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Sentiment Analysis of Loudspeaker Regulations in Houses of Worship on Social Media Using Support Vector Machine Algorithm

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ABSTRACT

Social media is an online platform where users can share content or interact with each other through discussions and debates that involve sentiments, such as agreement or disagreement on various topics. User sentiments on social media can be utilized in multiple ways, such as to gauge public opinion regarding the issuance of Circular Letter Number SE 05 of 2022 by the Ministry of Religious Affairs, which provides guidelines for the use of loudspeakers in mosques and prayer rooms. Due to the high volume of comments on social media regarding this circular, a sentiment analysis system is necessary. The sentiment analysis system in this research employs the Support Vector Machine (SVM) algorithm to classify comments as positive or negative. A total of 350 comments were collected from each social media platform—Facebook, Twitter, YouTube, and Instagram—about the issuance of the circular. These comments were divided into 250 for training data and 100 for testing data on each platform. The training data from all platforms were combined, resulting in a total of 1000 training data. Based on system testing using the Support Vector Machine algorithm, the accuracy achieved was 72%. This result reflects the system's capability to analyze sentiments related to the guidelines for using loudspeakers in mosques and prayer rooms as stated in the circular.

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1. Introduction

The masjid (mosque) holds a central position in the lives of Muslims, serving not only as a place for religious worship but also as a hub for various community activities. While the primary role of a mosque is to facilitate mahdah worship, such as performing daily prayers, reciting the Qur'an, and engaging in dhikr (remembrance of Allah), its significance extends far beyond these practices. Mosques are essential venues for da'wah (Islamic preaching), fostering community cohesion through social activities, and disseminating religious knowledge. These functions reflect the mosque’s role in shaping both the spiritual and social aspects of Muslim life [1].

Amon the various components of a mosque, the loudspeaker system has become a critical tool for fulfilling its religious duties, particularly in calling the faithful to prayer. The adhan (call to prayer), traditionally made from the mosque's minaret, is amplified through loudspeakers to signal the time for salah (prayer), ensuring that even those living far from the mosque are notified [2]. Moreover, these loudspeakers are also used for other religious purposes, such as broadcasting Qur'anic recitations, delivering sermons, and announcing community events, including important notifications like obituaries and charity collections. The presence of these loudspeakers has thus enhanced the mosque's ability to reach its wider congregation effectively.

However, the widespread use of loudspeakers has led to growing concerns regarding noise pollution and disturbances, particularly in densely populated areas where mosques are in close proximity to residential neighborhoods. To address these concerns and prevent potential conflicts, Indonesia's Ministry of Religious Affairs (Kemenag) issued Circular Letter No. SE 05 of 2022, which provides detailed guidelines for the proper use of loudspeakers in mosques and prayer rooms (musala). This circular aims to strike a balance between the need for religious expression and the maintenance of public tranquility, ensuring that mosque activities do not infringe on the peace of the surrounding community. The guidelines emphasize the importance of using loudspeakers in a manner that promotes social harmony and respects the diverse soundscapes of Indonesia's urban and rural settings.

The guidelines categorize loudspeakers into two types: internal and external. Internal loudspeakers are directed inside the mosque, used during prayer and sermons, while external loudspeakers are used for activities like the adhan, which need to reach a wider audience. The circular stipulates specific conditions for the use of external loudspeakers, including volume limits (up to 100 decibels) and restricted time frames for their use before and after prayers. For instance, prior to the Subuh prayer, the external loudspeaker can only be used for 10 minutes, while for Zuhur, Asar, Maghrib, and Isya, the time limit is 5 minutes. Such regulations are designed to reduce potential noise disturbances while maintaining the mosque's religious functions.

One of the more contentious aspects of loudspeaker usage in religious settings is its potential to foster riya (showing off) and sum'ah (seeking popularity), both of which are prohibited in Islam. Some scholars argue that broadcasting Qur'anic recitations or religious lectures via loudspeakers, especially in public spaces, may lead to individuals seeking attention or recognition, which contradicts the core Islamic values of humility and sincerity in worship.

