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Sentiment Analysis of Public Opinion on Supreme Court Decisions Using SVM and NB Methods

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***Abstract*— The legal events that happened to Ferdy Sambo and the Supreme Court's decision in the cassation triggered emotional reactions and various opinions among the public, especially on social media sites X. The purpose of this study is to analyze public perceptions of the Supreme Court's decision on the case. The research process includes data collection, data preprocessing, labeling, weighting, and classification using Support Vector Machine and Naïve Bayes, and performance evaluation using confusion matrix. A total of 624 tweets were retrieved from Twitter using crawling techniques to be used as datasets. Lexicon method is used in this research as data labeling which divides the dataset into 3 classes namely positive, negative, and neutral. There are 46 tweets categorized as positive, 133 tweets classified as negative sentiment, and 422 tweets considered as neutral sentiment. The test results show that the SVM method provides better performance with an accuracy rate of 84%, while the NB method only reaches 73% in its measurement.**

Keywords*— Sentiment Analysis, Naïve Bayes, SVM, Ferdy Sambo, X

I. INTRODUCTION

The Supreme Court (MA) is a judicial institution that functions as the highest state court in a country or jurisdiction[1]. The judicial system plays a crucial role in maintaining justice and public trust in the law. Supreme Court decisions in cases that are in the public spotlight often create diverse responses and opinions among the public. The legal case involving Ferdy Sambo in the murder of Brigadier Yosua has been one such case that has attracted significant and often controversial public attention. The case reflects the complex dynamics of the justice system, the death penalty, and its effects on society and legal policy in Indonesia.

The Supreme Court's decision on Ferdy Sambo's appeal[2] has caused controversy in the community in recent times. Twitter, now known as X has become a very popular platform worldwide that allows people to get the latest news, share their views or thoughts, and participate in various online discussions[3]. With the rapid development of social media, people quickly engage and participate in discussions on the subject. Often, new perspectives reveal the complexity of social and political changes relating to the justice system. Thus, the main focus of this research is to systematically identify and analyze the sentiment of public opinion related to the Supreme Court's decision in Ferdy Sambo's cassation case.

This research aims to to analyze the sentiment of public opinion related to the Supreme Court's decision in Ferdy Sambo's cassation using the Support Vector Machine (SVM) and Naive Bayes (NB) methods. The combination of these two methods is expected to help comprehensively capture public opinion on this case. The data used in this study was obtained from the social media platform Twitter, currently known as X, through a crawling process. The next step involves data preprocessing, which includes a series of cleaning, case folding, tokenization, normalization, stopword removal, and stemming processes. Once the preprocessing stage is complete, the next step is labeling to attribute sentiment classes such as positive, negative, and neutral, using a Lexicon-Based dictionary. The next process includes TF-IDF weighting, after which the system will process the data by applying SVM and NB methods. The last step is model evaluation, where the evaluation process uses a confusion matrix to generate metrics such as accuracy, precision, and recall.

Several previous studies have conducted sentiment analysis research that discusses public opinion regarding the image of the Police institution. Research by researchers [4] obtained 1100 datasets using the SVM method with an accuracy of 85.5%, precision of 86%, recall of 64% and the NB method with an accuracy value of 81.25%, precision of 91%, and recall of 51%. In addition, another study [5] with 269 datasets using the NB Classifier method resulted in an accuracy rate of 98.51%, precision of 98.97%, and recall of 97.40%. Similar research related to other subjects [6] with 2000 datasets using the NB method resulted in an accuracy of 95%, precision of 90.82% and recall of 98.89%. Not only that, other researchers [7] with 1000 datasets using the SVM method got 88% accuracy, Extra Trees Classifier with 86% accuracy, Logistic Regression with 85% accuracy, Random Forest Classifier with 85% accuracy, K-Nearest Neighbor with 83% accuracy, and Multinomial Naïve Bayes with 78% accuracy. In another study [8], 1200 datasets using the SVM method showed good performance in the 90:10 data scenario with an accuracy value of 0.82.

Sentiment analysis plays a very important role in gaining a deeper understanding of individual opinions and perceptions on a particular topic[9] . Overall, sentiment analysis provides valuable insights for various types of organizations and entities to make better decisions, respond more effectively to

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customer feedback, and understand the changing dynamics of public opinion[10]. Within the framework of this study, sentiment analysis is expected to have the ability to provide comprehensive insights into the diverse perspectives and sentiments of the public in relation to the Supreme Court's decision in Ferdy Sambo's cassation case. Therefore, the results of sentiment analysis are expected to provide a more detailed understanding of the positive, negative or neutral feelings felt by the public.

