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Sentiment analysis of user comments on the shopeepay feature in the shopee application: Evaluation of accuracy with k-nearest neighbors (KNN) algorithm

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ABSTRACT

This research analyzes Shopeepay user reviews on the Shopee app using the K-Nearest Neighbor (KNN) algorithm with TF-IDF weighting and a Cosine Similarity matrix. Data was collected through web scraping 500 reviews from the Google PlayStore and labelled into positive, neutral, and negative sentiments. The process includes literature study, data collection, labelling, text preprocessing, word weighting, and sentiment classification using KNN. Results show an accuracy range of 86%-91%, with Precision, Recall, and F1-Score as evaluation metrics. The findings indicate that convenience, trust, and risk significantly affect users' interest in Shopeepay, especially during the Covid-19 pandemic. A Word Cloud was also used to visualize common terms in the reviews, providing insights for Shopee to enhance Shopeepay based on user feedback.

1. Introduction

Nowadays, technology is developing very rapidly. The development of technology affects almost all human activities along with the increasing needs of humans themselves. One of the technologies that are developing today is technology based on the internet. The internet has a very important function in channelling information [1]. The Internet is a network of computers that connects one computer to another in all parts of the world, where the computers are interconnected, thus creating a virtual space of computer networks [2]. Based

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on data from the Association of Indonesian Internet Service Providers (APJII) in 2018, the number of internet network users in Indonesia reached 171.17 million out of a total of 264.16 million Indonesians. This means that 64.8% of all Indonesians have utilized the internet, which shows an increase of 27.9 million or 10% when compared to 2017 [3]. The ease of internet access allows all levels of society to get the information they want. The ease of accessing the internet is supported by technological devices such as cell phones, PCs, and laptops. Apart from obtaining information, the internet is also used for e-commerce activities, one of which is Shopee.

Shopee is an e-commerce application that was founded in Singapore in 2009, then expanded its reach to various countries such as Indonesia, Thailand, Malaysia, Philippines, and Vietnam. At the end of June 2015, the Shopee application began its operations in Indonesia with the aim of meeting the needs and lifestyle of the Indonesian people. Based on Jakpat's survey in 2022 involving 1,420 respondents in Indonesia, Shopee managed to outperform seven other e-commerce platforms, such as Bukalapak, Tokopedia, Lazada, JD.ID and others [4]. The products offered at Shopee consist of various categories such as clothing, accessories, food, and other categories with the aim of making it easier for users to shop online. The Shopee application is a platform that connects sellers and buyers to facilitate and provide a pleasant experience when shopping, especially since the trend of shopping via mobile phones is currently popular.

In the Shopee application, there are services for shipping goods that have been integrated and various features such as social features and payment features. In social features, Shopee provides a live chat feature to interact between sellers and buyers to make it easier to communicate. In the payment feature, Shopee provides various payment methods, including bank transfers, direct payments at Alfamart or Indomaret, Spaylater, and the use of credit or debit cards. In addition, Shopee also collaborates with fintech Shopeepay, which is an innovation that combines financial services with technology to facilitate payments for users [5].

Shopeepay was established by the company Shopee with several functions, including to process online transactions at Shopee, make offline payments through Shopeepay partners, and store change funds for the next transaction process [6]. The features contained in Shopeepay are adding balances, withdrawing Shopeepay funds, and paying for transactions on Shopee. Currently, Shopeepay is very popular among Indonesians because it provides various attractive promotions such as cashback, discounts, and free shipping especially on certain dates of each month, such as January 1st and February 2nd [7]. The use of Shopeepay features has increased especially during the spread of the Covid-19 outbreak. The Covid-19 pandemic has caused people to spend most of their time indoors with the aim of minimizing the spread of Covid-19 [8].

Based on research from MarkPlus, a company engaged in business management consulting, which involved 502 respondents who used financial technology (fintech) payment services between June-August 2020, the results showed that as many as 26% of the total transactions were made through the Shopeepay platform. The transaction value on Shopeepay is also very dominating at 29% compared to other financial technology services. The public's perception

of the ease of use of Shopeepay has a big influence on their interest in using it. In addition, the attractive promotions offered by Shopeepay also increase people's interest in using it, because the majority of Indonesians like promotions when going shopping [9].