Given the diversity of opinions on this issue, there has been considerable public discussion on the guidelines introduced by the Kemenag. Social media, in particular, has become a platform for expressing various sentiments regarding the use of loudspeakers in mosques. Public opinion ranges from full support of the regulations as necessary for social harmony to opposition, viewing them as restrictive or infringing on religious freedoms. These differing perspectives offer a unique opportunity for sentiment analysis to understand how the public perceives the Circular No. SE 05 of 2022.

In a study by Herlinawati et al. (2020), comparing the performance of the Naïve Bayes algorithm and SVM for sentiment analysis, SVM achieved an accuracy rate of 81.22%, outperforming Naïve Bayes, which had an accuracy rate of 74.37%. This demonstrates the robustness of SVM for text classification, reinforcing its application in this study to capture the nuances of public opinion [3].

In this study, titled "Sentiment Analysis of Loudspeaker Regulations in Houses of Worship on Social Media Using Support Vector Machine Algorithm", the aim is to classify public sentiment regarding the new guidelines. By leveraging machine learning techniques, particularly the Support Vector Machine (SVM) algorithm, we aim to provide an in-depth analysis of social media responses to the regulation. The SVM algorithm is well-known for its high accuracy in text classification tasks, making it an ideal choice for sentiment analysis.

2. Research Method

2.1. Loudspeakers

In mosques or prayer rooms, loudspeakers are often used for various activities. Loudspeakers are essential equipment in these places, primarily serving to amplify the call to prayer (adhan) to signal the beginning of the obligatory prayer or to announce prayer times, ensuring that even those living far from the mosque can hear it [2]. Loudspeakers are also used for reading Quranic verses and disseminating important information, such as news of misfortunes and other announcements.

2.2. Social Media

Social media is one of the most widely accessed internet services by netizens, serving as a platform for virtual interaction. Beyond communication, social media provides a space for disseminating both personal and public information. Information is often shared through tagging, sharing, or using hashtags [4].

2.3. Sentiment Analysis

Sentiment analysis is the process of observing opinions or viewpoints on a particular issue to determine whether the sentiment is positive or negative. It involves understanding, extracting, and processing textual data automatically to identify sentiments expressed in a statement [5]. Also known as opinion mining, sentiment analysis classifies text into various sentiment categories, such as positive, negative, neutral, or sarcastic [6]. This approach helps in estimating or analyzing sentiments within textual data.

2.4. Preprocessing

This technique is crucial for eliminating noise, inconsistent information, and incomplete data from the dataset [7]. Since social media data is unstructured, preprocessing was necessary to clean and align the data. Following standard steps [6], preprocessing included:

1. Case Folding: Converting all text to lowercase for uniformity.
2. Cleaning: Removing elements such as punctuation, special characters, URLs, hashtags, and mentions that are irrelevant to sentiment analysis.
3. Tokenizing: Splitting text into individual words to facilitate word-by-word analysis.
4. Filtering: Applying stopword removal techniques to eliminate low-information words while retaining important words.
5. Stemming: Returning words to their root form to enhance consistency [6].

2.5. Term Frequency-Inverse Document Frequency (TF-IDF)

Term Frequency-Inverse Document Frequency (TF-IDF) is a method for calculating the weight of each word in document data by transforming the data into a vector of terms for classification [8]. Commonly applied in information retrieval and text mining, TF-IDF evaluates each word's relevance in a document set, identifying keywords, determining search rankings, and more. The "TF" in TF-IDF represents the frequency of a term within a document, where higher values indicate greater importance within that document. Conversely, "DF" measures the frequency of a term across multiple documents; high DF values typically indicate common words with less importance. Therefore, IDF (the inverse of DF) is used to assess the significance of terms across documents: a high IDF value denotes rarity, signaling increased importance [9]. TF-IDF produces vector representations of each document used in classification. The equations for TF-IDF are as follows:

$$\text{TF Normalisasi} = \frac{F_{t,d}}{\text{Max}\, F_{t,d}} \quad \text{(1)}$$

