

## SENTIMENT ANALYSIS ON RENEWABLE ENERGY ELECTRIC USING SUPPORT VECTOR MACHINE (SVM) BASED OPTIMIZATION

Pungkas Subarkah<sup>1\*</sup>; Bagus Adhi Kusuma<sup>2</sup>; Primandani Arsi<sup>3</sup>

Informatics<sup>1,2,3</sup>

Universitas Amikom Purwokerto, Indonesia<sup>1,2,3</sup>

www.amikompurwokerto.ac.id<sup>1,2,3</sup>

subarkah18.pungkas@gmail.com<sup>1\*</sup>, bagus@amikompurwokerto@ac.id<sup>2</sup>,

ukhti.prima@amikompurwokerto@ac.id<sup>3</sup>

(\*) Corresponding Author

(Responsible for the Quality of Paper Content)



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**Abstract**— Government policy regarding the discourse on the use of renewable energy in electricity, this discourse is widely discussed in the community, especially on social media twitter. The public's response to the implementation of the use of renewable energy varies, there are positive, negative and neutral responses to this government policy. Sentiment analysis is part of Machine Learning which aims to identify responses in the form of text. The data used in this study amounted to 1,367 tweets. The purpose of this study is to determine the sentiment analysis of government discourse related to the use of renewable energy using an optimisation-based Support Vector Machine (SVM) algorithm approach. This research involves several stages including data collection, data pre-processing, experiments and modelling and evaluation. The data is divided into 3 classes, 120 positive, 1221 neutral and 26 negative. In this research, there are five optimisation models used namely Forward Selection, Backward Elimination, Optimised Selection, Bagging and AdaBoost. The results obtained are the use of Optimised Selection (OS) optimisation with the Support Vector Machine (SVM) algorithm obtained an increase in accuracy from 93% to 96%. The increase in the use of SVM using selection optimization obtained the highest increase, because other optimization techniques only reached 1% and 2% of the original results using the SVM algorithm, namely the accuracy value of 93% to 96% (high accuracy). From the research that has been done, it is certainly important to understand public sentiment towards renewable energy policies, especially renewable energy electricity, the hope is that this research will become a reference for the government.

**Keywords:** electric renewable energy, optimization, sentiment analysis, SVM.

**Intisari**— Kebijakan pemerintahan mengenai wacana penggunaan energi terbarukan listrik, wacana ini ramai dibicarakan di masyarakat khususnya di media sosial twitter. Respon masyarakat akan diberlakukan penggunaan energi terbarukan listrik beraneka ragam, ada yang respon positif, negatif dan netral mengenai kebijakan pemerintah ini. Analisis sentimen merupakan bagian dari Machine Learning yang bertujuan untuk mengidentifikasi tanggapan dalam bentuk teks. Data yang digunakan dalam penelitian ini sejumlah 1.367 tweet. Tujuan penelitian ini untuk mengetahui sentimen analisis mengenai wacana pemerintahan terkait penggunaan energi terbarukan listrik menggunakan pendekatan algoritma Support Vector Machine (SVM) berbasis optimasi. Penelitian ini melibatkan beberapa tahapan diantaranya pengumpulan data, pra-pemrosesan data, eksperimen dan modelling dan evaluasi. Data terbagi menjadi 3 kelas, 120 positif, 1221 netral dan 26 negatif. Dalam penelitian ini, ada lima model optimasi yang digunakan yaitu Forward Selection, Backward Elimination, Optimized Selection, Bagging and AdaBoost. Hasil yang didapatkan yaitu penggunaan optimasi Optimized Selection (OS) dengan algoritma Support Vector Machine (SVM) memperoleh peningkatan akurasi dari 93% menjadi 96%. Peningkatan pada penggunaan SVM menggunakan optimasi selection memperoleh peningkatan yang paling tinggi, dikarenakan teknik optimasi lainnya hanya mencapai 1% dan 2% dari hasil semula menggunakan algoritma SVM yaitu nilai akurasi sebesar 93% menjadi 96% (akurasi yang tinggi). Dari penelitian yang sudah dilakukan tentu pentingnya memahami sentimen publik terhadap

