Journal of Applied Intelligent System (e-ISSN : 2502-9401 | p-ISSN : 2503-0493)
Vol. 9 No. 1 2024, pp. 136– 146

Naive Bayes Sentiment Analysis Study on Street Boba And Gildak Kediri Consumen Reviews

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Abstract - Streetboba & Gildak Kediri outlet is a restaurant that serves a variety of Korean food menus and various kinds of drinks with boba and jelly toppings that are sold at low prices that suit the student's budget. This restaurant is located in East Java province which is precisely on Jalan Yos Sudarso No.43, Kediri City. With technological advances that continue to grow to affect various aspects, especially in the business and industrial world. Sentiment analysis is a technology that extracts or manages text to be expressed using text that can also be classified into positive and negative polarity. Consumer reviews are a form of communication that occurs in the sales process, the stage where potential buyers receive an explanation of the product posted and buyers receive reviews that explain the advantages or disadvantages of purchasing the product. In this study, sentiment analysis was conducted based on consumer opinions regarding social media accounts. The study aimed to use social media data to assess the service, cleanliness and quality of products offered by categorizing companies as having positive and negative reviews. To classify sentiment, the Naive Bayes method is used, which combines survey data collection methods, questionnaires, and observation data.

Keywords - Sentiment analysis, Streetboba and Gildak, Naive Bayes, Survey Poll, Observation, Reviews

1. INTRODUCTION

Culinary tourism is a popular activity for tourists visiting domestic and international tourist destinations. With the variety of cuisines available, more and more food vendors or restaurants are offering a variety of delicious dishes. The variety of restaurants also causes problems for tourists in choosing which restaurant to visit, so potential visitors often make their choices based on recommendations or restaurant ratings from other visitors [1], [2], [3], [4]. By doing a sentiment analysis of previous visitor ratings or reviews, you can find out how satisfied your customers are with your restaurant [5], [6], [7]. Sentiment analysis has been widely performed using various methods, objects, and data as well as parameters [8], [9], [10], [11].

With the advancement of big data technology, large amounts of unstructured data are collected at enormous scale and complexity [12], [13], [14]. Resource management that can be utilized to improve the accuracy of more accurate sentiment analysis results [15], [16]. Reviews and testimonials are numerous, hard to read, and long [17], [18], [19], [20]. Therefore, we can design an automated system to analyze available comments and opinions by class. Emotion classes are divided into positive, and negative for users to read, choose what they want to read as they wish. The sentiment analyst system utilizes a classification process applying the Naive Bayes Algorithm [4], [5], [21], [22]. One of the advantages of the Naive Bayes algorithm [23], [24] allows adjusting the classification of data according to different needs and characteristics.

Sentiment analysis helps everyone by providing brand and product feedback based on opinions and reviews. Naive Bayes [6], [25], [26], [27] is a useful tool for understanding and using customer sentiment data. Sentiment Analysis is one type of research in the field of data mining, especially text mining, serves to analyze comments or reviews [28], [29], [30], [31]. Sentiment analysis is used to gain insights from text data that is extracted and processed first [32], [33], [34].

This research uses the Naive Bayes algorithm because it does not require a large amount of data, the calculation is also fast and efficient, and for classifying documents can be personalized according to needs [35], [36]. This research was conducted using sentiment analysis to identify opinion trends related to reviews about Streetboba and Gildak kediri. Gildak Kediri, located on Jalan Yos Sudarso No. 45 Pakelan, Kediri, is the third branch after successfully opening branches in Malang and Surabaya which was established in Kediri on October 21, 2021. The existence of this branch proves the growing and popularity of Streetboba and Gildak Kediri in various cities. Its strategic location in the city of Kediri gives customers easy access to the menu and services offered. As Streetboba and Gildak Kediri's consumer base grows, of course, the number of people leaving reviews on social media also increases. These opinions influence businesses and help actors develop future marketing strategies and understand customer needs. Business people can also improve the quality of Streetboba and Gildak Kediri products. Customer reviews are provided by social networks and are often used by the public to rate and comment on issues related to the restaurant's service and menu.