Description:
$F_{t,d}$ = Term Frequency value
Max $F_{t,d}$ = The highest term frequency in a document

$$IDF_t = \log\left(\frac{D}{DF}\right) \quad \text{(2)}$$

Description:
D = Total number of documents
DF = Number of documents containing the term t

$$W_{t,d} = TF_{t,d}\, x\, IDF_t \quad \text{(3)}$$

Keterangan:
$W_{t,d}$ = The weight of term t in document
$TF_{t,d}$ = The frequency of term t in document d
IDF_t = *Inverse document frequency*

2.6. Sentiment Classification with Support Vector Machine (SVM)

Support Vector Machine (SVM) is a type of supervised machine learning algorithm that can be applied to both regression and classification problems. In Supervised Learning, the term "supervise" means that a teacher assists the program during the training process: there is a training set with labeled data. For example, if we want to teach a computer to sort red, blue, and green socks into different baskets, we first show the system each object and label it correctly. Then, we test the program with a validation set to check if the learned function is accurate. The program makes predictions, and the programmer corrects it when the conclusions are wrong. The training process continues until the model achieves the desired accuracy on the training data. However, this algorithm is primarily used in classification tasks [10]. The concept of classification with Support Vector Machine (SVM) involves finding the best hyperplane that separates two classes of data. The basic idea behind SVM is to maximize the margin, which is the distance between the separating classes of data [11].

The SVM algorithm primarily operates as a linear classification technique designed to identify the optimal hyperplane function. This hyperplane separates the input space into two distinct classes. The method can be extended into a nonlinear classifier by utilizing the kernel trick, allowing for classification in a high-dimensional space. Furthermore, the data must be converted into a vector representation within this high-dimensional space. Labels are assigned as +1 and -1, enabling complete separation by the hyperplane, as described in equation (4) [12] :

$$w.x + b = 0 \quad (4)$$

where

w is the weight vector,

x is the input vector, and

b is the bias value.

For data objects , a value of -1 is assigned in inequality (5):

$$w.x_i + b \leq -1 \quad (5)$$

Meanwhile, +1 is assigned in inequality (6):

$$w.x_i + b \geq +1 \quad (6)$$

Furthermore, the largest margin is achieved by maximizing the distance between the hyperplane and the nearest points (objects), as in equation (7):

$$\frac{1}{\|w\|} \quad (7)$$

The steps in the classification process using the Support Vector Machine (SVM) algorithm are as follows:

1. Identify Frequent Words

   Determine the most frequently occurring words from each document used.

2. Initialize Parameters

   Set initial values for the parameters: $\alpha = 0.5$, $C = 1$, $\lambda = 0.5$, gamma = 0.5 dan epsilon = 0.001

3. Calculate the Matrix

Use the following formula to compute the matrix:

$$D_{ij} = y_i y_j \left(K\left(x_i . x_j\right) + \lambda^2\right. \quad \text{......} \quad (8)$$

Explanation:

- Dij : the ij-th element of the data matrix
- yi,yj : class or label of the i-th and j-th data points
- λ : derived theoretical boundary
- $K(xi \cdot xj)$: kernel function

4. Calculate for Each Data Point n=1,2,3,…,n:

- Compute the error value (Ei):

$$E_i = \Sigma_{j=1}^{n} \alpha_i D_{ij} \quad \text{......} \quad (9)$$

- Update δαi using:

$$\delta\alpha_i = \min\{\max[\gamma(1 - E_i), -\alpha_i], C - \alpha_i) \quad \text{......} \quad (10)$$

- Update

$$\alpha_i = \alpha_i + \delta\alpha_i \quad \text{......} \quad (11)$$

Explanation:

- Ei : error value of the i-th data point
- γ : learning rate
- max(i)D ij : maximum value of the Hessian matrix diagonal

5. Determine the Bias (b):

Calculate the bias using the following equation:

$$b = -\frac{1}{2}\left[w . x^{+} + w . x^{-}\right] \quad \text{......} \quad (12)$$

6. Testing on New Documents

Perform tests on the documents being evaluated.