II. RESEARCH METHODS

This research uses a comparative approach that pits Support Vector Machine (SVM) with Naïve Bayes (NB) algorithm to measure the accuracy of public sentiment towards Ferdy Sambo's cassation case. The implementation of this comparative model involves several stages to achieve optimal accuracy. Figure 1 shows the various steps in the research process.

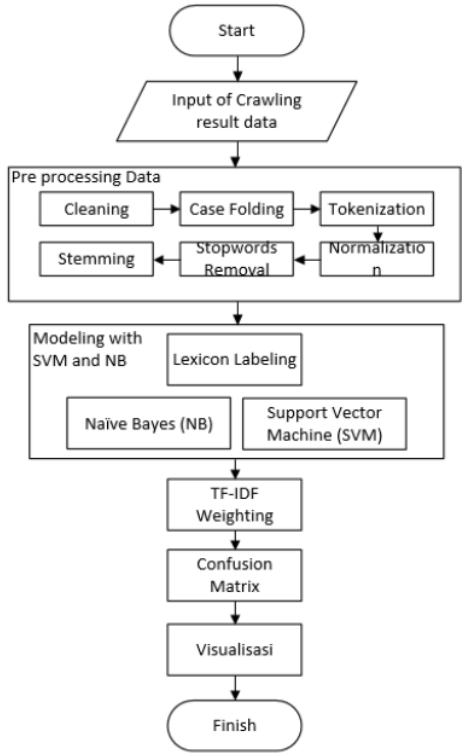

Figure 1. Research Process Design

The research begins by collecting data by crawling twitter. Then the crawl results will go through pre-processing which includes cleaning, case folding, tokenization, normalization, stopword removal, and stemming. Next, data labeling is done with a lexicon to distinguish positive, negative, and neutral class categories. After the labeling process, feature extraction is performed by utilizing metode TF-IDF, singkatan dari Term Frequency-Inverse Document Frequency. Next, classification is performed with SVM and NB algorithms. Confusion Matrix will be utilized in the evaluation of the outcomes to guarantee F1-Score, accuracy, precision, and recall.

A. Data Collection

The dataset that was utilized in this research came from comments or tweets seen in the detikcom and kumparan account posts on 08-08-2023[11][12]. The dataset was collected using crawling techniques by utilizing the Python library and using Google Collaboratory. The total amount of data collected reached 624 tweets, then this data was saved in CSV file format.

B. Preprocessing Data

In this process, data pre-processing is performed before proceeding to sentiment analysis. The data obtained through the crawling process is a raw dataset, which is still in the form of unstructured text and contains a lot of noise[13]. Pre-processing is a critical step in text analysis that aims to improve data quality and remove irrelevant text efficiently[14]. Therefore, processing is needed so that the data can become more structured and easy to understand. The following pre-processing stages refer to Figure 2.

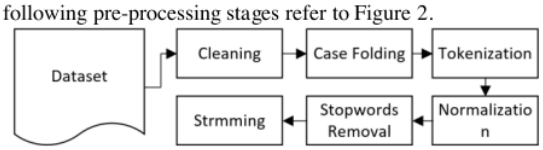

Figure 2. Pre-processing Flow

1. Cleaning is a process where text data is cleaned from irrelevant information or noise[14].
2. Case Folding refers to the procedure that is the process of changing every capital letter to a lowercase letter [15].
3. Tokenization is the process of breaking down text into the smallest units, such as sentences or words[15].
4. Normalization is changing words that are less efficient into words that are in accordance with the standards in the KBBI (Kamus Besar Bahas Indonesia)[16]
5. Stopwords Removal, namely taking important words in a sentence or removing words that have no meaning[15].
6. Stemming, which is converting words into basic forms (root words) to reduce word variations [15].

C. Data Labeling

After the preprocessing stage, the data consists only of cleaned opinions. After that, each sentence is scored for positive, negative, and neutral labeling. The automatic process of data labeling will involve the utilization of a lexicon dictionary to calculate the score value. The result of the score calculation shows that the sentence is categorized as a positive class if the score is > 0, categorized as a negative class if the score is < 0, and categorized as a neutral class if the score = 0 [17]. Calculating the sentence sentiment score can use Equation 1[17].

$$Skor = \left(\sum kata\ positif - \sum kata\ negatif\right) \quad (1)$$

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D. Word Weighting

The correlation of a word (term) in a document can be given significance using the TF-IDF (Term Frequency-Inverse Document Frequency) method[18]. This method combines two fundamental weight calculation concepts: the frequency of a word appearing in a certain document and the inverse frequency of documents containing that word[19].