Here, we applied a naïve bayes classifier algorithm that has high accuracy and is combined with questionnaire survey data and observational data collection methods to form customer assessments of Streetboba and Gildak Kediri brands. This study aims to categorize and observe the positive and negative emotions that customers convey on social networks.

2. RESEARCH METHOD

The frame of mind serves as a guide that assists researchers in carrying out research in a structured and focused manner. Here are the steps to be implemented as illustrated in the following frame of mind as in Figure 1.

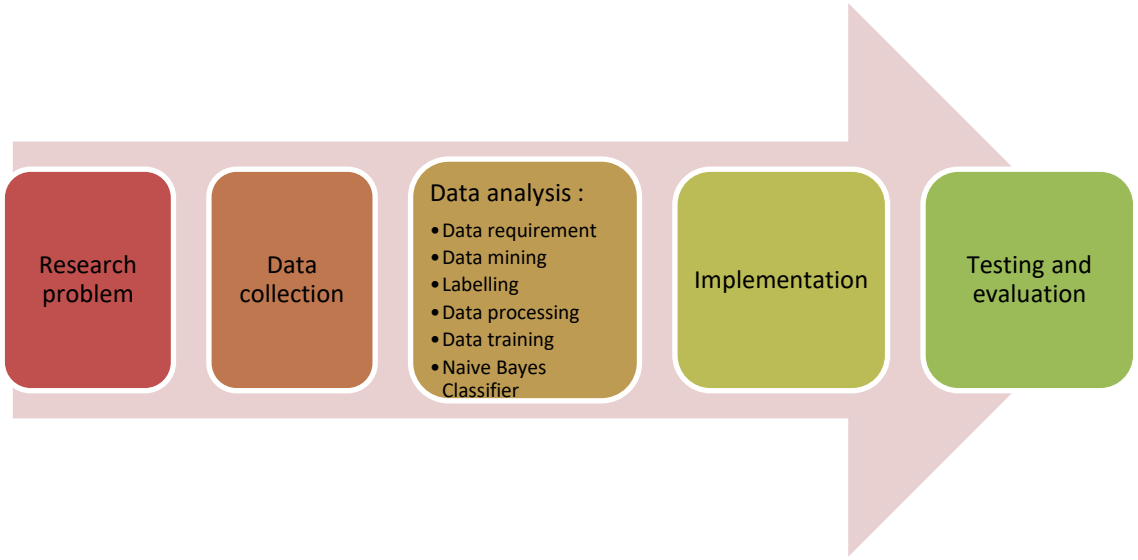

Figure 1. Proposed Research Flow

2.1. *Problem identification*

This study aims to identify the main issues that are the focus of sentiment analysis of Streetboba and Gildak Kediri customer reviews. The identification of these issues will provide an in-depth understanding of the background and importance of this research as well as direct the objectives and methodologies to be used in this research.

2.2. *Data Collection*

Data collection is a key step in this study to obtain information that will form the basis of sentiment analysis of Streetboba and Gildak Kediri customer reviews. Data will be obtained from three main sources, namely google maps reviews, instagram comments and gofood reviews.

2.3. *Data analysis*

Data analysis begins with a system requirements analysis that includes software needs such as the Windows 11 operating system, Data Scraper software, and RapidMiner, as well as hardware needs including AMD Ryzen processors, 8 GB DDR4- 3200 MHz memory, and 512 GB PCIe ® NVMe ™M.2 SSD storage. The next stage is data mining using Data Scraper to collect data from online sources such as Google Charts and Instagram.

