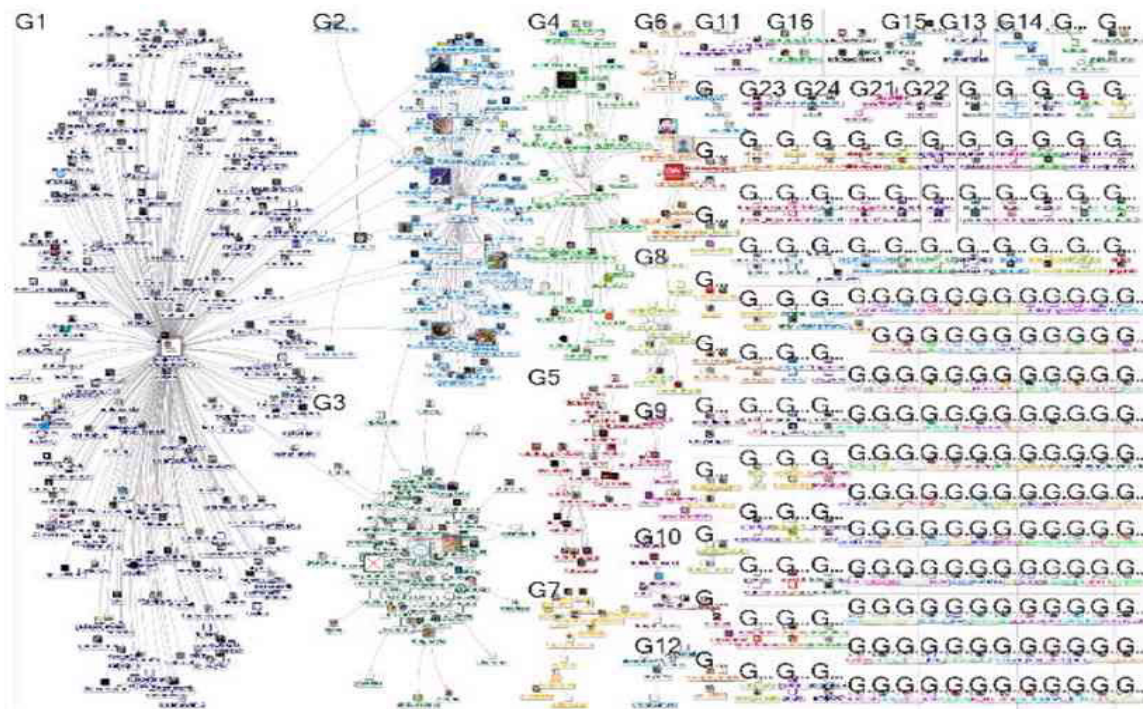more complex. This happens because the number of edges and vertices around the network structure is enormous.

Figure 1: Ego Network of Actors Related to #GunungLawu

Degree centrality

The count of the unique sides connected to it shows the actor's popularity in social networks. As the first rank in disseminating forest and land fire information, Gunung Lawu has a *degree* of 229, which is higher than other x application users. As shown in the following figure no. 2:
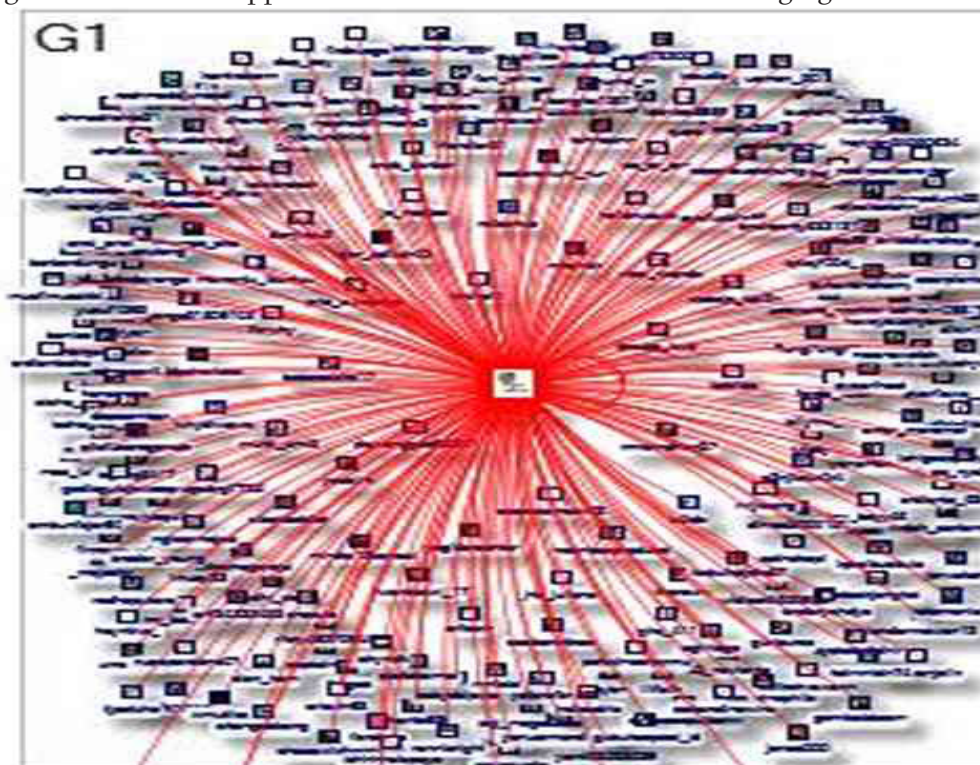