*kebijakan energi terbarukan khususnya energi terbarukan listrik, harapannya dengan adanya penelitian ini menjadi rujukan bagi pemerintah. nya energi terbarukan listrik, harapannya dengan adanya penelitian ini menjadi rujukan bagi pemerintah.*

**Kata Kunci:** energi listrik terbarukan, optimasi, analisis sentimen, SVM.

## INTRODUCTION

The rapid growth of the era, most notably the growth of social media, continues to make it easier for users to access data on the internet [1]. While accessing information was difficult in the past, with the development of the times, it is now easy. Social media allows users to not only consume but also channel their aspirations, one of which is in commenting on, and sharing various content in various types of formats such as reading video, and audio [2]. Social media is also used as a means of conversation, community, facilitating business management, community organizations and even making it easier for government agencies to connect directly with the public [3]. Government policies and public opinion must be monitored, one of which is by analyzing sentiment collected data from social media, namely twitter. Among them are government policies regarding covid handling [4], regarding the 2024 presidential candidacy [5], issues that nominate the 2024 president [6][7] and government policies related to community needs, namely fuel oil (BBM) [8]. With the control of the community through sentiment analysis, it is hoped that the government will be more sensitive to the policies that have been made and implemented. Government policies and public opinion will still be monitored by the community in general, one of which is through twitter social media. Currently, topics regarding government policies are massively spread on social media, one of which is on twitter. The existence of this government policy has created pros and cons for the general public. Therefore, researchers made a new breakthrough to find out public sentiment about this government policy through social media, one of which is twitter.

Currently, social media today is not just one platform, one of which is still popular is Twitter [9]. Like most social media, Twitter is a social media that allows its users to interact personally or openly. Various topics are discussed on Twitter ranging from economy, culture, politics, law, social, and others [10], [11], [12]. By utilizing hashtags, Twitter users can identify topics that are being discussed in real-time. In addition, keywords on Twitter can also be a source of conversation for its users. It is not uncommon for news to be discussed on Twitter before it appears as a headline in the online media. Even discussions on Twitter trigger the emergence

of a news story. One of them is the conversation about the government's discourse on renewable energy electricity. Thus, this government discourse needs to be analyzed sentimentally. Twitter provides a platform for researchers to study public sentiment through analysis.

Sentiment analysis is the process of extracting, mastering and processing information in the form of unstructured reading automatically to obtain sentiment data contained in an opinion sentence or comment [13]. Sentiment analysis is performed to assess the opinion and tendency of an opinion on a topic whether negative, positive or neutral [14]. Sentiment analysis can be applied to opinions in all fields such as politics, economics, social and others. Sentiment analysis can be categorized as a part of knowing and measuring public opinion that occurs on social media, one of which is Twitter. The Twitter social media opens a window for researchers to study public emotions, moods, and opinions through sentiment analysis [15]. Twitter social media is the most tested and competent social media for researchers in using public opinion narratives, one of which is public opinion regarding government policies, namely renewable energy electricity, this is still a debate because there are pros and cons regarding government policies. The following is a literature review used by researchers as a reference, as follows:

Several previous studies have been conducted on sentiment analysis regarding government discourse, including by William Silalahi and Adi Hartanto with the title of research on the classification of sentiment analysis Support Vector Machine based on optimization welcoming the 2024 Election. The method used is applying the Support Vector Machine (SVM) algorithm. The purpose of this research is to find out about people's views regarding the 2024 elections that will be held. The results obtained in the research conducted are getting 1000 positive sentiment data and 400 negative sentiment data. With the acquisition of accuracy using SVM without optimization of 87.33% and the acquisition of SVM using optimization of 87.50%. The novelty of research that will be carried out by researchers is the use of different optimization techniques [16].

