Sentiment analysis of hate speech as an information tool to prevent riots and environmental damage

G A Marchellim* and Y Ruldeviyani
Faculty of Computer Science, Universitas Indonesia, Depok, Indonesia

gleen.allan@ui.ac.id

Abstract. Twitter is currently one of the most popular social media in the world. Indonesia ranked in 8th the most Twitter users from all over the world with the 10.65 million users. President of the Republic of Indonesia, Joko Widodo, was ranked 8th leader with the most followers on Twitter, with 11 million users. Everyone can express or give an opinion on something or what they thought through social media including create or spreading the hate speech. One result of this hate speech can lead to mass demonstrations which can result in environmental destruction. Our research focused on sentiment analysis of hate speech towards Indonesian president by comparing the performance between Random Forest algorithm and Support Vector Machine algorithm to prevent the negative result of hate speech that can happen in the future. This research obtained 550 tweets and labelled manually whether it is categorized as a hate speech or not and divided into each of 275 data for positive and negative sentiments. Random Forest classifier has the best performance by combining gini criterion with the number of trees 128 with the result of the accuracy score is 76.7%, precision score 82.7%, recall score 64%, and F1 score 73.3%. Support Vector Machine classifier has the best performance by combining the linear kernel type and set the C parameter to 100 with the result of the accuracy score at 74.7%, precision score 100%, recall score 49.3%, and F1 score 66.1%. Random Forest classifier performs its best in scoring F1 score, accuracy, and recall while Support Vector Machine classifier performs its best in scoring precision. Based on the results, Random Forest classifier for hate speech detection can be applied for hate speech detection to prevent damaging the environment as it shows better score on accuracy and F1 score than Support Vector Machine Classifier.

1. Introduction
Social media has become common today for almost all of people in the world. Twitter is one of social media that allows users to send short message within 280 characters called tweet [1]. Currently, Twitter is one of the most popular social media in the world. Based on Statista, shows that in Q1 2019, twitter has more than 330 million monthly active users [2]. On Q4 2019, country with the most Twitter users in the world is United States with total 59.35 million users [3]. Indonesia ranked in 8th the most Twitter users from all over the world with the 10.65 million users [3]. Twitter has become an increasingly relevant tool in domestic and international politics. Twitter is a platform that is used to promote policies related to politics and interact with the public and other officials. Almost all leaders in the world and their foreign ministries have official Twitter accounts. The President of the United States, Donald Trump, became the leader of the country with the most followers in the world with 61 million users, while the President of the Republic of Indonesia, Joko Widodo, was ranked 8th leader with the most followers on Twitter, with 11 million users [4].
The Ministry of Communication and Information (Kementrian Komunikasi dan Informatika) of the Republic of Indonesia has a machine that can crawl and ward off negative content on the internet namely AIS [5]. The negatives content includes hoaxes, false news, expressions of hatred, terrorism, radicalism, pornography, gambling, and other negative content. AIS is supported by a team of 100 personnel who work 24 hours to support, approve, and validate the content [5]. AIS also monitoring on social media such as Facebook and Twitter. According to the AIS team, there are 3901 that have been identified, verified, and validated as hoaxes, false news, and hate speech between August 2018-November 2019 [6]. There are several categories including hoaxes, fake news, and hate speech, namely 973 items in the political category, 743 items in the government category, 401 items in the health category, and 307 hoaxes in the other categories [6].

Everyone can express or give an opinion on something or what they thought through social media. The opinion can be on events that are viral, politics, official news, reviews of products or services, etc. These opinions can be either positive or negative. Twitter became one of the media in online social media in the expression of these opinions. There are still many people who use Twitter to create hate speech including Indonesian users. While many users doing it on social media, people can also bring up the hate speech to the streets such as when protest on demonstration. The focus of sentiment analysis research is to analyze the opinions of a text [7]. Sentiment analysis is a study of how opinions and perspectives can be related to emotions and attitudes shown towards an event or event [8]. To find out the opinion expressed in the sentence or even document so that can be classified as a positive, negative, or neutral opinion it can be analyzed using sentiment analysis [9].

