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COSINE SIMILARITY IMPLEMENTATION IN INVESTIGATION ANALYSIS *CYBERBULLYING*ON TWITTER WITH NIST FRAMEWORK

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Abstract

Twitter users in Indonesia in 2021 are recorded at 63.6% of the total population and ranks 5th on social media that are often accessed by Indonesian people. The higher level of Twitter users provides opportunities for users to commit cybercrime such as cyberbullying. Victims of cyberbullying are more prone to depression than other victims of verbal abuse. Seeing the impact, it is necessary to take steps to overcome cyberbullying with forensic investigations to prove and find digital evidence that helps resolve cyberbullying cases that are rife on social media such as Twitter, so that it can be submitted as strong, concrete evidence, and can be processed in court. The purpose of this study was to find digital evidence and identify acts of cyberbullying on the Twitter direct message group with the NIST (National Institute of Standards and Technology) methodology. This study succeeded in obtaining digital evidence in the form of text conversations on the victim's smartphone which was extracted with the MOBILEdit Forensic Express tool and analyzed by text processing, weighting terms/words, and applying the cosine similarity formula to identify cyberbullying. The results of the study show that the NIST has succeeded in raising evidence for reporting evidence. The cosine similarity method succeeded in identifying sentences that indicated bullying with different values, the perpetrator with the highest score reached 0.377, while the perpetrator with the lowest score touched 0.

Keywords*: digital forensics, cyberbullying, cosine similarity, nist, twitter*

1. INTRODUCTION

Twitter is a social media with a simple and easy interface to share information in the form of text, photos and videos(Chamidah and Sahawaly, 2021). Twitter users in Indonesia in 2022 are recorded to have reached 58.3% of the total population and rank 6th as the social media that is frequently accessed by Indonesian people according to a survey from Wearesocial Hootsuite as shown in Figure 1 below.

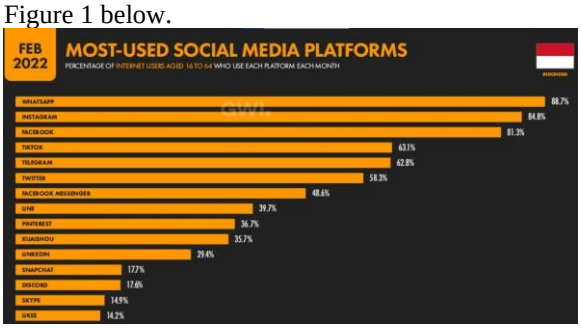

Figure 1. Statistics of the most widely used social media in Indonesia

2. LITERATURE REVIEW

Currently, Twitter is widely used by Indonesians, both as individuals, communities, organizations, and government institutions with various purposes and objectives such as promotional platforms, information media, and so on. Twitter offers many benefits, but not a few users who are not wise enough to cause negative impacts(Abdulloh and Hidayatullah, 2019).

The increasing number of Twitter users has resulted in a higher probability of crimes such as fraud, extortion, defamation, cyberbullying, etc.(Abdulloh and Hidayatullah, 2019). The increase in Twitter users provides an opportunity for anyone to have an opinion because of its nature which tends to be anonymous so that it triggers users not to hesitate to do cyberbullying.(Chamidah and Sahawaly, 2021).

*Cyberbullying*is an intimidating attitude that is carried out by someone on a continuous basis to humiliate and harm the victim using the help of information technology(Pandie and Weismann, 2016). Cyberbullying can be carried out through messages with negative or unkind words that refer to ridicule such as abnormal, idiocy, stupid, bad, crazy, ugly, treacherous, and hypocritical.(Widiandana, Riadi and Sunardi, 2019). Forms of cyberbullying on Twitter such as swearing or mocking (flaming), sending or posting grapevines, or rumors to destroy a person's good name (denigration), as well as commenting to denounce a person's figure, size, and physical appearance or body shaming(Chamidah and Sahawaly, 2021).

*Cyberbullying*able to attack anyone regardless of background and status of a person, researchers found that cyberbullying victims are prone to depression compared to other victims of verbal violence(Chamidah and Sahawaly, 2021). Cyberbullying is a treatment that is not justified for any reason. Based on Law Number 19 of 2016, that cyberbullying is categorized as a crime because it includes intentional acts that cause harm so that victims are entitled to defense in the eyes of the law(Paat, 2020).

Indonesia has Law Number 11 of 2008 concerning Information and Electronic Transactions (UU ITE) and its amendments which are referred to as the legal basis for cyberbullying(Paat, 2020). It also regulates legal consequences where those who violate will be subject to Article 27 paragraph (3) of the ITE Law with a prison sentence of at least 4 years and/or a fine of Rp. 750 million, while from the perspective of cyberbullying perpetrators, they are entangled in Article 27 paragraph (4) of the ITE Law with (maximum) 6 years in prison and/or a fine of Rp. 1 (one) billion (www. Hukumonline.com).

The impact of cyberbullying on victims is the emergence of psychological conditions that are depressed and even have the potential to close their life history(Chamidah and Sahawaly, 2021). It is known that one in five children who are victims of cyberbullying has the thought of ending their life, even one in ten victims of cyberbullying dies on purpose. Within a year, there are some 4500 children who commit suicide due to cyberbullying(Gumbira, Sulistiyono and Tejomurti, 2019).

One example of a cyberbullying case is Ruben Onsu's child, Betrand Peto, who experienced acts of bullying or bullying on social media by a number of individuals and ended up bringing the problem to court (www.kompas.com). The most recent case was in April 2021, a same-sex couple from Thailand who had just got married received a lot of criticism from the Indonesian people which occurred through uploading their second wedding celebration on social media and in the aftermath, the couple took this matter to legal channels (www.kompas. com).