Furthermore, research conducted by Trifebi Shina Sabrila, Yufis Azhar and Christian Sri Kusuma



Aditya, with the title of research on sentiment analysis of tweets about the Job Creation Law using SVM based on Particle Swarm Optimization (PSO). The method used is the Support Vector Machine ((SVM) algorithm by applying Particle Swarm Optimization (PSO) The purpose of this research is because many people have pros and cons regarding the Job Creation Law in Indonesia, especially workers. The results obtained are with 1000 tweet data containing 3 labels, namely positive, negative and neutral using SVM of 92.99% and the results obtained by PSO-based SVM are 94.97%. Of course there is an increase in accuracy by optimizing PSO [17].

Further research was conducted by Atan Saepudin, Riska Aryanti, Eka Fitriani and Dahlila. The research conducted was the optimization of SVM and KNN algorithms based on Particle Swarm Optimization (PSO) on the sentiment of the #2019 Ganti President hashtag phenomenon. The purpose of this research is to find out the opinions or opinions of the public about #2019 Change President obtained data from twitter. The results obtained are the data obtained, namely 400 data with details (200 positive review data and 200 negative reviews). Applying the SVM algorithm produces an accuracy of 88.00% [18].

Then the research conducted by Annisa Elfina Augustia, Resi Taufan, Yuris Alkhalifi and Windu Gata. The research conducted is about sentiment analysis of omnibus Law using the Support Vector Machine (SVM) method based on Particle Swarm Optimization (PSO). The data used in the study were obtained from tweets with a total of 1332 data. The results obtained are using SVM of 84.95% [19].

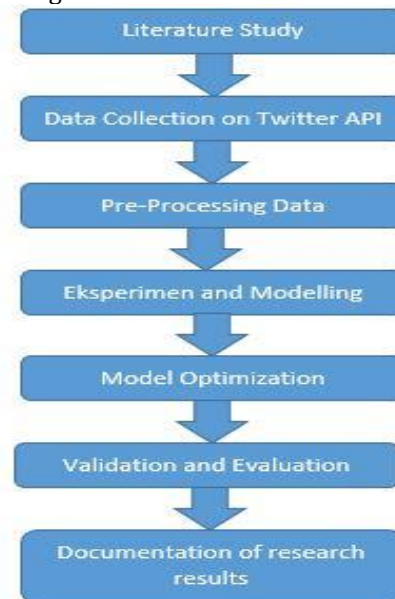
In this study, researchers will conduct sentiment analysis regarding the discourse on renewable energy electricity on twitter media, Indonesian people in particular are still unfamiliar with the existence of renewable energy electricity, one of which is the pros and cons of this government policy which is discussed on one of the social media, namely twitter, this is certainly a challenge for researchers to prove with the expertise of researchers. Dataset information will be collected from 2021 to 2022 regarding the discourse on renewable energy electricity from twitter. Labels on the dataset include positive, negative, and neutral. The purpose of this research is to analyze sentiment regarding the discourse on renewable energy electricity from twitter using an optimization-based Support Vector Machine (SVM) algorithm. Another goal is to find out the level of acceptance of Indonesian society regarding renewable energy obtained from twitter users. This is certainly the

hope of researchers so that it can be a reference for the government, especially government policies. Government policies that will be implemented in Indonesia are policies that will be used by the wider community, the need for in-depth studies for policy makers in determining policies to be taken, of course there will be pros and cons in government policies taken, one of which is government policy on renewable energy electricity. Previous research that has been presented above regarding sentiment analysis of government discourse is used as literature review and consideration in the research conducted.

Based on the background that has been described, the authors try to conduct research on sentiment analysis using different objects, namely renewable energy discourse, data collected from twitter. This research uses the optimization-based Support Vector Machine (SVM) method. The renewal of research from previous research is the use of optimization. The optimization that will be used in this research is to use various optimization techniques carried out by various optimization models such as Forward Selection (FS), Backward Elimination (BE), Optimized Selection (OS), Bagging and AdaBoost which are useful for finding the best accuracy value by utilizing optimization features.