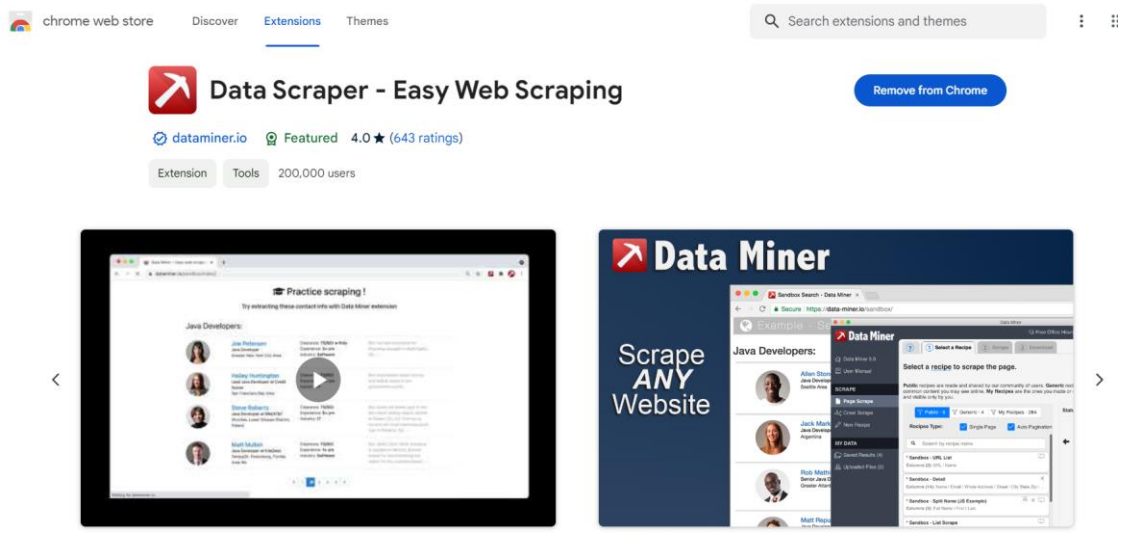

Figure 2. Data Scraper tools for crawling

An automatic labeling of customer reviews is carried out to categorize sentiment into positive or negative. In this case, the labeling will be done automatically using the sentiment analysis method. The example of labeling from one of @gildak.id's Instagram comments is as shown in Table 1.

Table 1. Examples of Labeling Positive & Negative Comments

Kategori	Review
Positif	@lincelin27 Enak banget lohh.. lbh enak dr collab sblmnya
Negatif	@rinaambar12 Promo ini gildak Jember berlaku minggu depan katanya saos nya abis. Capedeh. Kok bisa begitu ya min? Selalu alasan saos nya abis ntahlah knp..

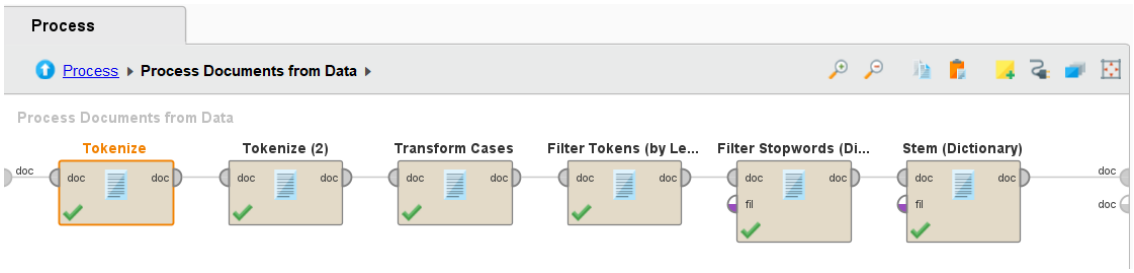

Figure 3. Preprocessing stages

Then, a data preprocessing process is carried out to prepare the review text by cleaning, normalizing, and removing stopwords. The data is then divided into training data to train the sentiment analysis model and testing data to test the model's performance. Lastly, the Naive Bayes Classifier is used with a training phase that involves building dictionaries, calculating word weights, and class and word probabilities, while the classifying stage calculates the probability of a text against a class and selects a suitable fading class based on the highest probability. Data preprocessing is the stage of data preparation before sentiment analysis that includes several processes with rapid miner applications as in Figure 3, as follows:

1. In using Rapidminer Studio for tokenization, there are two modes that can be customized to suit the needs of text analysis. First, there are options to filter certain characters, such as emoticons, periods, or commas, which can be accessed through the settings in the Tokenize operator. Then, tokenizing non-letter mode can be enabled to filter numbers and other non-letter characters.
2. Transform Case is the next stage after tokenizing in preprocessing which is done to break the text into small units called tokens. This process allows for a more detailed representation of the text, with each token being able to represent a word, phrase, or character.
3. At the stage of eliminating stopwords, this step involves the elimination of common words that generally do not provide special meaning or significant informative value in text analysis. Stopwords include words such as "and", "or", "the", and the like, which appear frequently but do not carry a distinctive feel. By deleting Stopwords.
4. The stemming process is a critical step in the preprocessing stage, where words are transformed into basic or root forms. For example, words like "enjoy", "enjoy", and "enjoy" would be simplified to the basic form "delicious".