Figure 2: Actor Popularity Communication Network (Degree Centrality)

Influence metrics are the total number of fans or followers and the information that can be used to determine how much influence is formed. From the results of network graph analysis, it can be seen that in disseminating information related to the issue of democratic coups, the most influential and influential actors include @jelajahi_idn accounts, @jateng_twit and @conomfs. An account can be considered a top influence because of the ability of the account to be an intermediary between one actor and another (Erianto, 2014). These key actors play an essential role in forming relationships within the group and creating topics of conversation, thus providing trigger points for other actors to interact with each other using the hashtag #gununglawu. By analysing social network analysis tools, you can understand the popularity of popular accounts by looking at the statistical percentage of the tweet posted by any popular account.

Table 1: Popularitas Aktor (Degree Centrality)

Nama Aktor	Total *Tweet*	Level Top Account
@jelajahi_idn	229	1
@jateng_twit	82	2
@convomfs	60	3
@langkahanies	37	4
@idn_horor	11	5

Beetweennes centrality

Actors with an intermediary position did not take sides with any camp—connecting various parties neutrally. The value of Betweenness centrality @jelajahi_idn is 156074,166667, which means that @jelajahi_idn has two roles in this network, namely as a source of information as well as an intermediary or glue (outpoint) of relations between actors in the Gunung Lawu network. Although popularity is essential, uniting the group is also important. Besides being popular, @jelajahi_idn also acts as an intermediary that bridges the interests of various circles.

Table 2: Actors Who Have Intermediary Positions (Beetweennes Centrality)

Nama Aktor	Total *Tweet*	Level Top Account
@jelajahi_idn	156074,167	1
@jateng_twit	72540,333	2
@convomfs	55194,833	3
@langkahanies	31426,000	4
@idn_horor	237,000	5

Closeness centrality

It calculates the average shortest distance of each node to each other. A lower closeness centrality score indicates a more central position in the network. The @jelajahi_idn actor has a closeness centrality value of 0.252, indicating that the @jelajahi_idn actor is not passive and becomes an actor who is close to other actors. The @jelajahi_idn actor on this network contacts the @ayy_kusumaa actor by mentioning the actor, so the actor@jelajahi_idn has an out-degree score. This is because @jelajahi_idn actor has

relationships with other actors on this network, namely @ayy_kusumaa actors. This relationship is formed because the @jelajahi_idn actor has mentioned actor @ ayy_kusumaa, while press actors and actors with a significant degree of centrality never retweet, reply, mention, or quote other actors. So, @ jelajahi_idn actor is an influential and active actor because he has a closeness centrality value compared to other actors.

Table 3: Actor Closeness (Closeness Centrality)

Nama Aktor	Total *Tweet*	Level Top Account
@jelajahi_idn	0,252	1
@ayy_kusuma	0,199	2
@insana	0,199	3
@pliketdeq	0,199	4
@ayunabylla	0,199	5

Eigenvector centrality (sentralitas eigenvektor)
Taking into account considerations not only how many connections the vertex has but also the quality of the actors connected to it. Quality means accessing economic, political, social, and power resources. The size of the feature eigenvector centrality network considers more than just what number of connections the node has (i.e. its degree) and the level of nodes connected to it jelajahi_idn and jateng_twit are the individuals who act as feature vectors because both these individuals have high-quality networks of social media users.