Seeing the impact, steps are needed to overcome cyberbullying such as investigative analysis to prove and find digital evidence that helps resolve cases of cyberbullying that are rife in cyberspace through social media such as Twitter, so that it can be submitted as strong and concrete evidence of cyberbullying and being processed in court(Widiandana, Riadi and Sunardi, 2019).

In previous research by Riadi, Yudhana and Putra (2018) in acquiring digital evidence of cyberbullying on the Instagram Messenger application, this digital evidence was successfully found and can be used to facilitate investigators in identifying cyberbullying actions. In research conducted by Widiandana, Riadi, and Sunardi (2020) conducted an investigative analysis to uncover cases of cyberbullying by looking for digital evidence on the Whatsapp application. Based on previous research, it was found that potential evidence such as date or time, text, even photo

images can be found on social media applications(Riadi et al., 2018). In the research of Widiandana, Riadi, and Sunardi (2019) the National Institute of Standards and Technology (NIST) framework is a framework in digital forensics with work guidelines that comply with national standards and policies, thus ensuring that all who apply this method use the same workflow, repetitive and consistent. Proven in research(Star, Umar and Yudhana (2020)in raising digital crime evidence on the Facebook Lite application using the NIST framework.

Based on the things described earlier, this study will conduct an investigative analysis to identify cyberbullying actions that often occur on social media applications such as Twitter using the NIST framework so that it can assist investigators in handling cyberbullying cases. This study aims to apply the NIST framework to search for digital evidence on the Twitter group message feature and prove cases of cyberbullying with digital evidence of text conversations that have been obtained with the help of MOBILEdit Forensic Express, as well as evaluate the results of digital evidence obtained by applying text processing and the cosine similarity method based on references. from previous research. The stages of this research follow the NIST forensic investigation framework which is based on Syahib's research,(Shahib, Riadi and Umar, 2018)

3. RESEARCH METHODS

This research implements the NIST or National Institute of Standards Technology forensic framework. The process of acquiring evidence is carried out with the help of the Forensic MOBILEdit tool then text mining is applied to process digital evidence in the form of conversational text, and the Cosine Similarity method to support the process of identifying cyberbullying cases.

3.A. Research methodology

This research applies the National Institute of Standards and Technology (NIST) framework which is used to obtain information from digital evidence which consists of four structured stages, namely collection, examination, analysis, and reporting which are expected to be applied as a guide to assist in the investigation of cyberbullying cases.(Widiandana, Riadi and Sunardi, 2019). The research stages based on the NIST framework are represented in Figure 2 below.

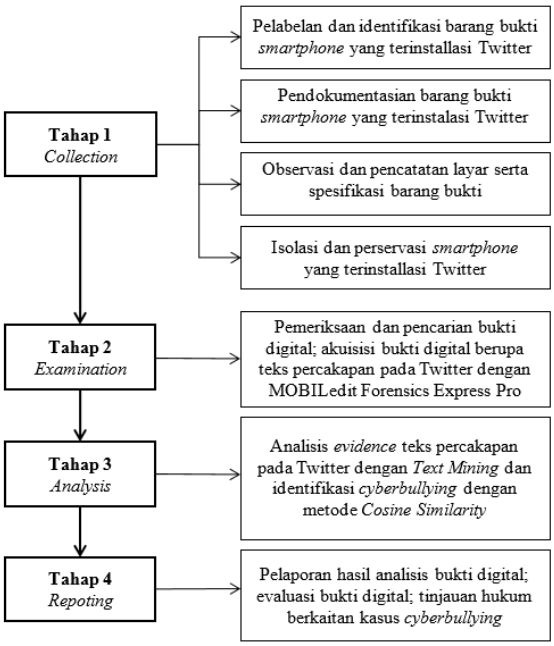

Figure 2. Research flow

1. *collection*

The collection stage is a stage composed of preparation, collection, documentation and isolation of evidence(Nasirudin, Sunardi and Riadi, 2020). Collection is the initial stage of a series of NIST frameworks where at this stage it is carried out with detailed design activities including labeling and identification of evidence obtained in the form of a smartphone installed with the Twitter social media application which is suspected of being used as a medium for carrying out acts of cyberbullying. Then document the evidence obtained in the form of a smartphone installed with the Twitter social media application. Furthermore, observing text conversations on the Twitter direct message feature installed on smartphones, and isolating and securing evidence so that it is not contaminated by unauthorized parties and maintaining the integrity of the evidence obtained.

2. *examination*

The examination stage is the step in the inspection process after digital data is found(Faiz, Prabowo and Sidiq, 2018). Examination is the next stage where an examination is carried out on the Twitter social media application installed on the smartphone to be extracted. Conversational texts in Twitter direct messages are then extracted by utilizing assistance in the form of forensic tools such as MOBILedit Forensic Express so that conversational text data is obtained from the victim's smartphone, and then analyzed to identify whether it contains elements of cyberbullying or not.

3. *Analysis*

The analysis stage is analyzing digital evidence that has gone through the inspection process and then reprocessed to obtain information related to the

case(Shahib, Riadi and Umar, 2018). The analysis was carried out to identify whether there was evidence of cyberbullying in the evidence of conversational text from Twitter direct messages that had been extracted from the previous examination process.

The stages of this analysis are carried out using text mining which begins with text processing consisting of case folding, tokenizing, stopwords, and stemming.(Sunardi, Yudhana and Mukaromah, 2018). Then the results are weighted by TF-IDF, and applying Cosine Similarity to identify the cyberbullying index in the conversation data that has been obtained. The following analysis process carried out is represented in Figure 3.