7. Decision Calculation

If the decision calculation result is greater than or equal to 0, the sign h(x) is +1, which classifies it as a positive class.

If the result is less than 0, the sign h(x) is −1, classifying it as a negative class.

The decision calculation uses the following equations:

$$h(x) = w . x + b \quad \text{......} \quad (13)$$

or

$$h(x) = \Sigma_{i=1}^{m} \alpha_i y_i \, K(x, x_i) + b \quad \text{.......................................} (14)$$

2.7. Performance Evaluation (Confusion Matrix)

To evaluate the accuracy of the SVM model, a Confusion Matrix was used, providing information on classification results in the form of True Positives, False Positives, True Negatives, and False Negatives. Accuracy, precision, recall, and F1 score measurements were calculated from this matrix to obtain an in-depth performance evaluation [13].

3. Result and Discussion

3.1. Data Analysis

In this study, the data used consists of comments collected from posts on several social media platforms, namely Facebook, Twitter, YouTube, and Instagram, related to the Ministry of Religious Affairs (Kemenag) issuing Circular Letter Number SE 05 of 2022 on Guidelines for the Use of Loudspeakers in Mosques and Prayer Rooms. The comments were taken from February to June 2022, with a total of 350 comments per social media platform, divided into 250 training data and 100 test data. The comments were collected using the Google Chrome extension Instant Data Scraper. The data analysis stages were carried out to ensure the sentiment analysis system produced the expected results. These stages include collecting comments as the dataset for the research. The analysis system applies a classification method, namely SVM to classify a comment is positive or negative.

3.2. Data Representation

a) Data Colletion

The data used comes from comments on social media posts related to the regulation of loudspeakers in places of worship, collected from Facebook, Twitter, YouTube, and Instagram. The data was obtained using scraping techniques with the help of a Google Chrome extension called Instant Data Scraper version 1.0.8. The collected data was then imported into an Excel file in .xlsx format. Before scraping, the extension must be installed on Google Chrome. Once installed, the comment collection process can be carried out on relevant social media posts.

b) Data Labelling

The next step is data labeling, where comments are manually categorized by the author as either positive or negative sentiments. The labeled data is used as training data for the research.

c) Preprocessing

Once the comment dataset has been labeled, it undergoes a preprocessing stage. Data preprocessing is necessary to transform unstructured text data into a clean and structured format ready for analysis. The preprocessing steps include Case Folding, Cleaning, Tokenizing, Filtering, and Stemming.

3.3. Testing

The system is tested using new comment data to classify sentiments through a model built using the Support Vector Machine (SVM) method. The testing process consists of the following steps:

a) Running the System

When the application is launched, the main page is displayed, featuring a form for uploading .xlsx files and a "submit" button. Before classifying comments, the comment file must be uploaded through the form. The file must be in .xlsx format, with the comment column named "uji." After uploading, the classification process starts by clicking the "submit" button on the right side of the upload form.

