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Volume 2470

International Conference on Informatics, Technology, and Engineering 2021 (InCITE 2021)

Leveraging Smart Engineering

Surabaya, Indonesia • 25–26 August 2021

Editors • Joniarto Parung, Nemuel Daniel Pah, Putu Doddy Sutrisna and Marcellinus Ferdinand Suciadi

InCITE 2021

Leveraging Smart Engineering

Faculty of Engineering Universitas Surabaya

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Location: Surabaya, Indonesia
ISBN: 978-0-7354-4180-4
Editors: Joniarto Parung, Nemuel Daniel Pah, Putu Doddy Sutrisna and Marcellinus Ferdinand Suciadi Suciadi
Volume number: 2470
Published: Apr 25, 2022

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Cite as: AIP Conference Proceedings **2470**, 010001 (2022); https://doi.org/10.1063/12.0009021
Published Online: 25 April 2022

Preface: International Conference on Informatics, Technology, and Engineering 2021 (InCITE 2021)

Welcome to the 3rd biannual International Conference on Informatics, Technology, and Engineering 2021 (InCITE 2021). This year, InCITE is organized from Surabaya, Indonesia and researchers from around the world discuss current challenges and technological solutions via an online platform on August 25-26, 2021.

InCITE 2021 presents "Leveraging Smart Engineering" as its central theme. In response to several world challenges, such as sustainable development, global convergence of information and communications technologies, along with smart systems as opportunities as well as challenges in developments for better industries, it is considered important to discover innovative approaches from science and engineering perspectives. Innovation suggests the introduction of novelty to create better solutions. Innovation in engineering and science requires contributions from multidisciplinary sectors, involving industries, practitioners, researchers, and academics.

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AIP Conf. Proc. 2470, 010001-1–010001-1; https://doi.org/10.1063/12.0009021
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Cite as: AIP Conference Proceedings **2470**, 010002 (2022); https://doi.org/10.1063/12.0009708
Published Online: 25 April 2022

WELCOME FROM InCITE 2021 STEERING COMMITTEE

It is a great pleasure to welcome all of you to the 3rd Bi-Annual International Conference on Informatics, Technology, and Engineering 2021 (InCITE 2021) held by the Faculty of Engineering, University of Surabaya (UBAYA). The first and second InCITE have been successfully held in Bali, Indonesia in 2017 and 2019. Hence, now we are delighted to host the third InCITE through online media due to the Covid-19 pandemic situation.

There are 37 papers that have been selected to be presented in InCITE 2021. The papers were written by experts not only from Indonesia, but also from different parts of the world. The main theme of this conference is Leveraging Smart Engineering in response to the current and future Industrial Revolution 4.0 that should be handled by every country in the world. We hope through this conference, all participants will be able to know each other and interact to develop future collaboration.

We would like to express our sincere gratitude to the Keynote speakers, International Scientific Committee, Steering Committee, and Organizing Committee for their huge efforts to make this conference successful.

Thank you all for your support and attendance at InCITE 2021. Please enjoy the conference!

Asst. Prof. Doddy Sutrisna, Ph.D.
Steering Committee

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AIP Conf. Proc. 2470, 010002-1–010002-2; https://doi.org/10.1063/12.0009708
Published by AIP Publishing. 978-0-7354-4180-4/$30.00

WELCOME FROM InCITE 2021 ORGANIZING COMMITTEE

Welcome to InCITE 2021! The third bi-annual international conference on engineering domain conducted by the Faculty of Engineering, The University of Surabaya (UBAYA). Due to the COVID-19 pandemic, InCITE 2021 is held as an online conference. Online conference opens the opportunity for many researchers around the globe to share their findings and learn from other global researchers with less restrictions.

InCITE 2021 invites three keynote speakers, well reputable global researchers in their research domain from Australia and Taiwan. Following each keynote session are two presentation sessions run in parallel.

This year, we received 66 papers submitted by researchers from four distinct countries (i.e., first author's country of origin): Indonesia, Australia, Taiwan, and Kazakhstan.

We employed a double-blind review to ensure a high standard and a minimum level of bias in the reviewing processes. This resulted in 56% of the submissions were accepted and will be published to the AIP Conference Proceedings.