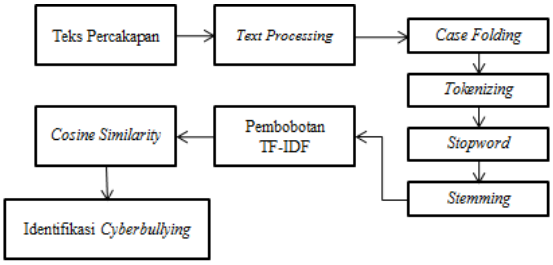

Figure 3. Stages of analysis with Text Mining

4. *reporting*

*reporting*is the final stage of a series of NIST frameworks after three successive stages. The results of decoding and analyzing digital evidence and crime cases that have been obtained for further reporting at the reporting stage(Shahib, Riadi and Umar, 2018). At this stage there is a process of reporting and submitting the results of the process of identifying conversational text that is suspected of containing elements of cyberbullying on the Twitter social media application so that the results can be used as valid evidence to be processed in the realm of law, in addition to evaluating what digital evidence is obtained and the performance of the tools used, as well as a discussion in terms of legal review related to cases of cyberbullying on social media.

3.B. Tools and materials

The tools and materials implemented in this study are software which is a forensic tool and hardware in the form of a smartphone which is evidence belonging to the victim. Following are the specifications of each tool and material used shown in Table 1.

Table 1. Research tools and materials

No.	Item name	Specification	Information
1.	Laptops	-Acer Aspire V5-132 - OS Windows 8.1 Single Language with Bing - Ram 2.00gb - Processor Intel(R) Celeron(R) CPU 1010Y @ 1.00 GHz	Hardware for the acquisition process
2.	*Smartphones*	-Oppo A37F - Android version 5.1.1 Processor Qualcomm MSM8916 QuadCore - 2.00GB of RAM	Hardware as digital evidence
3.	USB cable	Connector	Hardware as a connecting smartphone to a laptop
4.	MOBILedit Forensics Express	-Pro Version 7 -*tools*forensics	Software for the acquisition process
5.	Twitter	Version 8.64.0-release.00	Media software cyberbullying cases occur.

3.C. Case Scenario

In this study, case scenarios are arranged in a conversation on the Twitter direct message feature carried out by the perpetrator to the victim. The case scenario is based on Law Number 11 of 2008 concerning Electronic Information and Transactions (UU ITE) and its amendments which are referred to as the legal basis for cyberbullying. In this case scenario 4 (four) people will act as perpetrators and 1 (one) person as a victim. The illustration of the designed case scenario in Figure 4 is as follows.

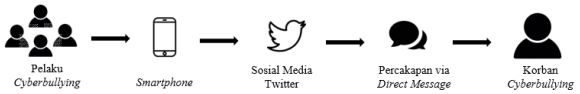

Figure 4. Case scenario

In this case scenario, there are 5 (five) Twitter user accounts that were created intentionally and are fake for research purposes. The five Twitter account users communicated with each other and conducted group conversations via Twitter direct messages containing sentences that indicated cyberbullying, where 4 (four) users were the perpetrators and 1 (one) user would act as the victim.

A series of incidents of cyberbullying cases carried out through group chats of the group message feature on Twitter are simulated to make it easier to identify cyberbullying cases(Riadi, Sunardi and Widiandana, 2020). The victim followed up on the incident by reporting the case to further search for evidence and analyze and identify the alleged cyberbullying case. The flow of events in the cyberbullying case that was made can be seen in Figure 5 as follows.

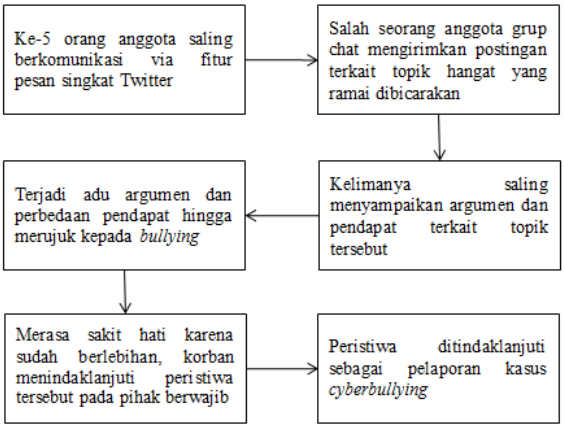

Figure 5. Case simulation

3.D. *TextMining*

*Text Mining*described as the process of obtaining information from various unstructured documents so that the many documents can be identified(Widiandana, Riadi and Sunardi, 2020). The stages of Text Mining can be seen in Figure 6 below.

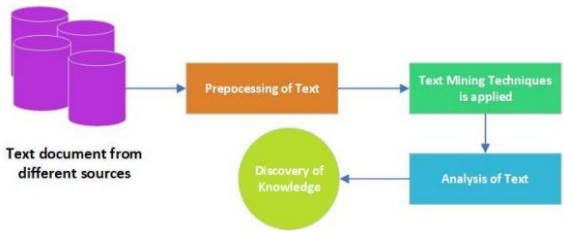

Figure 6. The stages of text mining (Source:(Widiandana, Riadi and Sunardi, 2020)

*Text mining*starting with text processing which is the initial preparation for transforming text which was originally in the form of a document by breaking the whole document into a set of phrases/words(Fadelillah et al., 2017). Henceforth, this initial stage is followed by steps such as changing the initial structure of sentences/words (case folding), reaping sentence constructors (tokenizing), removing unnecessary sentence structures (stopwords), and transferring words to basic forms (stemming).(Sunardi, Yudhana and Mukaromah, 2018).