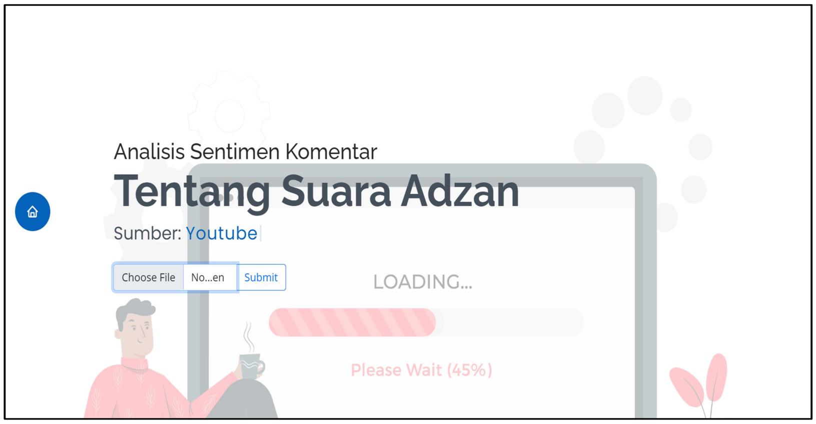

Figure 1. System Main Page

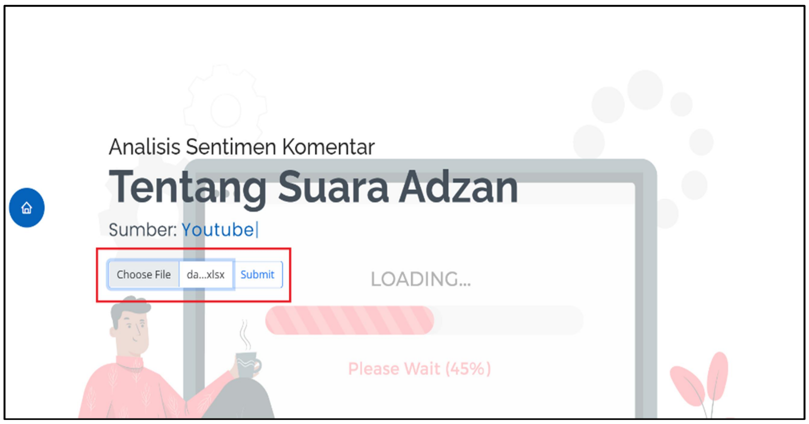

Figure 2. Upload Test Data File

b) Testing New Comments

The author tested the system using 100 comments from social media posts related to Circular Letter No. SE 05 of 2022, concerning the Guidelines for the Use of Loudspeakers in Mosques and Musallas. These test comments were prepared in files for each platform (Facebook, Twitter, YouTube, Instagram), named "uji" in the comment column, and saved in .xlsx format. The files were uploaded via the system's upload form, and classification results were displayed after clicking "submit."

c) Classification Results

Once the test data files were uploaded, the classification process utilized the SVM method. The system's performance in sentiment analysis was evaluated using a Confusion Matrix to measure the accuracy of the built model.

1) Testing on Facebook Data

The sentiment analysis model was evaluated using 100 comments from Facebook posts. The accuracy was calculated based on the Confusion Matrix results.

Table 1. Accuracy on Facebook Data Testing

	Predict No	**Predict Yes**
Actual No	59	1
Actual Yes	28	12

$$Accuracy = \frac{12 + 59}{12 + 59 + 1 + 28} \text{ x } 100\% = 71\%$$

2) Testing on Twitter Data

The sentiment analysis model was evaluated using 100 comments from Twitter posts. The accuracy was calculated based on the Confusion Matrix results

Table 2. Accuracy on Twitter Data Testing

	Predict No	Predict Yes
Actual No	45	8
Actual Yes	19	28

$$Accuracy = \frac{28 + 45}{28 + 45 + 8 + 19} \text{ x } 100\% = 73\%$$

3) Testing on Youtube Data

The sentiment analysis model was evaluated using 100 comments fromYoutube posts. The accuracy was calculated based on the Confusion Matrix results

Table 3. Accuracy on Youtube Data Testing

	Predict No	Predict Yes
Actual No	58	6
Actual Yes	24	12

$$Accuracy = \frac{12 + 58}{12 + 58 + 6 + 24} \text{ x } 100\% = 70\%$$

4) Testing on Instagram Data

The sentiment analysis model was evaluated using 100 comments from Instagram posts. The accuracy was calculated based on the Confusion Matrix results

Table 4. Accuracy on Instagram Data Testing

	Predict No	Predict Yes
Actual No	67	3
Actual Yes	23	7

$$Accuracy = \frac{7 + 67}{7 + 3 + 23 + 67} \text{ x } 100\% = 74\%$$

Based on the test data calculations for each social media platform, the model achieved an accuracy rate of 72%.