Authors of all accepted papers are to disseminate their findings during InCITE 2021 conference between 25 to 26 of August 2021. This presents a great opportunity for everyone, including the researchers, to discuss and further improve current achievements.

We thank all keynote speakers, presenters, and reviewers/scientific committees for the generous supports. We thank the University of Surabaya, the Faculty of Engineering UBAYA, and all InCITE 2021 committees that enable InCITE 2021.

We wish you a very pleasant and rich conference experience in InCITE 2021 and look forward to seeing you again on InCITE 2023! Thank you.

Yours sincerely,
Asst. Prof. Dr. Jimmy
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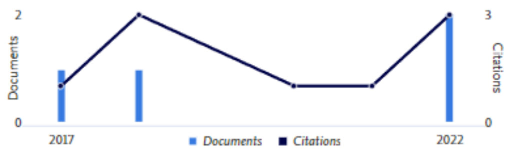

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AIP Conference Proceedings, 2022, 2470, 050001

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Citations

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Cite as: AIP Conference Proceedings **2470**, 050001 (2022); https://doi.org/10.1063/5.0080185
Published Online: 25 April 2022

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Hate Speech Content Detection System on Twitter using K-Nearest Neighbor Method

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Abstract. Twitter is a social media platform that many Indonesians use to express their thoughts on a variety of topics. In Indonesia, the use of social media is governed by a law known as Information and Electronic Transactions Law. However, until now, the implementation of this law has been subpar. This is because there are still violations occurring, and no legal action has been taken against these violations. Hate speech is a common violation on Twitter. The goal of this research is to create a system that can detect potential violations of content on Twitter, particularly content containing hate speech. The k-nearest neighbor (KNN) method was used in this research, along with the feature extraction method TF-IDF. The system built will detect whether the tweet you want to post violates a specific article in the Information and Electronic Transactions Law. Based on model validation, model classifier built has accuracy value is 67.86%, with *K* value in the KNN method is 10. Meanwhile, based on user validation, the system created has an accuracy of 77%.

Keywords: Hate Speech Detection, Twitter, K-Nearest Neighbor, ITE Law

INTRODUCTION

Social media is a type of online communication medium that allows people to share various types of information such as text, images, sound, and video. Twitter is one of the most popular social media platforms. Twitter is a social media platform that allows users to share information in the form of “Tweets”. According to data from the Ministry of Communication and Information Technology, Indonesia is the world's fifth-largest Twitter user country, trailing only the United Kingdom [1]. The number of Twitter users in Indonesia has risen to 19.5 million and is expected to rise further.

The Information and Electronic Transactions Law governs the use of social media as a medium of electronic communication in Indonesia. The regulation is a law that governs the use and utilization of electronic technology to support activities and ensures that activities are carried out in accordance with the Indonesian people's social and cultural conditions. However, the regulation's implementation has been ineffective, as violations are still being reported on social media. Hate speech was one of the violations that occurred. Hate speech is defined as an act of communication carried out by an individual or group in the form of provocation, incitement, or insults directed at other individuals or groups based on factors such as race, color, ethnicity, gender, sexual orientation, nationality, religion, etc [2]. Some hate speech violations have resulted in appropriate legal action, such as the examples of hate speech via Twitter shown in Fig. 1. The tweet has been determined with decision number: 1521/Pid.Sus/2017/PN Jkt.Pst and appeal decision number 1940 K/Pid.Sus/2018, where the defendant was sentenced to two years in prison. The articles that can be used to prosecute hate speech offenders are: Article 156 of the Criminal Code, Article 156a of the Criminal Code, and Article 45A paragraph (2) jo. Article 28 paragraph (2) of the ITE Law. These three articles are the focus of this research.

International Conference on Informatics, Technology, and Engineering 2021 (InCITE 2021)
AIP Conf. Proc. 2470, 050001-1–050001-10; https://doi.org/10.1063/5.0080185
Published by AIP Publishing. 978-0-7354-4180-4/$30.00

FIGURE 1. Hate Speech Tweet That Has Received A Legal Ruling

However, there are many hate-speech tweets that have yet to be investigated by the police. This is due to the large number of hate speech tweets in circulation, which makes it difficult for police to track down the original source or provocateurs of hate speech. Figure 2 depicts an example of a tweet that did not result in legal action by the police. Another factor that contributes to the widespread spread of hate speech is social media users' ignorance of the consequences of the hate speech they post. The system developed in this research can assist Twitter users in first checking the tweet to be posted, whether it has the potential to violate certain legal articles, and the consequences if the tweet is still posted. The method used in this study is k-nearest neighbor.