3.E. TF-IDF weighting

TF-IDF is a word weighting technique that functions to calculate the weight and weigh the importance or not of a word in a document or category.(Kowsari et al., 2019). The more words that appear impact the greater the weight(Riadi, Sunardi and Widiandana, 2020)as can be seen in Equation 1.

$$\mathrm{W(d,t)} = TF\ (d,t) \qquad (1)$$

Inverse Document Frequency(IDF) is the number of documents containing terms/words that are counted(Riadi, Sunardi and Widiandana, 2020)through Equation 2.

$$IDFt = \log 10\ (\frac{N}{dft}) + 1 \qquad (2)$$

N is the calculation of all documents in a set of documents and dft is the calculation of documents containing the target word. TF-IDF multiply the weight of TF with IDF of each word(Riadi, Sunardi and Widiandana, 2020)according to Equation 3 below.

$$Wd,t = tfd,t\ x\ IDFt \qquad (3)$$

3.F. *Cosine Similarity*

This study also applies the cosine similarity method to identify indications of cyberbullying. The set of notations that represent Cosine Similarity is clearly shown as in Equation 4(Pradnyana and Sanjaya, 2012).

$$Cos\ (Q,d_i) = \frac{\sum W_i \cdot W_Q}{\sqrt{\sum W_q^2} \cdot \sqrt{\sum W_i^2} \cdot} \qquad (4)$$

Information:

Cos (Q, di) : value of cosine similarity in Query (keyword) with the i-th document

Wi : the word weight of the i-th document

WQ : Query weight (keyword)

4. RESULTS AND DISCUSSION

4.A. *collection*

At this stage, a series of activities were carried out including labeling and identification of evidence obtained in the form of a smartphone installed with the social media application Twitter which was allegedly used as a medium for cyberbullying.

Furthermore, the documentation of the evidence obtained was in the form of a smartphone installed with the perpetrator's Twitter application as shown in Figure 7 below.

Figure 7. Documented evidence

Then, the digital evidence was observed and observed according to the victim's report of an alleged case of cyberbullying that occurred on the Twitter group message feature. The results of his observations were in the form of recording screens on the evidence found to find out information about the time and what programs were running when the evidence was found. The results of recording the screen of evidence are shown in Table 2 below.

Table 2. Screen record of evidence

No.	Running programs	*Timestamp*
1.	Twitter	Tuesday, 22/02/2022

2.	Gallery	07:32PM

The next record concerns the specifications of the evidence device, namely the perpetrator's smartphone. The results of the disabled specifications of the evidence found are summarized in Table 3 below.

Table 3. Records of evidence specifications

No.	Type	Specification
1.	*Smartphones*	OPPO A37F Android version 5.1.1 Processor Qualcomm MSM8916Quad Cores RAM 2.00GB

In addition to recording, observations of group conversations were also carried out on the Twitter direct message feature which was installed on the evidence according to the victim's report. The last stage in the collection process is closed by isolating and securing evidence so that it is not contaminated by unauthorized parties and maintains its integrity.

4.B. *examination*

*examination*is the next stage where an examination is carried out on the Twitter social media application installed on the smartphone to extract the data. The process of acquiring the data uses MOBILEdit Forensic Express tools.

The stage of acquiring evidence is carried out in order to obtain the desired data, especially conversation data on the Twitter group message feature. The acquisition process is carried out by connecting evidence to a laptop that has the MOBILedit Forensic Express software installed. The Twitter application extraction process is as shown in Figure 8.

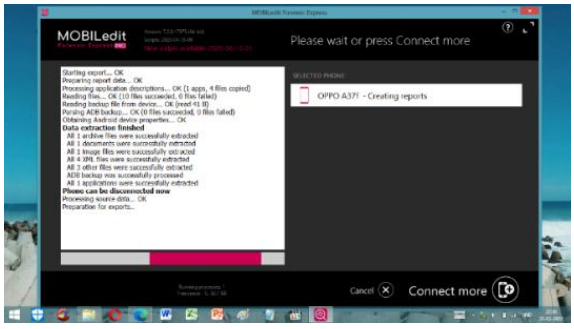

Figure 8. Data extraction process

The data extraction process is exported in the .xlsx file format to make it easier to find out the details of the messages contained in the group conversation. The summary of the results of the extraction process in the form of the .xlxs file extension is stored in the C:\Users\ENO\Documents\MOBILedit Forensic Express folder in the folder named MOBILedit Forensic Express tools.

4.C. *Analysis*

At this stage digital evidence in the form of conversational text that has been found through the examination process is then analyzed. The conversation text is then made into 1 (one) document classified by account user and named d1, d2, d3, d4, and d5. Then apply text preprocessing which consists of case folding, tokenizing, stop word, and stemming. The results of the preprocessing are seen in Table 5.

Table 5. Summary of the results of conversational text preprocessing

Document Contents		
id	Original sentence	After text processing
d1	“dizzy, the price is really expensive” "expensive" “yes, skincare takes time, you idiot” "It can't be instant, right?" "is it useless wkwkw" "Try looking at bed glass, your face is spotty and pretends to use skincare" "glowing or not, poor, yes" "The face of @najmeera__ is like this" "already items, ugly, dirty, everyone wants to buy skincare" “LOVE FUNNY LO” “what @hkde said the facts are not EVIL!” "Wkwkwk you know people are just kidding" 'That's right, a sono diet can't be like a fat pig” "HAHAHA FOOLISH FUCK" “unclear, you idiot” "If you have money, just report it" “wkwkwkwkw messed up”	'dizzy', 'price', 'terrible', 'damn' 'expensive', 'skincare', 'need', 'time', 'stupid' 'no', 'can', 'instant' 'useless', 'no', 'try', 'glass', 'there', 'face', 'you', 'acne', 'pretend', 'pre