Based on previous research conducted in Malang City during the Covid-19 pandemic, it was found that there are several factors that influence users' interest in using Shopeepay. Perceived user-friendliness has a significant impact on interest. In addition, users' trust in Shopeepay also has a big influence on their decision to continue using this service. However, perceptions of risk also play an important role, where an increase in risk perception can reduce their interest in using Shopeepay [10]. The large number of Shopeepay users in Indonesia invites various opinions about this platform, including reviews on Google PlayStore. Reviews on the Google PlayStore app is a potential source of data that can be analyzed and classified to determine the accuracy of sentiment analysis of user comments on Shopeepay on the Shopee app.

Shopeepay user review data is obtained by means of scrapping or web crawling techniques using the help of Google Colab tools, provided that the comments come from Indonesia using Indonesian language with a limit of 500 Shopeepay user comments. Sentiment analysis is a learning process to recognize, identify, and extract opinions, sentiments, emotions, judgments, and views from text, and study the content. Through sentiment analysis, it can be seen whether a text expresses an opinion that is positive, neutral, or negative [11]. Sentiment analysis can be used to determine user satisfaction based on the comparison between their expectations of a product and the actual results obtained from the product [12]. In addition, sentiment analysis is an effective approach to analyzing data that is interconnected with customer opinions, emotions, and attitudes towards a product or service [4].

Basically, review analysis can be done easily by observing the total number of stars given by users. However, the number of stars cannot be an initial indicator and does not reflect the content of the review, so it is important to review the review as a whole to understand the purpose of the review. This may be done manually by reading the reviews one by one or using a sentiment analysis system if the number of reviews is large to get more efficient results [13].

In this study, researchers conducted a sentiment analysis of user comments on the Shopeepay feature on the Shopee application using the KNN algorithm by considering the accuracy rate. Researchers utilize user comment reviews to identify information that is important to users when providing reviews. The purpose of this research is to analyze the sentiment of Shopeepay user reviews on the Shopee application using the KNN algorithm supported by TF-IDF weighting and the Cosine Similarity matrix. The classification of review sentiment is divided into three namely positive, neutral, and negative. In addition, the purpose of this research is to evaluate the accuracy results of sentiment analysis, so that if there are deficiencies in Shopeepay features, they can be corrected.

2. Method

Dataset for The Research

The research data used comes from crawling user reviews of the Shopeepay feature on the Shopee application on the Google PlayStore. Crawling the data is done with the help of Google Colab. When crawling data, there are several conditions, namely that reviews must come from Indonesia and use Indonesian with a limit of 500 user reviews.

The results of crawling data on Google PlayStore, initially there are several attributes, namely reviewId, username, date, score, and content. After that, the content attribute is determined whether the sentiment is positive, neutral, or negative, to get the accuracy of the acquisition rate. The following is a snapshot of the dataset table that will be used in this study.

Table 1. Dataset of the research

No	Content	Sentiment
1	Nyaman ada aplikasi standalone Shopeepay…	Netral
2	Akun dibatasi padahal cuma telat beberapa hari pembayaran itupun sudah lunas…	Netral
…	…	…
499	Tolong adakan fitur top-up e-money, tarik tunak ke minimarket terdekat	Positif
500	Tolong akun saya sudah terverifikasi dengan NIK tetapi saya lupa NO. HP…	Netral

Stage of The Research

At this point, the research description of the sentiment analysis of user comments on the Shopeepay feature in the Shopee application which considers the accuracy level of the KNN algorithm can be seen in Figure 1.

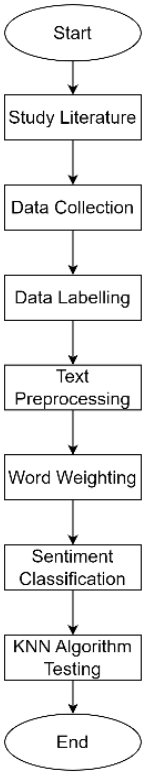

Figure 1. Stages of the research

Study literature

Study literature is an activity carried out by searching and reviewing previous research and theories that support the research process to be used as reference material. The references come from journals, books, and information on websites that review the topics of sentiment analysis, text mining, data mining, KNN method, word weighting using TF-IDF and Cosine Similarity, and testing using Confusion Matrix. Confusion Matrix is a table that displays the classification results of the number of test data classified correctly and incorrectly [14].

Data collection

The data collected comes from user reviews of the Shopeepay feature on the Shopee application on the Google PlayStore. The data is collected with the condition that the reviews come from Indonesia and speak Indonesian with a limit of 500 user reviews. The data collection process is carried out with the help of Google Colab tools using the python programming language and the Google Play Scraper library.