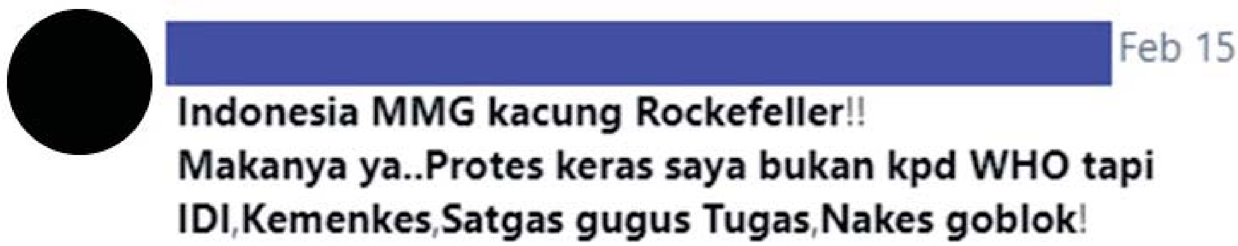


FIGURE 2. Hate Speech Tweet That Have Not Received Legal Action.

The k-nearest neighbor (KNN) is an instance-based learning method that stores all available data points (examples) and classifies new data points using a similarity measure to classify them. The KNN method works by assigning new unclassified examples to the class that contains the majority of its k-nearest neighbors. When the number of samples in the training dataset is large, this algorithm proves to be very effective in terms of reducing misclassification error. Another advantage of the KNN method over many other supervised learning methods such as support vector machine (SVM), decision tree, neural network, and so on is that it can easily deal with problems with class sizes of three or more [3].

RELATED WORKS

There has previously been research on the topic of detecting hate speech and using Twitter data. In their study, Alfina et al. [4] create a new dataset that includes hate speech in general, including hatred for religion, race, ethnicity, and gender. They also conducted a preliminary study utilizing a machine learning approach. They compared the performance of various features and machine learning algorithms for detecting hate speech. The extracted features were word n-grams with n=1 and n=2, character n-grams with n=3 and n=4, and negative sentiment. The classification was done with Nave Bayes, Support Vector Machine, Bayesian Logistic Regression, and Random Forest Decision Tree.

On the other hand, research conducted by Febriana and Budiarto [5] presents the process of developing a dataset that can be used to build a hate speech detection model from more than 1 million tweets successfully collected via Twitter API. Machine learning was used to perform basic preprocessing and preliminary research. The Latent Dirichlet Allocation (LDA) algorithm was used to extract the topic for each tweet in order to determine whether these topics are related to debate themes. The dataset was also subjected to pre-trained sentiment analysis, which resulted in polarity scores for each tweet. The number of positive and negative tweets is almost equal among the 83,752 tweets included in the analysis step.

Patihullah and Winarko [6] in their research compares the performance of Gated Recurrent Units (GRU) to that of other supervised methods such as Support Vector Machine, Naive Bayes, Random Forest, and Logistic Regression. Word2vec was used for feature extraction in their study because it has the ability to learn semantics between words. However, compared to TF and TF-IDF features, the use of word2vec in comparison methods yields lower accuracy. In contrast to previous research, Taradhita and Putra [7] propose a convolutional neural network method for classifying hate speech in Indonesian tweets. Twitter was used to collect datasets for both the training and testing stages. The collected tweets were divided into two categories: hate speech and non-hate speech. For feature extraction, they used the TF-IDF term weighting method.

This study employs a different classification method than previous studies, namely the KNN method. The KNN method was chosen because it is well-suited to problems with class sizes of three or more. Furthermore, if the number of datasets is increased, the KNN method can reduce classification errors [3]. This study employs the TF-IDF method for feature extraction because, according to the research conducted by Patihullah and Winarko [6], this method produces good accuracy. In addition, this research can specifically tell the user whether a tweet is included in hate speech or not and which rules are violated, so that the user knows the consequences if the tweet is still posted. This is not found in the studies that have been discussed previously.