Document Contents		
id	Original sentence	After text processing
		tend', 'want', 'use', 'skincare ', 'glowing', 'no', 'poor', 'yes', 'face', 'najmeera', 'like this', 'already', 'item', 'ugly', 'dirty', 'everything', 'want', 'buy', 'skincare', 'funny', 'lo', 'say', 'fact', 'no', 'evil', 'know', 'people',

Document Contents		
id	Original sentence	After text processing
		'joke', 'true' ', 'diet', 'there', 'no', 'pig', 'fat', 'stupid', 'builder', 'fight', 'no', 'obvious', 'basic', 'stupid', 'have', 'money', 'lo', 'report', 'mess'
d2	“Local products are really good, really crazy” "I don't think so" “but worth it huh...” "Wkwkwk sis "Already dirty items, why do you all use skincare" “never change again” "Najis really, you fool who has money just buy skincare" “wkwkwkwkwkwkwk” “wkwkw bastard” "That's why people know themselves" “looks like you @najmeera__” "hahaha this is really bad it's really funny" "Najis baper son.." "It's better to just focus on the body first, skincare can be done later" "Wkwk your bacot is really bad" "Come on, report it hahaha" “Ouch so serious like this” "rather than the hassle of business" "You'd better just accept what we have to say" "That's a fact haha, don't be baper wkwk"	'product', 'local', 'good', 'good', 'crazy', 'indeed', 'no', 'brain', 'worth',

Document Contents			Document Contents		
id	Original sentence	After text processing	id	Original sentence	After text processing
		'najmeera', 'already','item', 'dirty' , 'what', 'everything', 'use', 'skincare', 'no' , 'change', 'again' , 'unclean', 'indeed', 'stupid' , 'lo', 'have', ' money ', 'buy', 'skincare', 'bastard', 'people', 'know' , 'self', 'similar', 'lo',			'najmeera', 'terrible', 'funny', 'really' , 'najis', 'baper' , 'child', 'focus', 'body', 'skincare', 'can', 'back', 'cut', 'lo', 'severe', 'very', ' report' , 'serious', 'complicated' , 'take care of', 'you', 'accept', 'talk', we' , 'we',

id	Document Contents	
	Original sentence	After text processing
		'facts', 'no', 'no need', 'baper'
d3	"RIGHT ON!!!!" “whitelab brand, scarlett” “WKWKWK really say” "yes hang on" "If the base is already an item, then just an item" "HA HA HA HA" "Wkwkwk already item, dirty, ugly, alive again" "HA HA HA" "LOW" “WKWKWK IS TOLOL” "what a waste of effort" "think try" "stupid why maintained" “WKWKWK NAJIS AMBEKAN STUPID” “HAHAHAHAHAHAHAHAHAHAHAHAHAHAH AHAHAHAHAHAHAHAHAHAHAHAHAHAHAH AHAHAHAHAHAHAHAHAHAHAHAHAHAHAH AHAHAHAHAHAHAHAHAHAHAHAHAHAHA “haha many styles indeed” "here your face like a monkey dressed up" "what are you doing with him, stupid" “haha @najmeera__ you are fat!!!” "dih tai baperan really unclean" “the people we talk about are facts haha” "The police are laughing at how stupid you are" “poor, where does the money come from, wkwk” "Bacot lo you ugly!"	'right', 'really', 'brand,' 'whitelab', 'scarlett', 'true', 'say', 'hang', 'use', 'basic', 'already', 'item', 'item ', 'already', 'item', 'dirty', 'bad', 'live', 'again', 'glass', 'stupid', 'effort', 'waste', 'wasted', 'thought', 'try', 'stupid', 'maintain', 'unclean', 'ambek', 'stupid', 'stupid', 'a lot', 'style', 'face', 'lo', 'monkey', 'makeup ', 'lu', 'what', 'bela', 'he', 'stupid', 'najmeera', 'basic', 'fat', 'tai', 'baper', 'really', 'unclean',

Document Contents		
id	Original sentence	After text processing
d4	“lacoco, npure” “so many, I'm dizzy seeing it” "it's useless, it's expensive, there's no result" "uh can't do that" "the name is also a business" “hahahaha really funny” "Eh already dong, ga good like that" "why are you like that" "It's her right to want to use skincare" "already hey already" “this is too late” “@najmeera__ be patient patient” "really bad you guys"	'lacoco', 'npure', 'a lot', 'too much', 'me', 'dizzy', 'look', 'useless', 'expensive', 'no', 'there', 'results', 'people', 'we', 'chat', 'facts', 'police', 'laugh', 'look', 'lu', 'stupid', 'terrible', 'poor', 'money', 'bitter', 'lo', 'basic', 'bad'

Document Contents		
id	Original sentence	After text processing
		', 'no', 'may', 'that', 'name', 'business', 'funny', 'really', 'already', 'no', 'good', 'you', 'right', 'he', 'want', 'use', 'skincare', 'already', 'already', 'passing', 'najmeera', 'patience', 'patience', 'right', 'true', 'evi

Document Contents		
id	Original sentence	After text processing
d5	“Avoskin looks really good huh” "I see at the base there seems to be a lot of people discussing it" “wallet crying at the price” "Yeah, you can't use skincare, even if it's an item?" "Yes there is, but it's not instant" “If you want instant plastic surgery, just go there” "You bastards all of you" "If you say guarded yes!!!!" "bad all of you" "Watch out, all of you!" "I'm reporting to the police" "Look out, I'm reporting everything here!!!!" "Just look! your life will not be calm	l ', 'We' 'avoskin', 'good', 'very', 'me', 'see', 'base', 'crowded', 'many', 'discuss', 'wallet', 'cry', 'see', 'price', 'indeed', 'no', 'may', 'use', 'skincare', 'item', 'yes', 'no', 'instant', 'want', 'instant', 'surgery', 'plastic',