The occurrence rate of a word in a given document serves as a measure of the word's significance in a given document, while the frequency of documents that include the word provides insight into the word's overall prevalence across documents. Accordingly, when a word appears frequently in a document and is not frequently found in other papers, the association between the term and the document is strongest[19]. TF-IDF weight calculation can be done using Equation 2.

$$TF.IDF_{std}(t) = tf_d^t \; x \; log \frac{N}{df^t} \qquad (2)$$

Where tf_d^t is shown as the quantity of times the phrase "t" appears in the document $d.N$ denotes the total number of quantity in the corpus, while df^t specifically refers to the number that contain t.

E. Model Analysis

The algorithm model analysis involves a thorough comparison between Support Vector Machine and Naïve Bayes, which is performed separately and aims to distinguish which model produces the most optimal accuracy value.

1) Support Vector Machine (SVM)

SVM is a computational algorithm applied to categorize or partition a data set into different groups [20]. One of the machine learning algorithms commonly used for classification and regression. In the classification stage, SVM can provide optimal results even with limited datasets. SVM's capabilities also include handling overfitting problems by applying regularization techniques[20] .

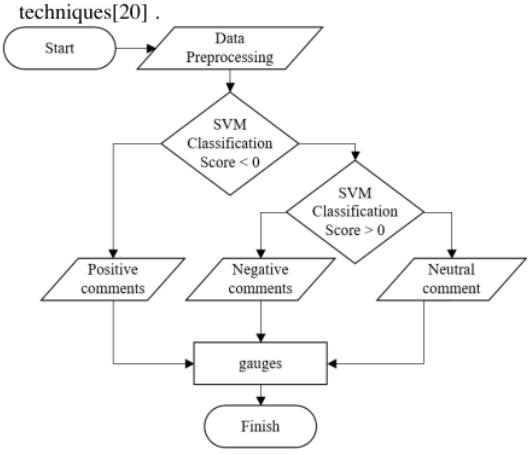

Figure 3. SVM Flow

The basic formula of Support Vector Machine can be seen in Equations 3 and 4.

$$f(\emptyset(x)) = w.\emptyset + b \qquad (3)$$

$$f(x) = w.x + b \qquad (4)$$

Where w is the weight vector, x is the available data, while b is the switch value.

2) Naïve Bayes (NB)

NB consists of a set of classification algorithms derived from the principles of Bayes' Theorem[21].

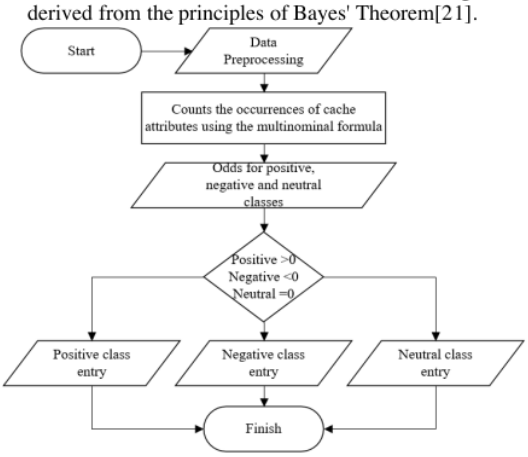

Figure 4. NB Flow

The formula of Bayes' Theorem is shown in Equation 5.

$$P(c|d) = \frac{P(c)P(d|c)}{P(d)} \qquad (5)$$

Where c,d denote events. $P(c|d)$ signifies the likelihood of C given D, conditionally. The conditional probability of D given C is represented by $P(d|c).P(c), P(d)$ indicates the likelihood of either C or D occurring.

F. Evaluation

In the discipline of machine learning, evaluation is done to measure the system's accuracy and test the classification findings [22]. After obtaining a classification model using SVM and Naïve Bayes, an evaluation stage is required before applying the model to test data. Evaluation is done by applying the Confusion Matrix method. Confusion matrix is one of the techniques to evaluate how effective or ineffective the performance of a classification process is[23]. Confusion matrix takes into account the level of accuracy, precision, and recall. The ratio of accurate predictions—positive, neutral, and negative—to the total data is what determines accuracy. The ratio of True Positive (TP) predictions to total positive predictions is used to calculate precision. The ratio of True Positive (TP) predictions to all positive data is known as recall. The confusion matrix, which is outlined in the formula below, contains all of this information[23].