RESEARCH METHODS

Collecting and Labeling Data

The first step in this study was to collect data in the form of hate speech-related tweets. The tweet data collected consists of Indonesian tweets. Crawling techniques are used in this data collection process. Crawling is a technique for retrieving the components of a web page and extracting the components contained within them. Obtaining a web URL is the first step in the crawling process. The URL is then downloaded in order to obtain a collection of pages from that URL. The obtained page is then extracted from the components that contain information related to the required data [8]. Crawling was carried out in this study using the Twitter API. The Twitter API is a developer-provided program that can be used to access information from Twitter. The Twitter API is commonly used for education, research, and analysis [9].

Following the collection of tweet data, the data must be labeled. Each tweet will be labeled with one of four labels: *"Pasal 156 KUHP", "Pasal 156a KUHP", "Pasal 45A ayat (2) jo. Pasal 28 ayat (2) UU ITE*", indicating that it violates certain articles, or "*Tidak Melanggar*", where the tweet does not violate the law. Several research assistants labeled the data after receiving guidance from ITE law experts.

Preprocessing data

Preprocessing occurs after the data has been collected and labeled. Preprocessing aims to obtain clean data in order to improve the accuracy of the detection process [10]. The first step in preprocessing is to remove symbols that frequently appear in tweet data, such as #, @, emoticons, and website links. Because the symbols have little influence on the detection process, this is done. The following stage is case folding, which converts all letters in a word to lowercase. This is done to avoid the use of words with the same meaning, such as "*SaYa*" and "*saya*".

Stemming is the next step in preprocessing. This is a process for determining the root of a word that will be implemented using the Nazief Andriani algorithm, which will be used in this study with the *Sastrawi 1.0.1* library. The Nazief Andriani algorithm was developed based on the broad Indonesian morphological rules, which were collected into one group and encapsulated into allowed affixes and disallowed affixes. This algorithm uses a basic word dictionary and supports recording, namely the rearrangement of words that have an excessive stemming process [11]. Wahyudi, et al [11] in their research also concluded that the Nazief Andriani algorithm gave better results than the Porter algorithm to support information retrieval systems. The next step after stemming is stop word removal. This step was used to eliminate words that had no effect on the categorization process, such as: *yang, dan, atau, ke, dari*, and so on. Tokenization is the final step in the preprocessing process. Tokenization is the process of dividing a sentence into words. Tokenization results will be saved as clean data.

Feature Extraction

The feature extraction process is carried out after the training data has been preprocessed. The Term Frequency - Inverse Document Frequency (TF-IDF) method can be used to extract features from text data. The TF-IDF method is a combination of weighting methods used to determine the importance of a word in a document. Formula (1) can be used to calculate TF-IDF values [12].

$$tf.idf = tf \times \log \frac{N}{df} \tag{1}$$

where *tf* is the term frequency, which is the frequency with which a word or term appears in a given document. Meanwhile, *idf* stands for inverted document frequency, which is the base 10 log value of the number of *N* documents divided by the *df* value. The *df* stands for document frequency, which is the number of documents that contain a specific term.

Training Data

After extracting the features, the training process begins. The goal of this process is to train the feature data using a specific method in order to create a classification model that can later be used to predict hate speech tweets. The KNN was used to train the data in this study. KNN is a classification method that computes the shortest distance between training and test data. The accuracy of this method is determined by the features it possesses. The accuracy of this method decreases as the number of relevant features decreases. This method is appropriate for training data that is large and noisy [13]. The stages of data classification by KNN method is shown in Fig. 3.