After passing the preprocessing stage the next step is to prepare the training data. At this stage, the processed dataset is used to train a sentiment analysis model like in Table 2. In the formation of the Naive Bayes Classifier on Rapidminer, the process begins with the initialization of the probability of each class based on the distribution of classes in the training data. Then, a calculation of the probability of occurrence of each word in each class is carried out, considering the attributes of the word that each class has. The attributes are grouped by positive and negative categories. Next, using the formula of Bayes' theorem, the posterior probability is calculated to determine the prediction class of an instance. Here's the overall flow of the Rapidminer app as in Figure 4.

Table 2. Test data each platforms

	Google Maps	*Gofood*	*Instagram*
Training	123	58	246
Testing	96	40	84

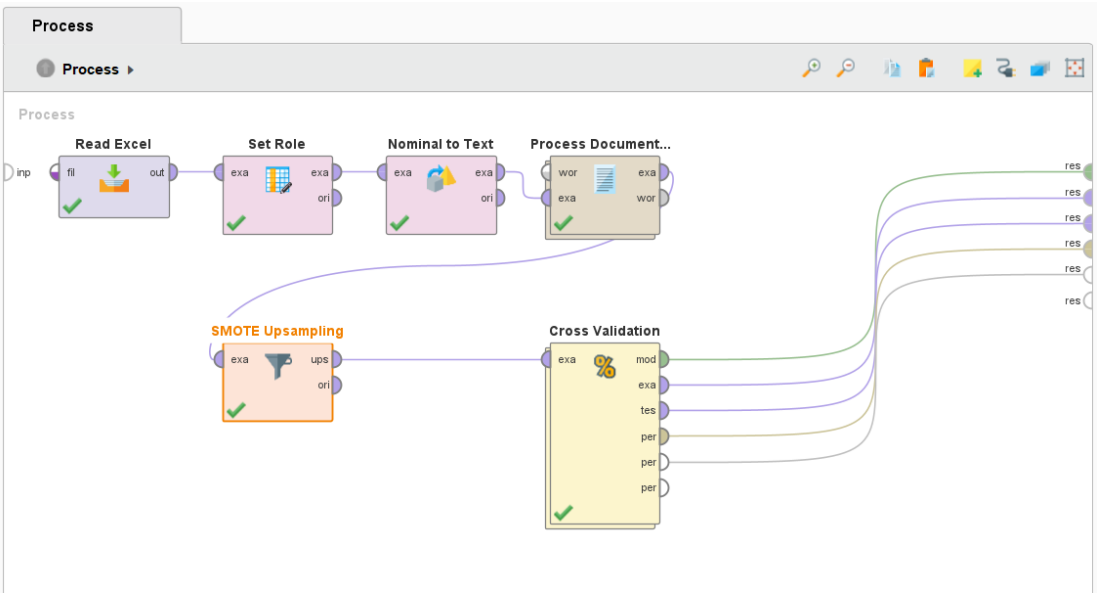

Figure 4. Naive Bayes Algorithm implementation process

2.4. Implementation

In the implementation phase, the Naive Bayes model will be executed after all previous stages have been completed, while testing is carried out to test the performance of the model in classifying customer reviews.

2.5. Testing and evaluation

Conclude the consumer review sentiment analysis by highlighting limitations in single-language analysis and its vulnerability to changing trends, and provide suggestions for considering multilingual analysis, increasing the duration of the study, and exploring additional social media to increase the validity and scope of the analysis.