Based on data from the Ministry of Communication and Informatics, hate speech on the political and government category was found the most during August 2018-November 2019 as a reference for this research. Detection of hate speech in Indonesia through tweets on Twitter is necessary to minimize the negative impact of hate speech such as can lead to a mass demonstration in the street and it can be damaging the environment while people do the demo and to help the AIS team to improve the AIS system further, especially in the detection of hate speech through social media, so it can prevent the negative impact that would happen in the future. Several examples of hate speech cases that not only impacted social life but also damaged the surrounding environment due to the riots were the conflict in Sampit from 1996 to 2001, the Shia case in Madura and the Indonesian Ahmadiyah Congregation in West Nusa Tenggara in 2016, and the 2017 DKI Jakarta Regional Head Election case. Hence this study will choose the topic of sentiment analysis of hate speech towards current Indonesian president, Joko Widodo. The system that can detect hate speech is expected to have an effect on social media users so that they can be wiser in a way of using social media especially Twitter and become input for each party involved, both social media users, the government, the police, and other parties, in preventing and handling the hate speech on social media.

2. Literature Review

In this section, will be explained regarding theoretical basis that support the research and previous study that related to this research. The theoretical basis that will be explained in this section is about Twitter, hate speech, sentiment analysis, Random Forest classifier, and Support Vector Machine classifier.

2.1. Twitter

Twitter is one of the social media networks that allow each user to post and interact with limited 280 characters messages known as tweets. Users can post, like, retweet the tweets, and direct message to the other users. Twitter was created by Jack Dorsey, Noah Glass, Biz Stone, and Evan Williams on March 2006 and now it spread globally and has more than 25 offices around the world with the base office in San Francisco, California. In 2012, more than 100 million users posted 340 million tweets a day, and the service handled an average of 1.6 billion search queries per day [1]. As of Q1 2019, Twitter had more than 330 million monthly active users [2].

2.2. Hate Speech
Hate speech is "usually thought to include communications of animosity or disparagement of an individual or a group on account of a group characteristic such as race, color, national origin, sex, disability, religion, or sexual orientation" [10]. According to article 154 of the Indonesian Penal Code (Kitab Undang-Undang Hukum Pidana) it states that “A maximum imprisonment of seven years or a maximum fine of three hundred Rupiahs shall punish the person who publicly gives expression to feelings of hostility, hatred or contempt against the Government of Indonesia.” Indonesian National Police issued Circular Letter of Chief of Police No: SE/06/X/2015 governing acts of hate speech against a person, group or institution pursuant. Humiliation, defamation, unpleasant behavior, provocation, instigate, and hoax are the form of hate speech and all of those acts have a purpose to discrimination, violence, disappearance, or even social conflict. Hate speech aims to incite hatred towards individuals or even groups of people as distinguished by religion, ethnicity, race, intergroup, color skin, gender, people with disabilities, and sexual orientation. Hate speech can be done through various online or offline media such as oration, campaign, banner, social media, public opinion, religious lectures, pamphlets, and so forth.

2.3. Sentiment Analysis
Sentiment analysis or opinion mining aims to analyze the opinions, sentiments, and emotions from a person about anything, it could be about a topic, product, services, activities, and so on that written in the text, in this case, tweets from a person [11]. Sentiment analysis to determine opinion by considering a certain topic. It may indicate the reason, judgment, tendency, condition, emotion, and many more [12]. According to [13], the steps of the sentiment analysis process on the text classification are:
1. Define dataset domain
   There are a lot of datasets that can be collected. Before starting the classification, the first thing to do is collect the dataset then define the domain of the dataset that will be collected.
2. Preprocessing
   According to [14] preprocessing contains some steps until the dataset ready to be classified. The preprocessing will help the classification to have a better score in accuracy compared to non-preprocessed data. Here is the preprocessing stage:
   • Text cleansing is the stage to eliminate special characters such as numbers, punctuation, and emoticon on the dataset that are not needed for the classification processes.
   • Case folding is the next stage. To distinguish similar words, need case folding stage to convert into lowercase letters all of the words in sentences. This process will only receive the lowercase letters "a" to "z", the other characters will be considered as a delimiter.
   • Tokenization to convert the long text into small parts into sentences, sentences into words, and so on.
   • Stopwords removal purposes to delete words that considered do not have an important meaning in a sentence.
   • Stemming stage purposes to convert a word into a basic word that matches to structure of the Indonesian language that is good and true. To find the basic word of a word stemming will remove an affix such as prefixes, infixes, and suffixes.
3. Transformation
   Transformation purpose is to represent the calculated textual data by counting the presence or absence of a word in a document into a number. Weighting schemes of textual data will count how often or how many times a word appears in a document. Term Frequency-Inverse Document Frequency (TF-IDF) is one of the techniques to quantify how important a word in a set of textual data that have been represented in number. TF-IDF denote as
   \[ tf - idf_{t,d} = tf_{t,d} \times idf_t \] (1)
   Where \( tf_{t,d} \) measures the frequent a term appears in a document. Since the length of each document is different, there will be a possibility that a term will occur more in a long document than the short document. Meanwhile, \( idf_t \) measuring the importance of a term. After that, the scores be scaled into a range of zero to one to avoid the extreme range of the scores and denote as
The current score, then is the lowest score in a population, and is the highest score in a population.