Document Contents		
id	Original sentence	After text processing
		'bitch', 'you', 'all', 'talk', 'take care', 'evil', 'you', 'all', 'watch out', 'lo', 'all', 'me', 'report', 'police', 'watch out', 'me', 'report', 'everyone', 'here', 'see', 'alive', 'you', 'no', 'calm down'

Each of these documents represents the contents of messages written by Twitter account users who are members of a group conversation on

the Twitter group conversation message feature as follows:

1. d1 : contents of the @diottore account conversation
2. d2 : contents of the account conversation @handiyouk
3. d3 : contents of the account conversation @hkdewiii
4. d4 : contents of the account conversation @mbaennnnn
5. d5 : contents of the account conversation @najmeera__

The conversation data that has been pre-processed is then applied the TF-IDF weighting technique to the queries which are keywords that refer to acts of cyberbullying between 5 (five) Twitter users. The results are shown in Table 6 below.

Table 6. TF-IDF Results

Term	DF	IDF	W(d,t) = TF. IDF					
			Q	d1	d2	d3	d4	d5
bastard	4	1.176	0.079	0.018	0.019	0	0	0.024
stupid	3	1,301	0.087	0.039	0	0.039	0	0
pretentious	2	1,477	0.099	0.044	0	0	0	0
items	5	1,079	0.072	0.016	0.017	0.049	0	0.022
bad	3	1,301	0.087	0.02	0	0.039	0	0
filthy	4	1.176	0.079	0.018	0.019	0.018	0	0
pig	2	1,477	0.099	0.022	0	0	0	0
stupid	3	1,301	0.087	0.02	0	0.079	0	0
crazy	2	1,477	0.099	0	0.024	0	0	0
unclean	4	1.176	0.079	0	0.038	0.035	0.031	0
arrogant	2	1,477	0.099	0	0.024	0	0	0
Too much talking	3	1,301	0.087	0	0.021	0.02	0	0
monkey	2	1,477	0.099	0	0	0.022	0	0
fat	2	1,477	0.099	0	0	0.022	0	0
shit	2	1,477	0.099	0	0	0.022	0	0

After the calculation process by implementing the TF-IDF weighting, then implementing the method*Cosine Similarity*using Equation (4).

Table 7. TF-IDF Results with Queries

Term	W(In)*W(Q)					
	Q	d1	d2	d3	d4	d5
bastard	0.079	0.001	0.002	0	0	0.002
stupid	0.087	0.003	0	0.003	0	0
pretentious	0.099	0.004	0	0	0	0
items	0.072	0.001	0.001	0.004	0	0.002
bad	0.087	0.002	0	0.003	0	0
filthy	0.079	0.001	0.002	0.001	0	0
pig	0.099	0.002	0	0	0	0
stupid	0.087	0.002	0	0.007	0	0
crazy	0.099	0	0.002	0	0	0
unclean	0.079	0	0.003	0.003	0.002	0
arrogant	0.099	0	0.002	0	0	0
Too much talking	0.087	0	0.002	0.002	0	0
monkey	0.099	0	0	0.002	0	0
fat	0.099	0	0	0.002	0	0
shit	0.099	0	0	0.002	0	0

First calculate the weight value on each document multiplied by the weight*queries*to fill in the value of the numerator part in Equation (4) the results are shown in Table 7. While the denominator is obtained by calculating the value of (TF-IDF)2 in Table 6, then the total is squared to fill in the value of the denominator part in Equation (4). The results of calculations with the method*Cosine Similarity*as follows.

Cos(Q, d1) = 0.016/(0.3504 × 0.2135) = 21.4
Cos(Q,d2) =0.014/(0.3504 × 0.2261) = 17.7
Cos(Q,d3) = 0.029/(0.3504 × 0.2195) = 37.7
Cos(Q,d4) = 0.002/(0.3504 × 0.2846) = 0.02
Cos(Q, d5) =0.004/(0.3504 × 0.2871) = 0.04

4.D. *reporting*

The last stage is reporting on the results of research regarding the search for digital evidence and the process of identifying conversational text related to alleged cases of cyberbullying in group conversations on the Twitter social media application.

The first report from the results of the acquisition of evidence obtained is in the form of an evaluation report on evidence which is summarized in Table 8.

Table 8. Report on the Acquisition of Evidence

No.	Digital Evidence	Description	Forensic Tools
1.	Conversation text	88 texts out of a total of 207 messages (42.51%)	MOBILEdit Forensic Express
2	*Timestamp*	37 timestamps out of a total of 76 conversation timestamps (48.68%)	MOBILEdit Forensic Express
3	Victim identity and perpetrator	*Id-username*the 5 Twitter account users who joined the conversation messages on the reports extraction application (@diottore, @handiyouk, @hkdewiii, @mbaennnnn, @najmeera__)	MOBILEdit Forensic Express

Furthermore, the results of the conversation data analysis through the text preprocessing process and the frequency of using the bullying keywords included in the body-shaming, denigration, and flaming categories are found from each document for each message sent by a Twitter user account in a group conversation. visualized in Figure 9.