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$$precision = \frac{TP}{TP + FP} \quad (4)$$

$$recall = \frac{TP}{TP + FN} \quad (5)$$

$$accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (6)$$

True Positive events are denoted by TP, True Negative events by TN, False Negative events by FN, and False Positive events by FP. As opposed to TP, TN indicates that both the expert and the system produce unfavorable outcomes. When the expert provides a positive result but the system provides a negative outcome, this is known as FN. Conversely, FP happens when the expert provides a positive result but the system provides a negative result[23].

III. Results and Discussion

A. Data Collection

By applying crawling methods, this research successfully collected 624 tweets from public comments related to the case on the X detikcom and kumparan accounts.

TABEL I. Sample Comment Data

No.	Comment
1.	Tidak ada yg tidak mungkin buktinya hukuman mati kena diskon flash sale 8.8
2.	Tidak ada yg tidak mungkin untuk hukum dinegara Konoha ini pak
3.	Another Kejadian paling lucu di 2023 😂

Tabel I. is the result of the data collection process carried out by crawling twitter.

B. Data Labeling

The data that has been collected is then subjected to a labeling stage to classify whether the comment belongs to the negative, positive, or neutral sentiment category.

TABEL II. Labeling Results

No.	Comment	Score	Sentiment
1.	Tidak ada yg tidak mungkin buktinya hukuman mati kena diskon flash sale 8.8	-1	Negative
2.	Tidak ada yg tidak mungkin untuk hukum dinegara Konoha ini pak	0	Neutral
3.	Another Kejadian paling lucu di 2023 😂	1	Positive

Table II. above is the result of labeling with the lexicon formula, value -1 which means negative label, value 0 which means neutral and value 1 which means positive label.

A. Data Preprocessing

As described in the research method, the preprocessing stage of this research involves several steps, including cleansing, case folding, tokenization, normalization, and stemming.

TABEL III. Prerocessing Results

Dataset	
Another Kejadian paling lucu di 2023 😂	
Preprocessing	
Cleansing	Another Kejadian paling lucu di
Case folding	another kejadian paling lucu di
Tokenize	“another”, “kejadian”, “paling”, “lucu”, “di”
Normalized	“another”, “kejadian”, “paling”, “lucu”, “di”
Stopword	“another”, “kejadian”, “paling”
Stemming	“another”, “jadi”, “paling”

Table III. is the result of the data cleaning process. The table shows that the data has undergone cleansing, case folding, tokenization, normalization, stopword, and stemming.

B. SVM Classification

Next stage involves data classification, which is achieved through the application of the Support Vector Machine (SVM) algorithm model.

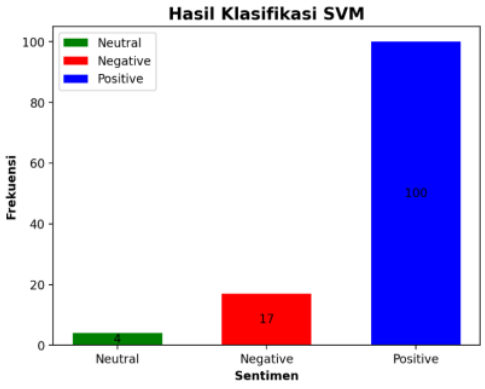

Figure 5. SVM classification result

Figure 5, shows that this algorithm model obtained 3 diagram results, with 1 neutral comment, followed by 17 negative comments, and finally 100 positive comments.

C. NB Classification

The next stage in addition to data classification through Support Vector Machine (SVM), this research also applies the Naïve Bayes (NB) algorithm model.

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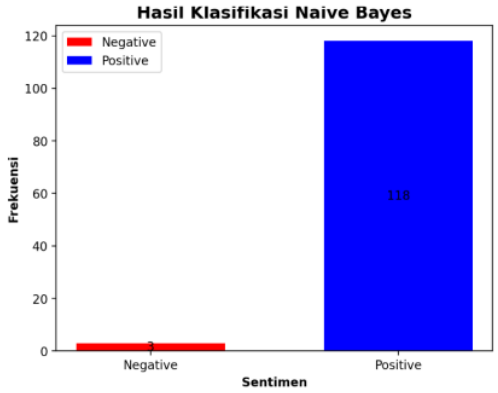

Figure 6. NB classification result

Figure 6, shows that this algorithm model obtained 2 diagram results, with 3 negative comments, and 118 positive comments.