## MATERIALS AND METHODS

The research stages in sentiment analysis of government discourse related to renewable energy electricity on twitter consist of several stages as shown in Figure 1.



Source : (Research Results,2024)

Figure 1. Research Stages

**A. Data Collection**

In this study, the data that will be used is data on the discourse of renewable energy on twitter. Data is collected with the Twitter API with hastag and keywords of renewable energy electricity.

**1. Dataset**

A dataset is a set of attributes and objects. Other terms for objects are entities, records and observations [20]. In this study, the data used is data sourced from the results of twitter reviews regarding government discourse related to renewable energy electricity. the keywords or hashtags used are renewable energy electricity. We collected data from January 2021 to December 2022.

**Table 1. Government Discourse and Review Data**

No	Government Discourse	Review Data
1	Energy	Net Zero Emission Target 2060 Indonesia's hope to transition electricity to renewable energy
2	Energy	SOE Minister Erick Thohir supports the gradual transition of electricity to renewable energy (EBT) Wednesday (7/12/2022) Indonesia has a Net Zero Carbon (NZC) target by 2060.

Source : (Research Results, 2024)

**2. Preprocessing Data**

This preprocessing stage process is a stage that serves to process data so that it is ready to be used in the next process [6]. The preprocessing stage aims to improve the dataset which will be easy and efficient when processed into useful information. At this stage, researchers use the python language based on google colabs in each stage of both tokenization, stemming, and TF-IDF weighting to the validation and evaluation stages. The preprocessing stages The following steps will be taken in this research:

- a. Tokenizing: A process where text data in the form of sentences will be separated into several texts based on delimiters in the form of spaces and punctuation marks. For example, the sentence 'SOE Minister Erick Thohir supports the gradual transition of electricity to New Renewable Energy (EBT)' is then converted into 'Minister', 'SOE', 'Erick', 'Thohir'. 'support', 'gradually', 'gradually', 'transition', 'electricity'. 'to', 'Energy', 'New', 'Renewable', 'EBT'.
- b. Stopword Removal: This stage is done to remove words, based on the words contained in the stoplist. Words that are included in stopwords such as "which is", "and", "at", "from" so as to leave important words. For example, the

sentence " Hyundai Plant to Use 100% Electricity from Renewable Energy " is then changed to " Hyundai Plant to Use 100% Renewable Energy Electricity ".

- c. Stemming: This stage is carried out to convert text into a basic form called a term, then the term will be listed and given a weight value. For example, the sentence " Because the solar one will bring our electrical energy back to glory." is then changed to " Because the solar ones will bring our electricity back to glory.".
- d. TF-IDF Weighting: Term Frequency (TF) is an expression that keeps coming up often in the text, which means that its weight will also keep growing. On the other hand, the TF process is the opposite of the Inverse Document Frequency (IDF) process. [21].

**B. Experiment and Modelling**

At this stage, researchers will conduct experiments and modeling of the support vector machine (SVM) algorithm. The main concept behind the SVM method is to create a hyperplane that optimizes the distance between the upper and lower margins built from the data in order to separate observations. The simplest and most fundamental type of support vector machines (SVM) is known as the "Linear SVM," which aims to classify data that is linearly separable by drawing straight lines between groups with either rigid or soft margins (incorporating slack variables that allow some misclassification but support the model's generalization) [22]. Using a hyperplane as a dividing line, SVM optimizes the distance between data points of various classes. SVM may categorize text in the context of sentiment analysis according to the attitudes it contains, such as positive, negative, or neutral [23]. The SVM classification technique uses three processes, including: Objective of the Linear SVM optimization function.