3.4. Implementation

The system implementation results based on the designed plan are as follows:

a) Main Page Display

When the system is launched, the main page will appear, featuring a form for uploading .xlsx files and a "submit" button. Before the comment classification process begins, the user must upload the comment file through the form. The uploaded file must be in .xlsx format, with the comment column named "uji." Once the file is successfully uploaded, the comment classification process can start by clicking the "submit" button on the right side of the form.

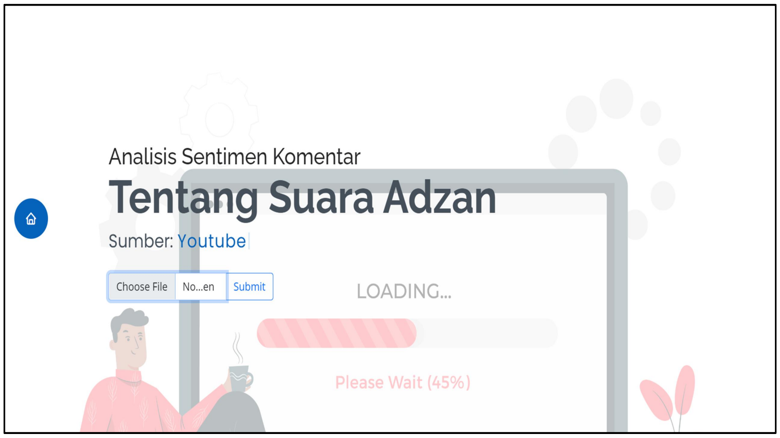

Figure 3. Main Page Display

b) Comment Analysis Results Display

The comment analysis results page displays the classification outcomes of the comments processed by the system. On this page, each comment is shown along with its classification result, indicating whether the comment is categorized as positive or negative.

HASIL ANALISIS KOMENTAR

Hasil Prediksi

Komentar	Sentimen
Ada orang islam yg seharusnya jadi panutan orang muslim malah mencela suara azan, orang di luar islam saja bisa toleransi, memang salah pilih pak jo...	Negatif
Adzan harus di suarakan lebih keras biyar bayak yg dengar ,untuk mengingatkan masuknya waktu sholat	Negatif
Agama Islam banyak musuhnya, aneh banget kan. Itu bukti kalau Agama ISLAM adalah agama yang BENAR.	Negatif
Agama super power di negara ini jng coba2 dilawan	Negatif
Akhir nya dia tenang di dlm penjara gk dgrin suara toa masji melain kan toa sang sipir buat bangunin dia bekerja di penjara	Positif
Aku setuju sih bangunkan sahur jgn paje toa. Baiknya kembali ke jaman dulu anak2 muda keliling kampung bawa kentongan	Positif
Alhamdulillah, memperjuangkan hak hukum y wajib ,jihad... maaf semua y	Positif
Allah itu segalanya, di atas segalanya,,,	Negatif
Allah SWT maha mendengar, tidak perlu speaker atau sound system! gitu saja kok repot.	Negatif
Allahuakbar	Negatif
Ambyar,....pasti pada tepuk tangan yg tdk senang umat islam bersatu.......Inilah produk pimpinan yg tdk menguasai agama Islam yg	Negatif

Figure 4. Comment Analysis Results Display

4. Conclusion

Based on the research conducted, several conclusions can be drawn. First, the dataset used consists of 350 comments from each social media platform, namely Facebook, Twitter, YouTube, and Instagram. These comments were divided into 250 training data and 100 testing data for each social media platform. All training data from the four platforms were combined into one, resulting in a total of 1000 training data.

Next, this research developed a web-based system using the Support Vector Machine (SVM) algorithm to analyze sentiments related to the issuance of Circular Letter Number SE 05 of 2022 Regarding Guidelines for the Use of Loudspeakers in Mosques and Prayer Rooms. This system achieved an accuracy rate of 72% in classifying comment sentiments.

However, this research has some limitations, particularly regarding the system's performance in retrieving information in both positive and negative sentiment classes. One of the main reasons is the imbalance in the training data, where the amount of negative data was higher than positive data, affecting the accuracy of the analysis performed.

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