Not only are jelajahi_idn and jateng_twit leaders of public opinion, but they also play crucial roles as '*betweenness*' and '*eigenvector*' in the formation of public opinion. Their influence is significant and far-reaching.
 jelajahi_idn has a connectedness score of 156074.166667, while jateng_twit has a connectedness score of 72540.333333. Jelajahi_idn and jateng_twit can act as intermediaries that connect various groups. While the eigenvector score owned by jelajahi_idn is 0.717019, and the eigenvector value score is jateng_twit 0.034366. jelajahi_idn and jateng_twit act as eigenvectors because they have more communication networks with X application users with social, economic, and political quality.

Table 4: Last Value (Eigenvector Centrality)

Nama Aktor	Total *Tweet*	Level Top Account
@jelajahi_idn	0,717	1
@jateng_twit	0,034	2
@convomfs	0,004	3
@langkahanies	0,003	4
@idn_horor	0,000	5

Cluster
The formation of issues in society and social media will be responded to in various forms, such as accepting (positive) and rejecting (negative). The formation of *these responses* is called *clusters*. In some cases of forest and land fires on Mount Lawu, one's friends may be friends with each other. For example, three good friends in the information dissemination of #gununglawu hashtags such asjelajahi_

idn, jateng_twit, and convomfsare, all connected to each other, creating a click like an impact in the following image:
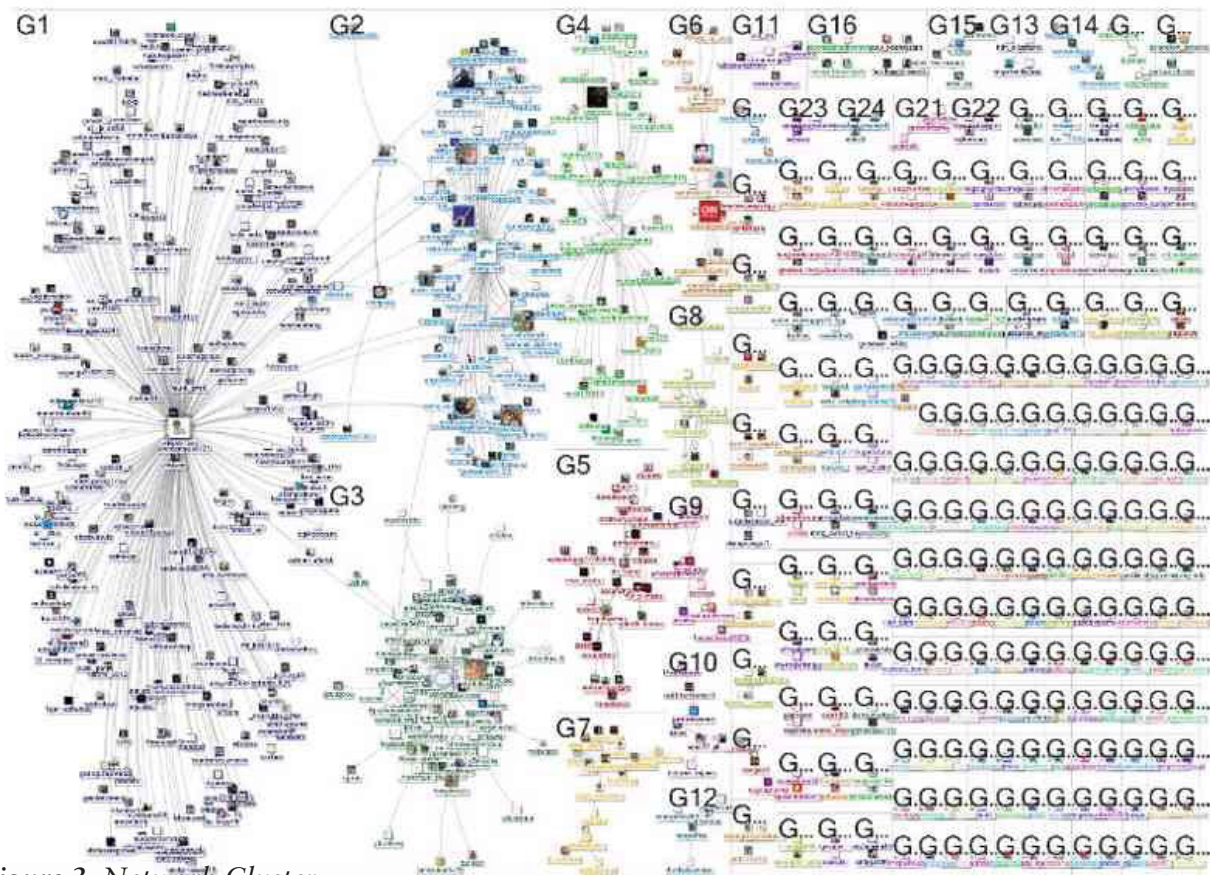