A hyperplane, or line or plane, that optimizes the margin between negative and positive classes is what SVM searches for. Here is the formula to get the distance between point c and the hyperplane if x is a feature vector and w is a weight vector:

$$\text{distance} = \frac{|w \cdot x + b|}{||w||} \tag{1}$$

Here b is the bias, and ||w|| is the length of the vector w.

- a. Support Vector Machine Linear Objective Function.

SVM attempts to find the weight vector w and bias b that minimizes it with the formula:





$$||w||^2 \quad (2)$$

b. Linear SVM Decision Function

The sign of the decision function, or the formula, dictates whether or not to forecast the class.:

$$f(x) = w \cdot x + b \quad (3)$$

If  $f(x) \geq 0$  then the class prediction is +1, and if  $f(x) < 0$  then the class prediction is -1.

C. Model Optimization

This stage is the model optimization stage, namely the optimization model adopted is feature selection or often referred to as attribute selection is the process of finding a subset of feature selection results from a dataset. Feature selection is used in the field of statistics, and machine learning, one of which is sentiment analysis [24]. Feature selection is an important method to produce good classification. Without feature selection, the computational process and model performance are poor. The purpose of feature selection is to remove irrelevant attributes [25]. Among the optimization models used are Forward Selection (FS), Backward Elimination (BE), Optimized Selection (OS), Bagging and AdaBoost. Forward Selection is adopting the principle of Linear regression. Forward Selection is one of the wrapper models used to reduce dataset attributes [26]. Furthermore, using Backward Elimination feature selection where this feature selection uses a way of working by means of a backward selection system that aims to optimize performance in the optimization model [27]. Then using Optimized Selection (OS) in this feature selection adopts a combination of forward selection and backward elimination which aims to evaluate the importance of each feature selection. The next use of feature selection optimization method is Bagging where this model usually involves several models of different types from different subsets of the training dataset. Finally, Adaboost is used where this feature selection adopts a model of combining weak classifications to form strong classifications.

D. Validation and Evaluation

In this stage, model validation is carried out using Cross K- Fold Validation to determine the resulting accuracy value. After obtaining the expected accuracy value, an evaluation is then carried out by comparing the accuracy level produced by other models, namely model optimization using Forward Selection (FS), Backward Elimination (BE), Optimized Selection (OS), Bagging and AdaBoost.

RESULTS AND DISCUSSION

The data used in this research is crawling data obtained from twitter with reviews of government discourse, namely renewable energy electricity from 2021 to 2022. Obtained data totaling 1367 data with details of Positive labels totaling 120 data, Neutral 1221 data and negative 26 data. Below are details of the dataset taken from python via google collabs, in figure 2.

```
(1367, 1000)
sentiment
Neutral    1221
Positif    120
Negatif    26
Name: count, dtype: int64
```

Source : (Research Results, 2024)

Figure 2. Sentiment data details

A. Result using Support Vector Machine algorithm.

In the scenario of using the support vector machine (SVM) algorithm using a dataset divided into two, namely training data and testing data; 80: 20, the accuracy value is 93% with details can be seen in Table 2 below:

Table 2. Result SVM

	Precision	Recall	F1-Score
Positif	0.83	0.42	0.42
Negatif	0.00	0.00	0.00
Neutral	0.93	0.96	0.96

Source : (Research Results, 2024)

The results of the analysis using the support vector machine (SVM) algorithm on the discourse of renewable energy electricity, obtained results that have high sentiment precision on neutral sentiment and positive sentiment, but on negative sentiment get low sentiment results. Of course, the results obtained indicate that the SVM model tends to classify neutral sentiments, and then positive sentiments but tends to have difficulty in recognizing negative sentiments related to the discourse on renewable energy electricity.