4. Feature Selection
Feature selection purpose to reduce the amount of data to be analyzed by identifying which relevant features that will proceed to the next step hence it can make the classifier more efficient. The several feature selection methods that usually used are Chi-Square, Expert Knowledge, Information gain, Minimum Frequency, and many more.

5. Classification
Classification purpose to classify the text into positive or negative opinions or sentiment by using classifiers such as Decision Tree, Random Forest, Neural Network, Support Vector Machine, Naïve Bayes, and so forth.

6. Interpretation/Evaluation
The evaluation stage purpose to calculates the score of accuracy, recall, precision, and F1 Score.

2.4. Random Forest Classifier
Random forest classifier is one of a method for classifications that combines tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all trees in the forest [15]. According to [16], random forests algorithm is as follows:

1. Draw \( n_{\text{tree}} \) samples from the given dataset
2. Decision tree will be constructed for each sample. Then it will get the prediction result from every decision tree.
3. Every predicted result will be voted.
4. The most voted prediction result will be selected as the final prediction result.

2.5. Support Vector Machine Classifier
Support Vector Machine (SVM) is one of the classifier methods which will classify the data by separate it into each class. The shown data on Figure 1 that represented by dots, separated into each group to create a dataset. To separate the dataset, it using line called a separating hyperplane. The hyperplane is a decision boundary, everything on one side belongs to one class and everything on the other side belongs to a different class [17].

2.6. Related Works
There are many works studied about sentiment analysis of hate speech but still little studies that works on hate speech in Indonesian especially using Twitter as a data source. [18], [19], [20], and [21] are several work studies about sentiment analysis of hate speech in Indonesia. The work in [18] focuses on hate speech detection in the Indonesian language that using machine learning methods such as

\[
x_{new} = \frac{x - x_{\min}}{x_{max} - x_{\min}} \tag{2}
\]

Where \( x \) is the current score, then \( x_{\min} \) is the lowest score in a population, and \( x_{\max} \) is the highest score in a population.

\[
x_{new} = \frac{x - x_{\min}}{x_{max} - x_{\min}} \tag{2}
\]
Bayesian Logistic Regression, Support Vector Machine (SVM), and Random Forest Decision Tree, and Naïve Bayes classifier. The word n-gram feature combined with Random Forest Decision Tree gave the best performance for F-score 93.5%. While Bayesian Logistic Regression F-score result is 91.5%, SVM F-score is 86.5%, and Naïve Bayes F-score is 90.2%. All of those methods also have been combined with word n-gram.

In [19], the study focuses on hate speech and cyberbullying during the 2019 Indonesian presidential election. To generate latent information for each tweet, the study using Latent Dirichlet Allocation (LDA) algorithm. There are some difficulties while doing this study such as there are many undefined languages and other languages than Indonesian that need to be removed from the successfully collected tweets because the study focuses on Indonesian tweets. The result of the study there are 43,372 tweets indicate positive tweets and 40,380 tweets indicate negative tweets.

Reference [20] focus on sentiment analysis of state official news on online media based on public opinion. The study collected the public opinion through the official news on their online news media official website. This study focuses on sentiment analysis using Naïve Bayes Classifier and Particle Swarm Optimization. The accuracy result of Naïve Bayes algorithm is 67% and the f-score 67.6%. The accuracy result of Naïve Bayes Classifier based on Particle Swarm Optimization is 76% and the f-score result is 77.1%.