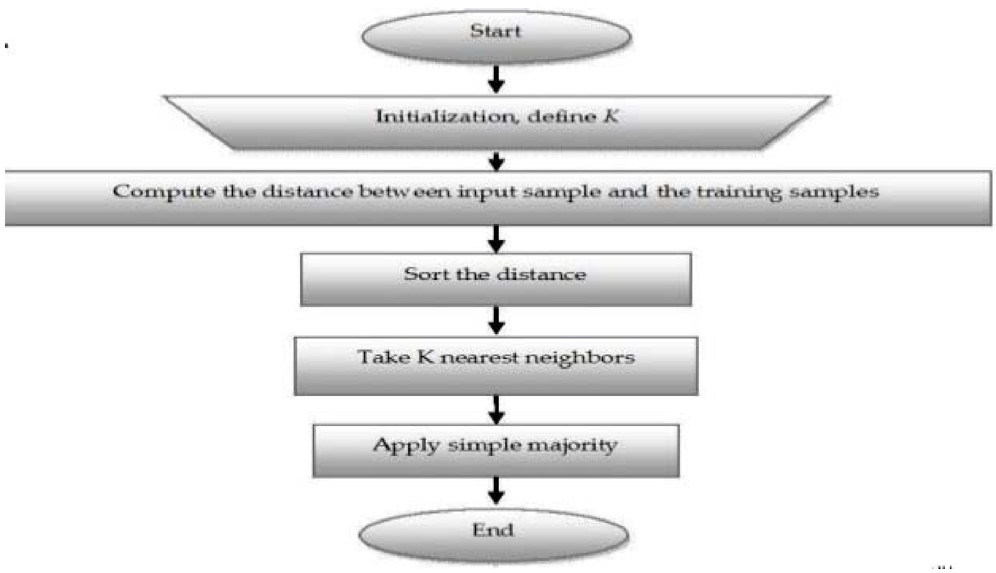


FIGURE 3. The Flowchart of KNN Method

Distances between input samples and training data can be calculated using a variety of methods, including Euclidean distance, Manhattan distance, and cosine similarity. The distance is calculated using the Euclidean method in this study. The Euclidean distance method, which has been modified to scale all attribute values to between 0 and 1, works well in domains where the attributes are all equally important to the outcome. Such domains, on the other hand, are the exception rather than the rule. Some attributes are irrelevant in most domains, while others are more important. The next step forward in instance-based learning is to incrementally learn the importance of each attribute by dynamically updating feature weights [14]. To calculate Euclidean distance, use

Formula (2), where W_{kj} is the value of TF-IDF from a term that has similarities to a term in the query, while W_{kq} is the TF-IDF value of a term in the query.

$$Sim(D,q) = \sqrt{\sum_{k=1}^{n} \left(W_{kq} - W_{kj}\right)^2} \tag{2}$$

Evaluation

In the validation system, this research employs the confusion matrix method. Confusion matrix is one of the important tools in the visualization method used in machine learning, which usually has two or more categories. Each matrix element displays the number of sample test data for the actual class, which is represented in rows, and the predicted class, which is represented in columns [15]. Table 1 illustrates examples of confusion matrix prediction results for two classes.

TABLE 1. Example of Confusion Matrix

		Actual Class	
		Class 1	**Class 2**
Predicted Class	**Class 1**	True Positive	False Negative
	Class 2	False Positive	True Negative

The correct prediction results are true positive (TP) and true negative (TN) values. The false positive value (FP) is the value predicted by the system to be class-1 but is actually class-2, whereas the false negative value (FN) is the value predicted by the system to be class-2 but is actually class-1. The accuracy value is obtained based on the correct prediction results divided by the total data or if based on Table 1, then the accuracy value is obtained by Formula (3).

$$Accuracy = \frac{(TP + TN)}{(TP + FP + TN + FN)} \tag{3}$$

RESULTS AND DISCUSSION

System Testing

This section went over the testing of the system that was built. The goal of this system is to detect tweets that have the potential to contain hate speech so that the user can determine whether the tweet is safe to post. Crawling, preprocessing, feature extraction, and training will be performed before the system can detect hate speech in tweets. As described in the previous section, the crawling process will be initiated to obtain the desired data. The crawled data are tweets with certain keywords that have been selected by an ITE law expert and several assistants. This selection process is carried out so that the tweet data obtained is in accordance with the hate speech cases that have occurred in Indonesia. The crawling process is carried out by utilizing the Twitter API as described in the previous section. The Twitter API has a maximum limit of 100 tweets for one crawling process. The total tweet data obtained from the crawling process is 973 tweets. After the tweet data was obtained, an ITE law expert and several research assistants selected the tweet data to discard tweets that were not relevant for this research. The total tweet data obtained from this selection process is 276 tweets, where this data will be further processed by the system. Several research assistants will manually label the collected data based on guidance from ITE law experts. For example, there is a tweet that says "*biksu penista Agama biksu itu botak semua itu mah biksu dukun*" so that tweet is labeled "*Pasal 156a KUHP*", because it is included in religious blasphemy. Table 2 shows the distribution of tweet data by class.