B. Results Optimization Model

The following are the results of each optimization of the SVM algorithm with several optimizations:

1. Results SVM using Forward Selection (FS)

The results obtained from the SVM algorithm using Forward Selection (FS) optimization have an accuracy value of 95% with details in table 3 below:

Table 3. Results SVM optimization FS

	Precision	Recall	F1-Score
Positif	1.00	0.56	0.71
Negatif	0.00	0.00	0.00



	Precision	Recall	F1-Score
Netral	0.95	1.00	0.97

Source : (Research Results, 2024)

The results of the analysis contained in table 3 above using the support vector machine (SVM) algorithm using FS optimization are obtained on the discourse of renewable energy electricity, the results obtained are having high sentiment precision on positive sentiment and neutral sentiment, but on negative sentiment getting low sentiment results. Of course, the results obtained indicate that the SVM model tends to classify positive sentiments and tends to have difficulty in recognizing neutral sentiments related to the discourse on electric renewable energy.

#### 2. Results SVM using Backward Elimination (BE)

The results obtained from the SVM algorithm using Backward Elimination (BE) optimization have an accuracy value of 95% with details in table 4 below:

Table 4. Results SVM optimization BE

	Precision	Recall	F1-Score
Positif	0.85	0.61	0.71
Negatif	1.00	0.20	0.97
Netral	0.96	0.99	0.97

Source : (Research Results, 2024)

The results of the analysis contained in table 4 above using the SVM algorithm using BE optimization are obtained on the discourse of renewable energy electricity, the results obtained are having high sentiment precision on negative sentiment and neutral sentiment, but on positive sentiment getting low sentiment results. negative sentiment and neutral sentiment, but in positive sentiment get low sentiment results. Of course, the results obtained indicate that the model of SVM using Backward Elimination optimization tends to classify negative sentiments and neutral sentiments. classify negative sentiments and yet tend to have difficulty in recognizing positive sentiments related to the discourse on renewable energy. positive sentiments related to the discourse on renewable energy electricity.

#### 3. Results SVM using Optimized Selection (OS)

The results obtained from the SVM algorithm that uses Optimized Selection (OS) optimization have an accuracy value of 96% with details in table 5 below:

Table 5. Results SVM optimization OS

	Precision	Recall	F1-Score
Positif	0.86	0.67	0.75
Negatif	1.00	0.40	0.57
Netral	0.97	0.99	0.98

Source : (Research Results, 2024)

The analysis results contained in table 5 above use the SVM algorithm using Optimized Selection (OS) optimization. vector machine (SVM) algorithm using Optimized Selection (OS) optimization, it is obtained on the discourse of renewable energy electricity, the results obtained are having high sentiment precision on neutral sentiment, but on positive and negative sentiment get low sentiment results. Of course, the results obtained indicates that the model of SVM using optimized selection optimization (OS) tends to classify neutral sentiments. (OS) optimization tends to classify neutral sentiments and yet tends to have difficulty in recognizing positive and negative sentiments related to the sentiment. in recognizing positive and negative sentiments related to renewable energy discourse electricity.

#### 4. Results SVM using Bagging

The results obtained from the SVM algorithm that uses Bagging optimization have an accuracy value of 93% with details in table 6 below:

Table 6. Results SVM optimization Bagging

	Precision	Recall	F1-Score
Positif	1.00	0.17	0.29
Negatif	0.00	0.00	0.00
Netral	0.93	1.00	0.96

Source : (Research Results, 2024)

The analysis results contained in table 6 above use the support vector machine (SVM) algorithm using Bagging optimization. vector machine (SVM) algorithm using Bagging optimization, it is obtained on the discourse of discourse on renewable energy electricity, the results obtained are that it has high sentiment precision on neutral sentiment, but on positive and negative sentiment get low sentiment results. low sentiment. Of course, the results obtained indicate that the model of SVM using Bagging optimization tends to classify neutral sentiment and tends to have difficulty in recognizing neutral sentiment and yet tends to have difficulty in recognizing positive and negative sentiments related to the discourse on renewable related to the discourse on renewable energy electricity.