3. RESULTS AND DISCUSSION

Evaluating the overall results implementation of Naïve Bayes on different platforms such as Google Maps, Gofood, and Instagram with review data of 427 reviews, researchers also found that this model is quite accurate in classifying review sentiment. Despite variations in accuracy across platforms, the overall results performed quite well in understanding and classifying user sentiment. The following are the overall results of the implementation of the Naïve bayes calculation using rapid minner studio software as in Figure 5.

accuracy: 86.52% +/- 8.92% (micro average: 86.45%)

	true Negatif	true Positif	class precision
pred. Negatif	100	22	81.97%
pred. Positif	7	85	92.39%
class recall	93.46%	79.44%	

Figure 5. Evaluate the results of the platform's overall review

A matrix table that aggregates the results of review calculations across all platforms provides an evaluation of the platform's overall review results some important information about the overall performance of the Naive Bayes model:

- Accuracy: shows how accurate the model is in classifying sentiment across reviews. In this case, the accuracy is 86.52%, with a deviation of about ±8.92%. This means that about 86.52% of reviews are classified correctly.
- True negative and positive: indicates the number of negative and positive reviews correctly classified by the model. In this case there are 100 negative reviews and 85 true positive reviews.
- Precision and Recall: Precision measures the accuracy of the model in classifying reviews, while Recall measures how many positive or negative reviews the model actually detects. The precision for the negative class is 81.97%, while for the positive class it is 92.39%. The recall for negative class is 93.46% and for positive class is 79.4%.

Thus, the results of the matrix calculation show that the Naïve Bayes model achieves a good level of accuracy in classifying the combined review sentiment of all evaluated platforms. In addition to evaluating the overall implementation results of Naive Bayes on different platforms, a manual calculation of the combined review matrix was also carried out below. In this calculation, the researcher reanalyzed the evaluation data to get a better understanding of the model's performance in classifying sentiment throughout the review, here is a table of calculation results as in Table 3.

Table 3. Manual calculation of Confession Matrix overall review

Measure	Value	Derivations
Sensitivity	0.7944	TPR = TP / (TP + FN)
Specificity	0.0654	SPC = TN / (FP + TN)
Precision	0.4595	PPV = TP / (TP + FP)
Negative Predictive Value	0.2414	NPV = TN / (TN + FN)
False Positive Rate	0.9346	FPR = FP / (FP + TN)
False Discovery Rate	0.5405	FDR = FP / (FP + TP)
False Negative Rate	0.2056	FNR = FN / (FN + TP)
Accuracy	0.4299	ACC = (TP + TN) / (P + N)

Several evaluation metrics were used to evaluate the performance of the Naive Bayes model in manual calculation of the entire combined inspection matrix platform. Sensitivity that measures the model's ability to detect really positive reviews reaches 79.44%, while specificity that measures the model's ability to detect really negative reviews only reaches 6.54%. The accuracy, the proportion of correctly classified positive reviews of all positive classification results is 45.95%, while the negative predictive value that measures the proportion of correctly classified negative reviews of all negative classification results is 24.14%. The false positive rate was 93.46%, while the false positive rate was 54.05%. The negative error rate was 20.56%, while the overall accuracy was 42.99%. At the stage of the final results of Naive Bayes, this model has gone through an evaluation and validation process on reviews from three different sources, namely Google Maps, Gofood, and Instagram. By combining the results of these three sources, the results that have been done are as follows in Table 4.

This model has an overall accuracy of 85.11% and can reliably recognize and understand consumer opinions about the Gildak platform. However, differences in model performance between platforms emphasize the importance of considering the unique characteristics of each platform when developing effective emotion models. After knowing the percentage of value of the entire platform, the next step can be determined visualization, which is used data in the calculation results of the entire Google Maps, Instagram and GoFood platforms by making wordcloud to provide a visual picture of keywords that often appear in reviews.

By using wordcloud, you can quickly see the most dominant words in Google Maps reviews, both positive and negative words. In addition to using wordcloud, in the visualization stage of Google Maps, researchers also present a chart diagram of words with frequency that often appears in reviews. This chart provides a more detailed overview of the most common words used by users when leaving reviews on Google Maps related to Gildak and Streetboba outlets.