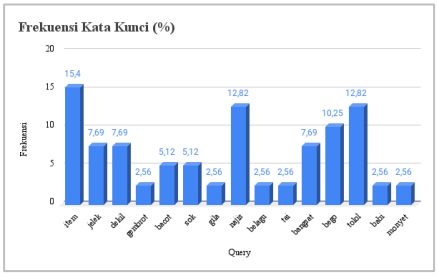

Figure 9. Identification of Keyword Frequency Used

It should be remembered that the 5th document on behalf of the Twitter account with the username (@najmeera__) is a report on alleged acts of cyberbullying as described in the previous case

scenario, so the calculation results are not included for further analysis.

As for the results of calculations for each document against the query which is the keyword for cyberbullying, different values are obtained, namely (@diottore) with a value of 0.214; (@handiyouk) with a value of 0.177; (@hkdewii) with a value of 0.377; (@najmeera___) with a value of 0.04; and (@mbaennnnn) with a value of 0.02. The calculation results are converted into percentages so that the words identified as bullying are known in each document as summarized in Table 9.

Table 9. Cyberbullying Identification Results

No.	User	Identification Results	
		Identified	Not identified
1	(@hkdewii)	37.7 %	62.3 %
2	(@diottore)	21.4 %	78.6 %
3	(@handiyouk)	17.7 %	82.3 %
4	(@mbaennnnn)	2 %	98 %

Based on Table 9 it is known that the Twitter user account (@hkdewiii) gets the presentation value as the highest actor with a value of 37.7%. This value indicates that the word is identified as cyberbullying and the remaining 62.3% are words or sentences that are not identified as cyberbullying. Likewise also applies to d1, d2, and d4 which represent the contents of the message (words or sentences) on each Twitter user account.

The comparison of cyberbullying identification results from each conversation made by each Twitter user who is a member of the conversation group is also visualized in Figure 10.

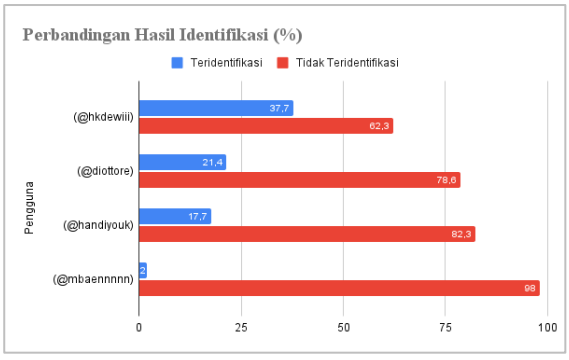

Figure 10. Comparison of Cyberbullying Identification Results

Next, sorting is carried out from the largest regarding the results of identifying cyberbullying actions for each user who is a member of the Twitter group conversation, so the account username (@hkdewiii) has the largest value and percentage for the use of negative words in conversations that refer to keywords bullying when compared to other users, while the lowest value and percentage goes to the account username (@mbaennnnn) which is represented by the 4th document. The results are visualized in Figure 11.

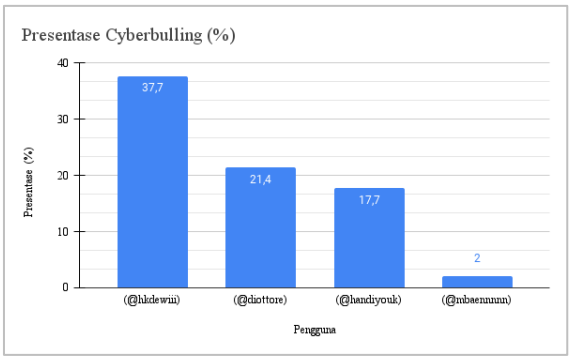

Figure 11. Results of the Percentage of Cyberbullying Actors from the Largest

The report on the results of the next analysis relates to a legal review of cyberbullying cases in this study. As for proving the existence of alleged cases of cyberbullying via social media such as Twitter, a legal review is needed so that the perpetrators involved can be held accountable for their actions in accordance with applicable legal regulations.

Digital evidence in the form of conversational data obtained through an investigative process by implementing digital forensic science is declared as evidence that is categorized as electronic information/documents based on Law Number 11 of 2008 concerning ITE Article 5 paragraph (1) and Article 6; and can legally be recognized as accurate evidence when brought to court which is categorized as expert testimony in accordance with the provisions of Law Number 8 of 1981 Article 184 of the Criminal Procedure Code paragraph (1)(Utami, Carudin and Ridha, 2021). Then the conversation data containing words or sentences with indications of bullying were actually written by the reported party (perpetrator) and can be charged with alleged defamation in Article 27 paragraph (2) of the ITE Law and Articles 310-318 of the Criminal Code and their explanations. In addition, the words or sentences written by the reported party contained an intentional element by embarrassing the complainant (accusations, insulting and physically humiliating, swearing or mocking) which were spread through/in the group message feature, so that such action could be subject to Article 27 paragraph (3) of the ITE Law by fulfilling the requirements referred to in Article 310 of the Criminal Code.

5. CONCLUSION

Based on the research process regarding the search for digital evidence related to alleged cases of cyberbullying in group conversations via social media Twitter by implementing the NIST systematic forensic workflow composed of collection, examination, analysis, and reporting, this study succeeded in finding digital evidence from evidence devices (smartphones) related to the existence of an alleged case of cyberbullying in the Twitter social media application's group message feature with the

help of the MOBILEdit Forensic Express tool. The process of proving alleged cases of cyberbullying was carried out by analyzing group conversation texts with Text Mining processing, TF-IDF word weighting search techniques, and the Cosine Similarity method. The results of acquiring digital evidence are text conversations group with 88 texts out of a total of 207 messages,*timpstamp*each message sent a number 37*timestamp*out of a total of 76 conversation timestamps (48.68%), as well as information on the id-usernames of the 5 Twitter account users who are members of the*conversation message*s*onreports extraction*application. Results of conversational text analysis with*Cosine Similarity*capableidentifying cyberbullying actions carried out by individuals with different levels, the cyberbullying perpetrator with the highest score by the user account @hkdewiii is worth 0.377 and the perpetrator with the lowest score is by the user account @mbaennnn with a similarity value to the query of 0.02.