#### 5. Results SVM using Adaboost

The results obtained from the SVM algorithm that uses Adaboost optimization have an accuracy value of 94% with details in table 7 below:

Table 7. Results SVM optimization Adaboost

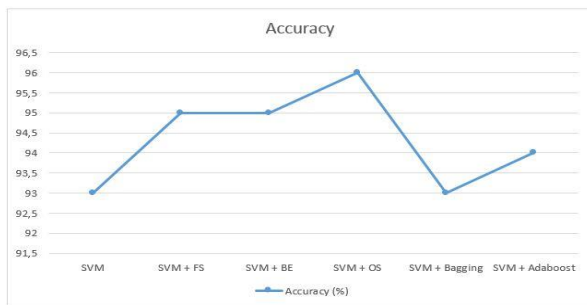
	Precision	Recall	F1-Score
Positif	1.00	0.44	0.62
Negatif	0.00	0.00	0.00
Netral	0.94	1.00	0.97

Source : (Research Results, 2024)



The analytical results in table 7 above make use of Adaboost optimization and the support vector machine (SVM) technique. technique for the vector machine (SVM) utilizing Adaboost optimization, it is obtained on the discourse of renewable energy and electricity. discourse on renewable energy electricity, the results obtained are that it has high sentiment precision on neutral sentiment, but on positive and negative sentiment get low sentiment results. Of course, the results obtained identify that the model of SVM using Adaboost optimization tends to classify neutral sentiment and tends to have difficulty in recognizing neutral sentiment. neutral sentiment and yet tends to have difficulty in identifying opinions, both favorable and unfavorable, about the discussion of power produced by renewable energy.

The results obtained using the Support vector machine (SVM) algorithm and by using several optimization models including Forward Selection (FS), Backward Elimination (BE), Optimized Selection (OS), Bagging and AdaBoost regarding sentiment analysis of renewable energy discourse electricity. Then it can be seen the results of the accuracy value in Figure 3 below:



Source : (Research Results, 2024)  
Figure 3. SVM accuracy and SVM optimization

## CONCLUSION

In this research, optimization techniques including Forward Selection (FS), Backward Elimination (BE), Optimized Selection (OS), Bagging, and AdaBoost have been successfully applied in sentiment analysis on twitter. and AdaBoost have been effectively used in sentiment analysis on Twitter about the discussion of renewable energy. Findings evaluating the method for classifying attitudes that have undergone data processing into positive, neutral, and negative categories, the use of TF-IDF, as well as applying the AdaBoost approach TF-IDF, and applying the SVM approach. From the results of modeling experiments and the application of various optimizations, it can be concluded that the use of the

SVM algorithm using Optimized Selection (OS) Optimization obtained a 3% increase from 93% to 96% of the accuracy value obtained 96% (Good Classification) accuracy value obtained. The increase in the use of SVM using selection optimization obtained the highest increase, because other optimization techniques were only because other optimization techniques only reach 1% and 2% of the original results using the SVM algorithm, namely the accuracy value of 93% (Good Classification).

Further research can be done using these other algorithms to see a wider community response to government discourse, especially in midwives. to government discourse, especially in midwives who are in direct contact with the wider community. Overall, this research makes a significant contribution in understanding the public's views on on government discourse policies and provides an important basis for further for further development in sentiment sentiment analysis on government discourse especially on social media twitter.

## ACKNOWLEDGEMENT

The author would like to thank Kemdikbudristek through DRTPM for providing financial support for the Skema Penelitian Dsen Pemula (PDP) in 2024 based on Decree Number 0459/E5/PG.02.00/2024 and Agreement Contract Number 108/E5/PG.02.00.PL/2024; 047/LL6/PB/AL.04/2024; 006/AMIKOMPWT/LPPM/15/VI/2024. The author also wishes to thank Amikom Purwokerto University through the Institute for Research and Community Service (LPPM) for providing support, so that this research runs well and smoothly.

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