Figure 3: Network Cluster

Network analysis produced by the NodeXL software shows that clusters formed on the network of application users x as many as 225 clusters. There are four most significant clusters in the X application user network, namely: the "wongindonesiaok" cluster, the "teratoid" cluster, the "comedian" cluster, and the "drawing" cluster. You can see 2 *clusters* of applications x users and two neutral groups from the four clusters. The number of x application users who are cluster members shows that the "wongindonesiaok" cluster has 830 users. The following ranking is the "tirtoid" cluster with 829 users and finally, the "ykomedian" cluster with 828 users. Looking at this fact shows that application x users of 834 are floating masses who have not decided to side with any of the #gununglawu hashtags.

Table 5: Group Cluster

Group	Vertex	Vertex ID
@jelajahi_idn	Wongindonesiaok	830
@jateng_twit	tirtoid	829
@convomfs	ykomedian	828
@langkahanies	Dzawinur	827
@idn_horor	pusmeowmeow_	826

Top tweet, mentions, dan sentiment

Issues or topics discussed on social media will create various kinds of responses; analysis of social media

user responses is fundamental to understanding what is widely discussed (*Top* Tweets), giving responses in particular mentions and sentiments. The most commonly used words in networking are Gunung, Lawu and Di. The word mountain was used 1,090 times, the word lawu was used 1,056 times, and the word fire was used 228 times. For example, the top *tweets* in #gununglawu hashtag communication network research like a mountain has *1090 tweets, and lawu has* 1056 *tweets* in the table no. 6 below:

Table 6: Top Word in Tweet

Top Words In Tweet in Entire Graph	Entire Graph Count
gunung	1090
lawu	1056
of	462
rt	429
from	366
tawangmangu	285
instagram	277
masbeepe	277
Views	276
Fire	228

Since Twitter is a networking platform, it must interact with the top mentions, no matter if it is positive or negative. For example, the top *mentioned* in #gununglawu hashtag communication network research, such as the @jelajahi_idn account has graph 228, and @jateng_twit has graph 88 in table no. 7 below:

Table 7: Top Mentioned

Top Mentioned in Entire Graph	Entire Graph Count
jelajahi_idn	228
jateng_twit	88
langkahanies	37
beritajatimcom	36
convomfs	15
idn_horor	14
Size Portals	11
jatengnews_id	8
threa	6
idntimesjatim	6

Based on this analysis, people's views on a problem vary on the issue of Mount Lawu. Based on the data obtained, this result shows that the community that cares about Mount Lawu is 7% neutral. Meanwhile, the percentage of people who contradict and oppose this issue is 5% and 6%, respectively. This data shows that based on the data obtained, actors in the network tend to be more neutral towards Mount Lawu news. This can be used as a reference to take the following steps in responding to this issue.
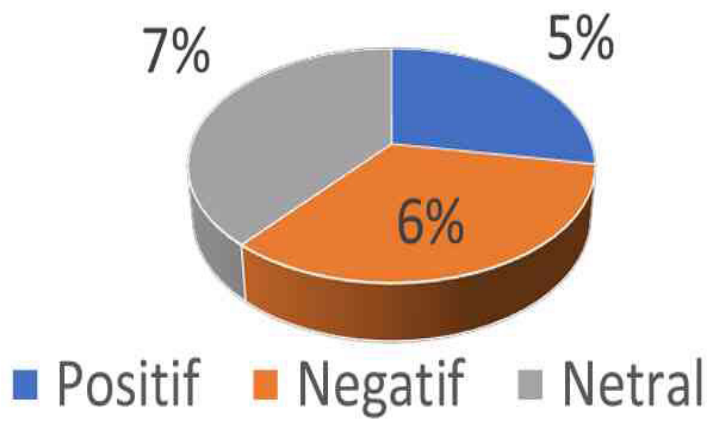
Figure 4: Public Sentiment on Gunung Lawu News