6. SUGGESTION

As for the suggestions as reference material for further research, it can be implemented both in terms of forensic methodology and other forensic tools/tools in finding digital evidence from the evidence found and removing digital evidence from evidence used by/from the side of the reported party. perpetrator). Then further research can also explore various forensic tools that are applied to evidence and can be extracted thoroughly contained in the evidence, and can implement other techniques or methods or algorithms in identifying cyberbullying actions on Twitter.

BIBLIOGRAPHY

ABDULLOH, N. AND HIDAYATULLAH, A.F., 2019. Deteksi Cyberbullying pada Cuitan Media Sosial Twitter. *Automata*, Vol 1(1), pp.1–5.

BINTANG, R.A., UMAR, R. AND YUDHANA, A., 2020. Analisis Media Sosial Facebook Lite dengan tools Forensik menggunakan Metode NIST. *Techno (Jurnal Fakultas Teknik, Universitas Muhammadiyah Purwokerto)*, 21(2), p.125. https://doi.org/10.30595/techno.v21i2.8494.

CHAMIDAH, N. AND SAHAWALY, R., 2021. Comparison Support Vector Machine and Naive Bayes Methods for Classifying Cyberbullying in Twitter. *Jurnal Ilmiah Teknik Elektro Komputer dan Informatika*, 7(2), p.338. https://doi.org/10.26555/jiteki.v7i2.21175.

FADELILLAH, M., MUCH, I., SUBROTO, I. AND KURNIADI, D., 2017. Sistem Rekomendasi Hasil Pencarian Artikel Menggunakan Metode Jaccard ' s Coefficient. *Jurnal Elektro dan Informatika (EI) Unissula*, 2(1), pp.1–14.

FAIZ, M.N., PRABOWO, W.A. AND SIDIQ, M.F., 2018. Studi Komparasi Investigasi Digital Forensik pada Tindak Kriminal. *Journal of Informatics, Information System, Software Engineering and Applications (INISTA)*, 1(1), pp.63–70. https://doi.org/10.20895/INISTA.V1I1.

GUMBIRA, S.W., SULISTIYONO, A. AND TEJOMURTI, K., 2019. Menanggulangi Cyberbullying Di Sosial Media Dalam Perspektif Analisa Ekonomi Mikro. *Masalah-Masalah Hukum*, 48(4), p.341. https://doi.org/10.14710/mmh.48.4.2019.341-354.

HUKUMONLINE.COM, 2021. Jerat Hukum Pelaku Cyberbullying. [daring] Tersedia pada: < https://www.hukumonline.com/klinik/a/jerat-hukum-pelaku-icyberbullying-i-lt6063521a8e344> [Diakses 8 Feb 2022].

KOWSARI, K., MEIMANDI, K.J., HEIDARYSAFA, M., MENDU, S., BARNES, L. AND BROWN, D., 2019. Text classification algorithms: A survey. *Information (Switzerland)*, 10(4), pp.1–68. https://doi.org/10.3390/info10040150.

KOMPAS.COM, 2020. Kronologi dan Perkembangan Kasus Bullying Betrand Peto. [daring] Tersedia pada: < https://www.kompas.com/hype/read/2020/01/18/113000966/kronologi-dan-perkembangan-kasus-bullying-betrand-peto/> [Diakses 8 Feb 2022].

NASIRUDIN, N., SUNARDI, S. AND RIADI, I., 2020. Analisis Forensik Smartphone Android Menggunakan Metode NIST dan Tool MOBILedit Forensic Express. *Jurnal Informatika Universitas Pamulang*, 5(1), p.89. https://doi.org/10.32493/informatika.v5i1.4578.

PAAT, L.N., 2020. KAJIAN HUKUM TERHADAP CYBER BULLYING BERDASARKAN UNDANG-UNDANG NOMOR 19 TAHUN 2016. *Lex Crimen*, [online] IX(1).

PANDIE, M.M. AND WEISMANN, I.T.J., 2016. Pengaruh Cyberbullying Di Media Sosial Terhadap Perilaku Reaktif Sebagai Pelaku Maupun Sebagai Korban Cyberbullying Pada Siswa Kristen SMP Nasional Makassar. *Jurnal Jaffray*, 14(1), pp.43–62. https://doi.org/10.25278/jj.v14i1.188.43-62.

PRADNYANA, G.A. AND SANJAYA, N.A., 2012. Perancangan Dan Implementasi Automated Document Integration Dengan Menggunakan Algoritma Complete Linkage Agglomerative Hierarchical Clustering. *Jurnal Ilmu Komputer*, 5(2), pp.1–10.

RIADI, I., SUNARDI AND WIDIANDANA, P., 2020. Investigasi Cyberbullying pada WhatsApp Menggunakan Digital Forensics. *Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi)*, 4(4), pp.730–735.

WIDIANDANA, P., RIADI, I. AND SUNARDI, S., 2020. SINTA Accredited Rank 2 ImplementationThe Jaccard Method in Cyberbullying Investigation Analysis. Validity Period Start, 4(6), pp.1046–1051.

WE ARE SOCIAL HOOTSUITE, 2021. DIGITAL 2021: INDONESIA. [online] Available at: <https://datareportal.com/reports/digital-2021-indonesia> [Accessed 8 Feb 2022].