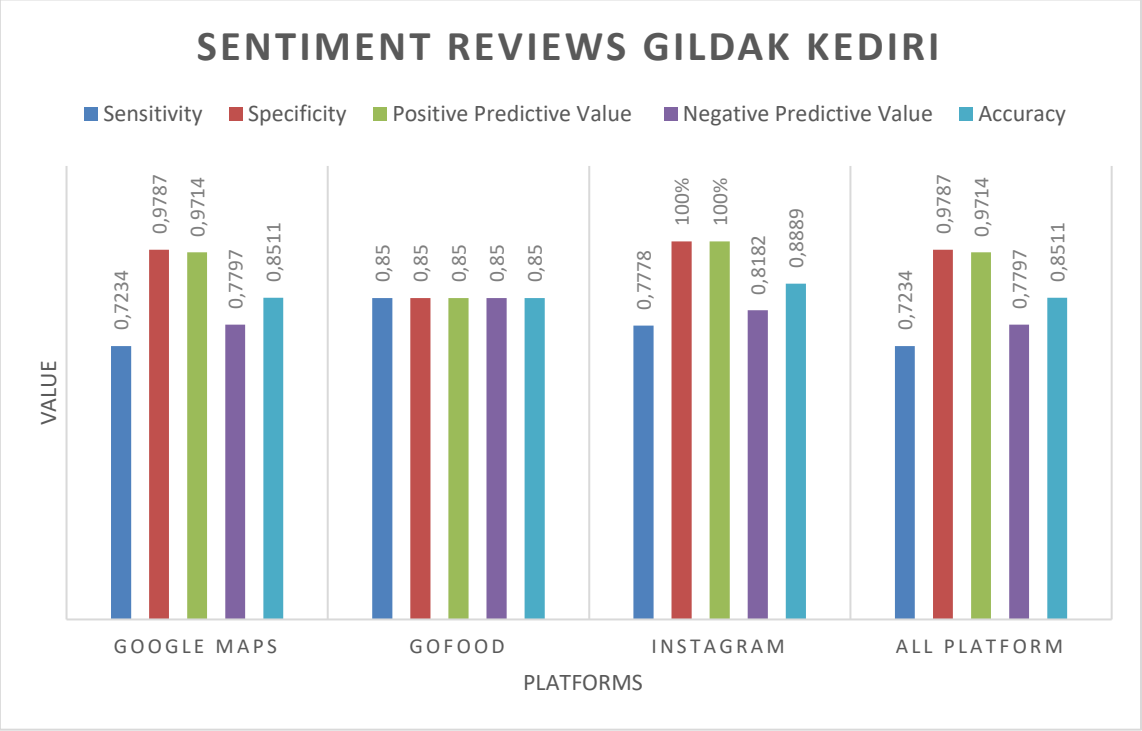

Figure 6. Sentiment graph of each platform

Figure 7. The wordcloud visualization

Based on Figure 8, frequency words that often appear in the overall review platform, some of the keywords that stick out are "comfortable," "place," "delicious," etc. These words reflect the focus on the comfort of the place, the taste of food, cleanliness. In addition, a diagram

of negative and positive labels based on a certain number of words is also presented. This chart shows how often certain words appear in reviews labeled positive or negative in Figure 9.