The study in [21] focuses on hate speech detection using Artificial Neural Network method that has been optimized using Backpropagation algorithm. This study successfully collected 1235 tweets. 652 tweets are positive to be classified as hate speech, while 583 tweets are not classified as hate speech. The study gave a result score of precision is 80.664%, recall score is 90.07%, and accuracy score is 89.47%.

Our research adopted several approaches that have been used in [18], [19], [20], [21]. We choose the topic of sentiment analysis of hate speech towards Indonesian president. This study will compare the performance between Random Forest algorithm and Support Vector Machine algorithm.

3. Methodology

This section will discuss on how to create the dataset and the methodology that will be conducted on detecting hate speech using machine learning approach. In this research, we use experimental research by comparing the performance of Random Forest classifier and Support Vector Machine classifier. This research will be focused on hate speech towards Indonesian president, Joko Widodo.

1. Data Collection

2,596 tweets successfully collected during April 7th, 2020 period using Twitter API. The tweets are mention or related to current Indonesian president, Joko Widodo, and the Indonesian government. After that, we remove the duplicate tweets, then 550 tweets ready to be labeled manually.

2. Data Labelling

Every tweet on the dataset will be labelled as a hate speech or not. Labelling people’s opinion is dealing with ambiguity because of the sarcasm tweet. Tweets with negative words are not always considered as hate speech and also tweets with positive words are not always considered as not hate speech. Labelling process by referring to Circular Letter of Chief of Police No: SE/06/X/2015 which opinion that includes to hate speech and which are not. Tweets containing hate speech will be labelled as 1, otherwise will be labelled as 0. The example tweet that has been labelled can be seen in Table 1.

| Tweet | Translated Tweet | Label |
|-------|------------------|-------|
| ini pasti salah pak jokowi bnpb sebut ada jabat daerah hambat distribusi apd corona | This must be Mr. Jokowi's fault, BNPB said that local officials were obstructing the distribution of personal protective equipment for Corona | 1 |
In [22], it was explained that imbalanced dataset between majority and minority class can cause the majority class to have better performance than the minority class it will give a negative effect on classification performing. Hence, kept the 275 tweets each labeled with 1 and 0 and our final dataset will become balance with the size of 550 tweets. The random dataset will be picked and divided into 400 tweets for data train and 150 tweets for the data test.

3. Data Preprocessing
The preprocessing stage that applied in this work includes text cleansing, case folding, tokenization, stopwords removal, and stemming. The preprocessing in this study refer to preprocessing in [14].

4. Term Frequency-Inverse Document Frequency (TF-IDF)
After preprocessing is done, then using TF-IDF the text on tweets are numerical represented by measuring how important a word in a collection of datasets.

5. Data Classification
Data classification process using Random Forest and Support Vector Machine classifier. The purpose of this stage to classify which tweet that classified as hate speech and which are not.

6. Result Analysis
In this stage, we will analyse the result that has been done in stage 1-5.

4. Experiment and Result
In this section we analyse the result of our implementation. Evaluation testing purposes to get a score of precision, recall, accuracy, and f-score. The evaluation also using k-fold cross-validation with k=6, to measure the classifier performances. We evaluate Random Forest classifier and Support Vector Machine classifiers with their parameters that can be seen in Table 2.
Table 2. Parameter for Each Classifier.

| Classifier          | Parameter Name | Parameter Value |
|---------------------|----------------|-----------------|
| Random Forest       | Number of trees| 32              |
|                     |                | 64              |
|                     |                | 128             |
|                     |                | 256             |
|                     | Criterion      | Entropy         |
|                     |                | Gini            |
| Support Vector Machine | Kernel      | sigmoid         |
|                     |                | linear          |
|                     |                | rbf             |
|                     |                | poly            |

Random Forest score result for accuracy, recall, precision, and F1 scores as seen in Figure 2 and Figure 3 for each parameter that have been set. As it seen on the Figure 2 that the best accuracy score (76.7%) is achieved by combining entropy criterion and the number of trees at 256 and 512. The best precision score (100%) is gained by combining entropy criterion and the number of trees at 64, 512, and 1024. Entropy criterion combined with the number of trees at 256 performs the best recall score (56%). The best F1 score (70.6%) is gained by combining entropy criterion and the number of trees at 256.