TABLE 2. Distribution of Tweet Data

Class	Number of Tweets
Pasal 156 KUHP	90
Pasal 156a KUHP	65
Pasal 45A ayat (2) jo. Pasal 28 ayat (2) UU ITE	68
Tidak Melanggar	53

After all the tweets have been labeled, the system will preprocess them. The first step in preprocessing is to remove symbols that frequently appear in tweet data, such as #, @, emoticons, and website links. The following step is case folding, which converts all the letters to lowercase. Table 3 shows examples of the result of symbol removal and case folding.

TABLE 3. Some Sample Tweets After Symbol Removal and Case Folding

No	Original Tweet	After Symbol Removal	After Case Folding
1	*@LsOwien Coba aja suruh tuh idi kacung who itu autopsi orang yang katanya mati karena coped ga akan berani*	*Coba aja suruh tuh idi kacung who itu autopsi orang yang katanya mati karena coped ga akan berani*	*coba aja suruh tuh idi kacung who itu autopsi orang yang katanya mati karena coped ga akan berani*
2	*Orang Kristen/Katolik mayoritas GAY.. RT @era_muslim: Paus : Gay Tidak Harus Dipinggirkan*	*Orang Kristen Katolik mayoritas GAY Paus Gay Tidak Harus Dipinggirkan*	*orang kristen katolik mayoritas gay paus gay tidak harus dipinggirkan*
3	*@VIVAcoid ohhh... jadi faham sampai sini... ternyata aktivis 98 biangkerok anti islam di negara ini.... yayaya*	*ohhh jadi faham sampai sini ternyata aktivis biangkerok anti islam di negara ini yayaya*	*ohhh jadi faham sampai sini ternyata aktivis biangkerok anti islam di negara ini yayaya*
4	*@iPatJnkyu Anjing lah mau jadi orang cina aja*	*Anjing lah mau jadi orang cina aja*	*anjing lah mau jadi orang cina aja*

The next step of preprocessing is stemming and stop word removal. The *Sastrawi 1.0.1* library was used in this study to perform stemming and stop words. Examples of stemming and stopword removal results are shown in Table 4. The tweets used as examples for stemming and stop word removal are the results of case folding in Table 3.

TABLE 4. Some Sample Tweets After Stemming and Stop word Removal

No	After Case Folding	After Stemming	After Stop word Removal
1	*coba aja suruh tuh idi kacung who itu autopsi orang yang katanya mati karena coped ga akan berani*	*coba aja suruh tuh idi kacung who itu autopsi orang yang kata mati karena coped ga akan berani*	*coba aja suruh tuh idi kacung who autopsi orang kata mati coped ga berani*
2	*orang kristen katolik mayoritas gay paus gay tidak harus dipinggirkan*	*orang kristen katolik mayoritas gay paus gay tidak harus pinggir*	*orang kristen katolik mayoritas gay paus gay pinggir*
3	*ohhh jadi faham sampai sini ternyata aktivis biangkerok anti islam di negara ini yayaya*	*ohhh jadi faham sampai sini nyata aktivis biangkerok anti islam di negara ini yayaya*	*ohhh jadi faham nyata aktivis biangkerok anti islam negara yayaya*
4	*anjing lah mau jadi orang cina aja*	*anjing lah mau jadi orang cina aja*	*anjing lah mau jadi orang cina aja*

The final step of preprocessing is tokenization. Tokenization will separate sentences into word by word based on spaces. Following the completion of the preprocessing, the tweet data will be subjected to feature extraction using the TF-IDF method before the training process begins. The system will automatically run the training after the feature extraction process is completed. The KNN method is used to carry out the training process. The *K* value used in the KNN method is 9. This value is derived from the results of the previous accuracy testing, which will be discussed in the following section.

After the training process is complete, the system is ready to detect new tweets entered by the user. Users are required to log in first with their respective Twitter accounts, before using this system. Figure 4 shows a view of the hate speech detection system built. Users can input new tweets, which will be detected through the text area provided by the system. The detection process will start after the user clicks the "*Check*" button, and the prediction results will be displayed below it. In Fig. 4, it can be seen that the prediction results are displayed in three columns. The first column contains the tweet that was entered, the second column contains the detection result, and the final column contains the maximum penalty that the user can receive if the tweet contains hate speech content. The system also provides a "*POST*" button, which is next to the detection result, where the button functions to post a tweet to our Twitter page.