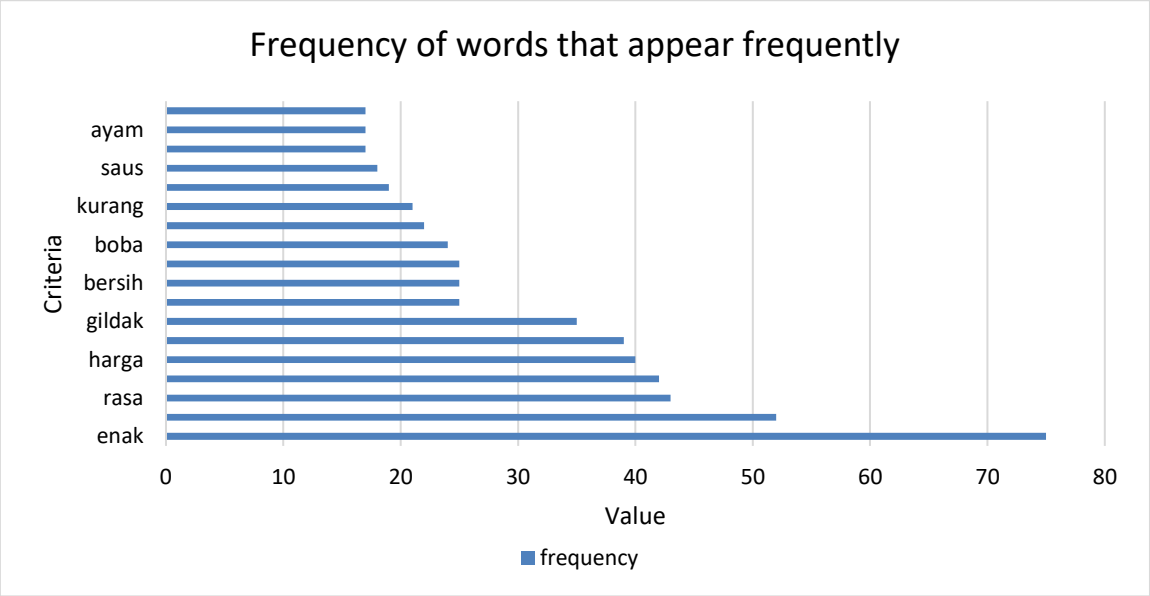

Figure 8. Frequency of words that appear frequently

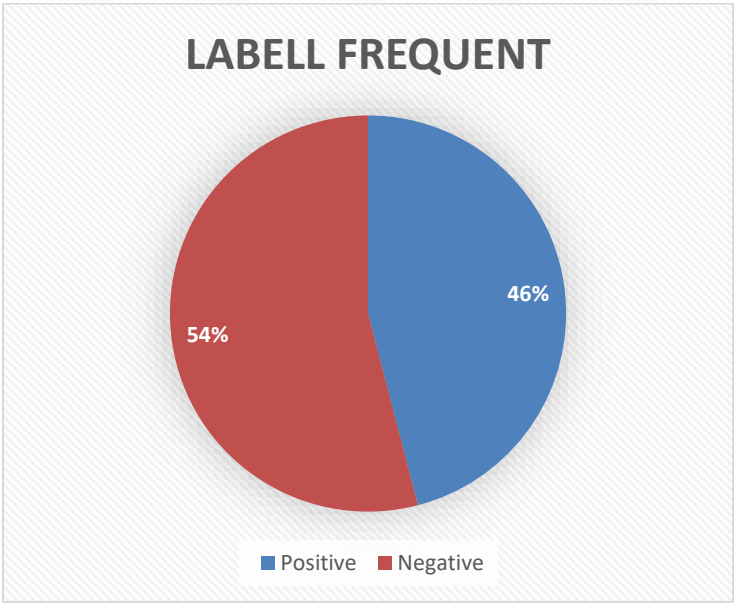

Figure 9. Labell Frequent

Based on the frequency with which words in reviews are labeled positive and negative on Google Maps, there are two main keywords that appear the most. The words "negative" and "positive" used by consumers to explicitly state whether their sentiment towards Gildak and Streetboba outlets tend to be negative or positive. In the diagram above, where negative labels outnumber positive labels from 112 negative reviews and 112 positive reviews, negative values of 100 and positive values of 85 are obtained, True Negative and True Positive values are obtained from the overall value matrix table of the platform. Therefore, these words can be considered as a key indicator in assessing user sentiment towards both outlets on the Google Maps platform.

4. CONCLUSION

The purpose of this study was to analyze user attitudes towards Gildak and Streetboba stores through Google Maps, Gofood and Instagram reviews using Naive Bayes classifiers. The results showed that data is obtained using Data Scraper, a Google Chrome extension to facilitate the search for reviews and information related to Gofood on Google Maps and Instagram. The data extraction and preprocessing process is performed to clean and prepare the data before processing the sentiment analysis model. The Naive Bayes classifier model provides accuracy, precision and recall rates for positive and negative classes indicating that the model has good accuracy in classifying reviews. Data visualization uses word clouds and word frequency graphs that provide an intuitive overview of common words in reviews. The overall accuracy model performance evaluation of the model is 86.52%, with a deviation of about ±8.92%. This means that about 86.52% of reviews are classified correctly. The negative and positive labels show that out of 112 positive and negative labels there are 100 true negatives and 85 true positives, this shows that the model has high accuracy in positive or negative classification.

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