In the next hold, a data reduction process will be carried out to ensure that the data taken or filtered is according to research needs so that the presentation and analysis of the data below have been adjusted to the needs of the data in answering research questions. The results and data analysis related to the topic of the #gununglawu hashtag will be displayed below in figure no. 5.
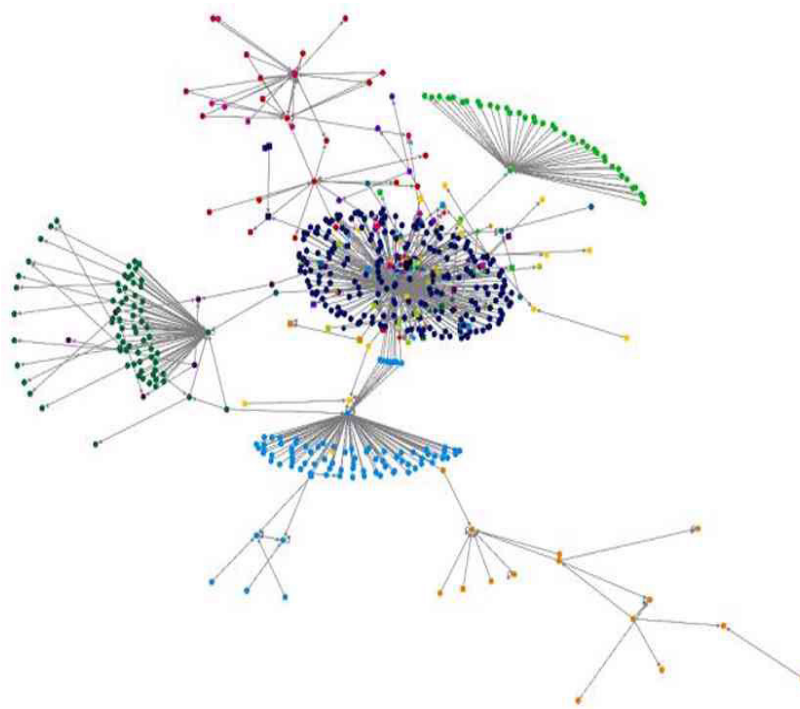

Figure 5: Sentiment Relation to Fire and Fire Spread #GunungLawu

Table 8: Sentiment Spread of Main Actor Relations #GunungLawu Hashtag

Line Colour	Sentiment	Information
	Positive	Line colour green actors are more as *tweet* actors (*nodes*)
	Neutral	Line colour blue actors as unrelated actors
	Negative	Line colour red actors as actors who have low popularity

The metric is the number of users who use hashtags/keywords. Based on the data obtained, 834 x application users *(vertice)* and 1,136 relationships *(edge)* formed in disseminating information about forest and land fires in GunungLawu from October 1 to October 25, 2023. There is also social media activity among users based on *tweets*, *retweets*, and replies. During the specified data collection period, 1,136 *tweets* related to forest and land fires in Mount Lawu were recorded. Based on the time series data obtained, it can be seen that the intensity of *tweet* uploads fluctuates within a certain period. The intensity of uploads or activities of net citizens began to be seen; on October 1, 2023, there were 1,136 tweets and uploads on that day. Until October 16, 2023, the highest number of tweets related to Mount Lawu was 218. This shows that what happens on social media reflects what is happening in the real world. A real-world furore about Mount Rawu occurred on the Twitter *timeline*.

Table 9: Time Series

Date/Month	Number of *Tweets*
02-Oct	1
05-Oct	14
06-Oct	53
07-Oct	50
08-Oct	28
09-Oct	40
10-Oct	44
11-Oct	18
12-Oct	15
13-Oct	27
14-Oct	105
15-Oct	83
16-Oct	218
17-Oct	165
18-Oct	74
19-Oct	51
20-Oct	25
21-Oct	39
22-Oct	55
23-Oct	7
Total	**1.134**

6. Conclusion

Things that become essential findings and conclusions in this study are:

1. The role of digital volunteers was successfully found by involving 834 *vertices* as accounts that provided disaster information and played an active role in its dissemination. This is evidenced by the 1,136 *edges* or relationships established using #GunungLawu hashtags during the *data crawling* period 1-25 October 2023. The existence of digital volunteers is actively proven to be able to fulfil disaster information in Application X (ex-Twitter) during forest and land fires that hit Mount Lawu.

2. Analysing the communication network of digital volunteers who disseminate disaster information has revealed the power of social media data. *This* network, centred on one issue (using #GunungLawu hashtags), is a testament to the effectiveness of hashtags in the X application (ex-Twitter) as a rich source of information. This data becomes particularly crucial in the disaster response stage, a pivotal point in disaster management. The information disseminated by digital volunteers on social media serves as a vital foundation for disaster management decision-making.

3. The social network analysis results successfully show digital volunteers' vital role in disseminating information with #GunungLawu hashtags through data on social media X (ex-Twitter). These findings inform the disaster management response stage, which in the future must involve social media as an essential aspect of disaster management in Indonesia. Using data on social media will save budgets, be efficient in time allocation, and be influential in determining disaster management planning steps.

Statement: This study is an original work by me and has not been published anywhere else.

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