![Random Forest Scores with Entropy Criterion](image)

**Figure 2.** Accuracy, Precision, Recall, and F1 Scores on Random Forest with Entropy Criterion

As seen on Figure 3, Random Forest classifier with gini criterion result in the best accuracy score (76.7%) is achieved by combining gini criterion and the number of trees at 128. Gini criterion combined with the number of trees at 64 performs the best precision score (100%). Gini criterion combined with the number of trees at 256 performs the best recall score (82%). Gini criterion combined with the number of trees at 128 performs the best F1 score (73.3%).
Figure 3. Accuracy, Precision, Recall, and F1 Scores on Random Forest with Gini Criterion

As seen on Figure 4, Support Vector Machine result for F1 score, accuracy, precision, and recall for each max parameter. Linear kernel type was combined with C parameter at 100 performs the best accuracy score (74.7%). Linear kernel type was combined with C parameter at 100 and poly kernel type combined with C parameter 100 performs the best precision score (100%). Sigmoid kernel type was combined with C parameter at 100 performs the best recall score (100%). Sigmoid kernel type was combined with C parameter at 100 performs the best F1 score (66.7%).

Figure 4. Accuracy, Precision, Recall, and F1 Scores on Support Vector Machine Classifier

The best score of accuracy, precision, recall, and F1 score can see on Table 3 for each classifier. It shown that each classifier has their own best score, Random Forest has the best score by combining gini criterion and number of trees 128. The accuracy score is 76.7%, precision score 82.7%, recall score 64%, and F1 score 73.3%. While Support Vector Machine has the best score by combining the linear kernel type and with C parameter 100. The accuracy score at 74.7%, precision score 100%, recall score 49.3%, and F1 score 66.1%.

Table 3. Best Score for Each Classifier

| Classifier | Accuracy | Precision | Recall | F1 Score |
|------------|----------|-----------|--------|----------|
| Random Forest | 76.7%    | 82.7%     | 64%    | 73.3%    |
| SVM        | 74.7%    | 100%      | 49.3%  | 66.1%    |

According to the result of experiments, there are still a lot of hate speeches made among Indonesian Twitter users towards Indonesian president. The research can be used as a reference for hate speech detection on Twitter using either Random Forest Classifier or Support Vector Machine Classifier. Random Forest classifier has the best result on accuracy and F1 score rather than Support Vector Machine classifier.
5. Conclusion and Future Works
Currently, there is no corpus available especially for doing research on the topic of sentiment analysis of hate speech towards Indonesian president. The research must collect the text for dataset from Twitter, then labelling the dataset manually, and then send it to database for training. A tweet may have positive sentiment or opinion although it contains the negative words and vice versa.

Based on the result of this research, can be drawn some conclusion that the best performance measurement for each classifier can be identified by looking at F1 score and the accuracy. Random Forest classifier has the best performance by combining gini criterion with the number of trees 128. Support Vector Machine classifier has the best performance by combining the linear kernel type and set the C parameter to 100. Random Forest performs its best in scoring F1 score, accuracy, and recall than Support Vector Machine classifier. While Support Vector Machine performs its best in scoring precision.

The research can be used as a reference to help the parties involved to the hate speech detection, prevention, and handling such as AIS team of The Ministry of Communication and Information of the Republic of Indonesia, Indonesian police, and others so they can detect, prevent, and handle it very well and fast. The parties involved also can use this research to prevent users made a hate speech by taking down their hate speech post or automatically deleted their hate speech post so it would not spread rapidly to other users then resulting in humiliation, defamation, unpleasant behaviour, provocation, instigate, hoax or even bigger result that led to mass demonstration and it can affect to damaging the environment, so this study can be used to prevent that would happen in the future. They can use Random Forest classifier for hate speech detection since the result shows the better score on accuracy and F1 score than Support Vector Machine Classifier.

For future work or study on sentiment analysis of hate speech in Indonesian language, we suggested some improvements. For the dataset, it can increase the amount and the variation to improve the performance score on each classifier. Do more research on tweaking the parameter for each method, Random Forest and Support Vector Machine, to get the highest performance for each.

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