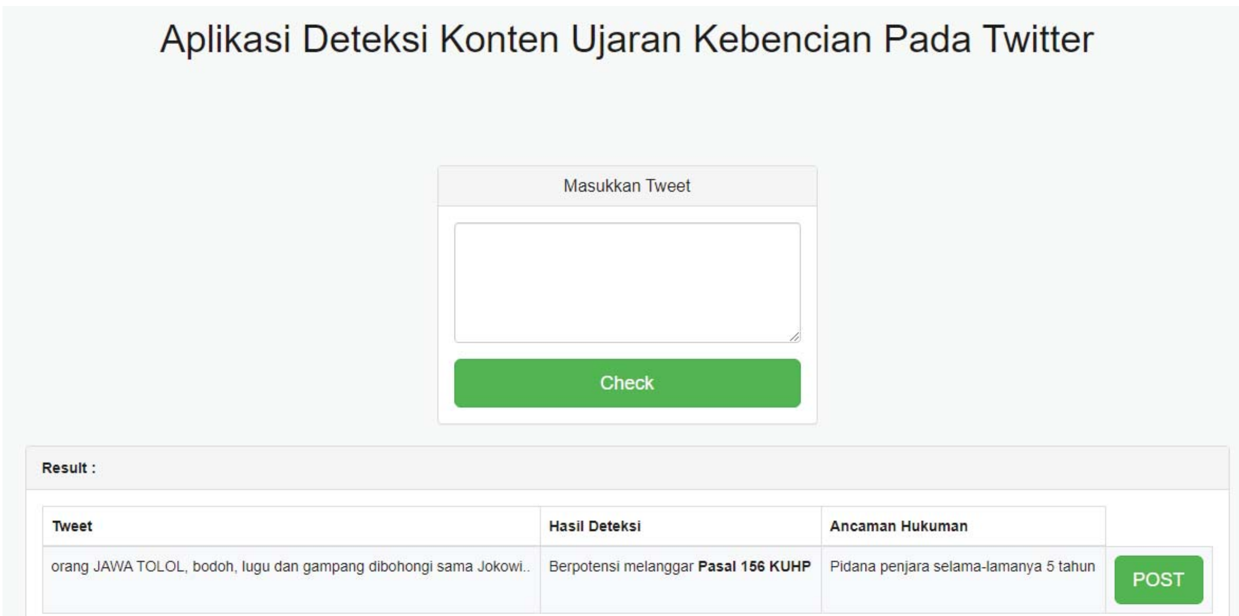


FIGURE 4. Hate Speech Detection System Display

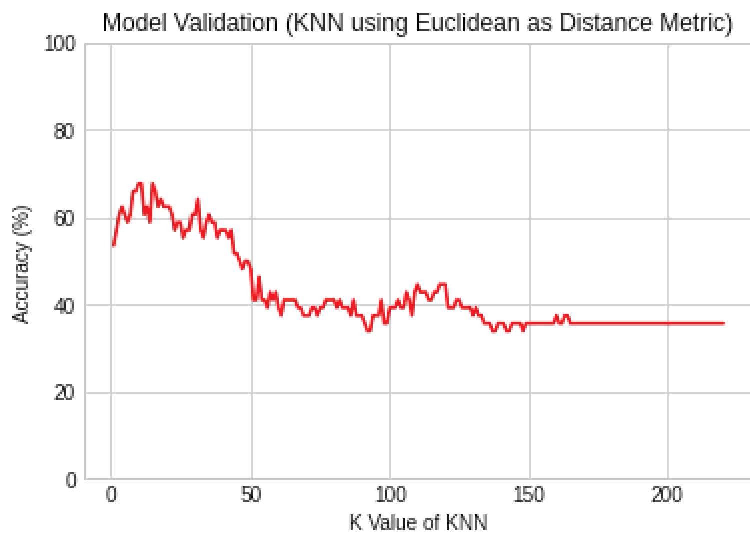
System Validation

The goal of system validation is to determine the level of accuracy of the system being built. Model validation and user validation are the two parts of system validation. The goal of model validation is to obtain the best accuracy value from the classifier used in this study, in this case the KNN method. The K value in the KNN method used in the training process will be determined by this validation. Model validation begins by dividing the owned tweet data into 80% training data and 20% testing data. Following that, the system will train using 80% of the training data, followed by a test using 20% of the testing data to determine the accuracy of the resulting classifier model. The ratio of the training and testing data was chosen because based on research conducted by Uçar et al [16], for a few datasets, the test rate that can be selected is between 10% and 20%. These processes are repeated from $K = 1$ to $K = 221$. The value of $K = 221$ was determined based on the total training data used, which was 80% of the 276 data. According to the experimental results of the model validation shown in Fig. 5, the highest accuracy is 67.86% with a K value of 10 for the KKN method using testing data of 20% of the total dataset owned. The confusion matrix from the model validation of the KNN method with a value of K=10 can be seen in Fig. 6. Based on the confusion matrix in Fig. 6, testing data that was classified correctly amounted to 38 tweets.

In addition to model validation for the KNN method that uses Euclidean as a distance metric, model validation is also carried out for other distance metrics, namely Manhattan and Cosine. It aims to compare and find out which distance metric has the best accuracy for this study. Based on the experimental results shown in Table 5, it can be seen that the validation model of the KNN method, with Manhattan as the distance metric, produces the highest accuracy of 57.14% with a value of K=6. Meanwhile, the highest accuracy for Cosine as a distance metric in the KNN method is 67.86% with a value of K=15.

TABLE 5. Comparison of Model Validation Results for Several Distance Metrics

No	Distance Metrics	Highest Accuracy	K value of KNN
1	Euclidean	67.86%	10
2	Manhattan	57.14%	6
3	Cosine	67.86%	15




```
Highest Accuracy= 67.86 %, with K= 10
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FIGURE 5. The Experiment Results of The Model Validation

	Pasal 156 KUHP	Pasal 156a KUHP	Pasal 45A ayat (2) jo. Pasal 28 ayat (2) UU ITE	Tidak melanggar
Pasal 156 KUHP	17	2	0	1
Pasal 156a KUHP	2	8	1	0
Pasal 45A ayat (2) jo. Pasal 28 ayat (2) UU ITE	5	0	9	1
Tidak melanggar	3	1	2	4

FIGURE 6. The Confusion Matrix of The Model Validation