D. Model Evaluation

After completing a thorough set of tests against all the data, the next step involves evaluating the performance of the implemented model. This evaluation uses a confusion matrix to calculate accuracy, precision, and recall values. The Confusion Matrix for the SVM model can be found in Figures 7 and 8.

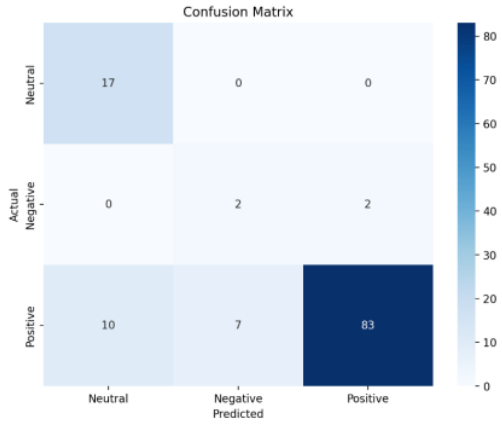

Figure 7. SVM Confusion Matrix Result

```
classification report :
              precision    recall  f1-score   support

          -1       0.63      1.00      0.77        17
           0       0.22      0.50      0.31         4
           1       0.98      0.83      0.90       100

    accuracy                           0.84       121
   macro avg       0.61      0.78      0.66       121
weighted avg       0.90      0.84      0.86       121
```

Figure 8. SVM Confusion Matrix Result

Based on the confusion matrix results illustrated in Figure 8, it can be seen that the SVM model obtained an accuracy value of 84%, a precision level of 61%, a recall level of 78%, and an f1-score of 66%.

Furthermore, Figures 9 and 10 display the confusion matrix with the NB model.

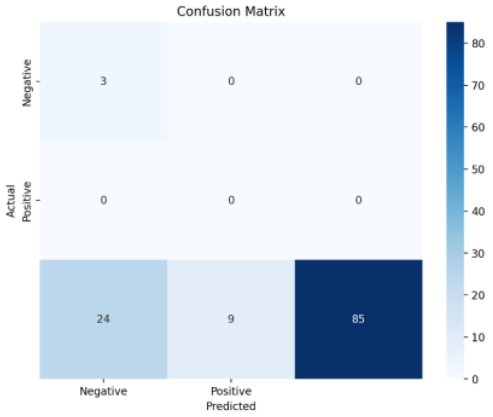

Figure 9. NB Confusion Matrix Result

```
Naive Bayes classification report :
              precision    recall  f1-score   support

          -1       0.11      1.00      0.20         3
           0       0.00      0.00      0.00         0
           1       1.00      0.72      0.84       118

    accuracy                           0.73       121
   macro avg       0.37      0.57      0.35       121
weighted avg       0.98      0.73      0.82       121
```

Figure 10. NB Confusion Matrix Result

Based on the confusion matrix results in Figure 10, it can be seen that the NB model obtained an accuracy value of 73%, precision 37%, recall 57%, and f1-score 35%.

E. Visualisasi Word Clouds

Figure 11. WordCloud Positive

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Figure 12. WordCloud Negative

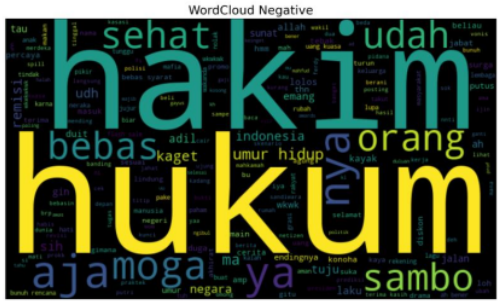

Figure 13. WordCloud Neutral

As described in the Research Methods, this research successfully produced three word cloud visualizations, namely word clouds for positive comments, negative comments, and neutral comments. From Figure 11,12, and 13, it can be seen that the word that appears most often in the word cloud of positive, negative and neutral comments is "hukum dan hakim ".

II. CONCLUSION

The results of this study show that public opinion tends to be neutral, with the majority of public responses using good language and jokes that do not contain insults or harsh words that can cause comments to become negative sentiments. Through further analysis utilizing the Support Vector Machine algorithm and Naïve Bayes matrix, and assisted by lexicon labeling, the accuracy rate obtained is 84% for SVM and 73% for NB. From these results, it is evident that the SVM method outperforms NB in terms of accuracy.

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