Based on the results of the model validation, the accuracy of the KKN method used in this study is quite good. However, the accuracy can still be improved by adding the number and variations of the tweet data used for the training process. Furthermore, based on the distribution of tweet data in Table 2, it is necessary to add tweet data to a certain class, so that the number of tweet data in each class is balanced. Another process that can be added to improve the accuracy of the classifier model is the process of converting slang words into standard words. Slang words are words that are not standardized but are commonly used in everyday life, especially activities on social media. Negative slang words were found in the tweet data used in this study, for example the words "*jancuk*", "*jancookk*", "*juancuuukk*", and "*jiannncuukkkk*". The four words actually have the same meaning, but are written differently, so the system will consider the four words to be different entities.

The second type of system validation is user validation. This validation is carried out by inputting 100 new tweets that are not in the dataset and are to be predicted by the system. The system's prediction results will be validated directly by ITE law experts. From the prediction results of 100 tweets that have been made, 77 of them are valid. Therefore, it can be concluded that the system accuracy based on user validation is 77%. The difference in accuracy between model validation and user validation lies in the amount of training data used. In model validation, the training process uses data from 80% of the total dataset owned. Meanwhile, in user validation, the training process uses 100% of the existing dataset. This proves that the more data used during the training process, the higher the accuracy produced.

CONCLUSION

Based on the model validation results, it is possible to conclude that the KNN method used in this research has the highest accuracy of 67.86%, with a K value of 10. Furthermore, based on the results of user validation, the hate speech content detection system developed has an accuracy of 77 percent, with 77 of the 100 tweets used for testing producing valid prediction results.

However, the system's accuracy can be improved in the future by increasing the number and variety of tweet data used in the training process. Furthermore, tweet data can be added in specific classes, ensuring that the number of tweets for each class is balanced. It is also necessary to include the process of converting slang words into standard words, so that duplication of words that have the same meaning can be eliminated.

ACKNOWLEDGMENTS

We would like to express our appreciation to LPPM Ubaya, who has supported this research, as well as other research assistants, in order for this research to be carried out successfully.

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