Data labeling

Data labelling is the process of tagging user reviews of the Shopeepay feature on the Shopee application on the Google PlayStore by categorizing these reviews as positive, neutral, and negative. Data labelling is seen based on the words contained in the text with the help of Google Colab tools and the TextBlob library. In this labelling there are three conditions. First, if the polarity is greater than zero, then the sentiment is positive. Second, if the polarity is equal to zero, then the sentiment is neutral. Third, if the polarity is less than zero, then the sentiment is negative.

Text preprocessing

In this step, researchers process the raw data generated from crawling to match the needs of the research. There are several stages of text preprocessing, namely Case Folding, Tokenizing, Filtering, Stemming, and Tagging. Case Folding is a process that involves converting all letters in a document into lowercase letters [15]. Tokenizing is a process of dividing sentences in a document into individual words [16]. Filtering is a process of selecting important word. Stemming is the process of making words with the same meaning uniform. Tagging is a linguistic process where each word in a text is labelled as a noun, verb, adjective, or other category based on its grammatical role in the sentence to aid text analysis.

Word weighting

At this stage, word weighting is carried out using the Term Frequency-Inverse Document Frequency (TF-IDF) method to determine how often a word appears in a document. The formula of the TF-IDF algorithm is:

$$idf_t = \log\left(\frac{N}{df_t}\right) \quad (1)$$

Description:

idf_t = IDF value with term t

N = Number of documents

df_t = Number of occurrences of term t in document d

TF-IDF weighting is done by looking at the following equation:

$$tf - idf_{td} = tf_{td} \times idf_t \quad (2)$$

Description:

$tf - idf_{td}$ = TF-IDF weight of term t in document d

tf_{td} = Frequency of occurrence of term t in document d

idf_t = IDF value with term t

Sentiment classification

At this stage, the KNN method is implemented using the KNeighbors Clasifier library. To classify sentiment in positive, neutral, and negative classes, training data and testing data are divided by relying on several parameters. The training data used are 10%, 20%, 30%, 70%, 80%, and 90%. Meanwhile, the testing data used are 90%, 80%, 70%, 30%, 20%, and 10%.

KNN algorithm testing

The performance evaluation of the KNN method is carried out by testing the classification results on positive, neutral, and negative classes. In using the KNN method, the Confusion Matrix and K-Fold Cross Validation models are needed as an evaluation. Confusion Matrix is a model that serves to evaluate whether the classification in the method is considered good

or bad [17]. Meanwhile, K-Fold Cross Validation is a model for evaluating algorithm performance by separating data into training data and testing data with iterations adjusted to the number K. In Confusion Matrix and K-Fold Cross Validation, the accuracy, Recall, Precision, and F1-Score values are obtained as evaluations.

a. Accuracy is the total number of correct values overall when a model performs classification. The accuracy formula can be seen in the following equation [18].

$$\frac{TP+TNg+TNt}{TP+FNt2+\cdots+FNt1+TNg} \quad (3)$$

b. Precision is how often a model makes positive predictions correctly. The Precision formula can be seen in the following equation.

$$Positif = \frac{TP}{TP+FP1+FP2} \quad (4)$$

$$Netral = \frac{TNt}{TNt+FNt1+FNt2} \quad (5)$$

$$Negatif = \frac{TNg}{TNg+FNg1+FNg2} \quad (6)$$

c. Recall is how often a model gives positive predictions when the actual class is indeed positive. The Recall formula can be seen in the following equation.

$$Positif = \frac{TP}{FNg1+FNt1+TP} \quad (7)$$

$$Netral = \frac{TNt}{FNg2+FP2+TNt} \quad (8)$$

$$Negatif = \frac{TNg}{FP1+FNt2+TNg} \quad (9)$$

d. F1-Score is the harmonic mean between the two values of Precision and Recall. The F1-Score formula can be seen in the following equation.

$$2 \times \frac{Precision \times Recall}{Precision+Recall} \quad (10)$$

3. Results and Discussion

List of Shopeepay Feature Reviews

The data used in this study is the Shopeepay feature review data on the Shopee application obtained on the Google PlayStore. The amount of data used in this study is 500 user review data. The data is obtained by scraping with the help of Google Colab. Based on the scraping

process, the resulting data consists of several attributes, but in this study only requires content attributes that contain user reviews. These attributes will be used for sentiment analysis of user comments regarding the Shopeepay feature on the Shopee application, by considering the level of classification accuracy using the KNN method.

After the scraping process is complete, the review data is saved in a suitable format for further analysis. The user review data obtained includes various user opinions and experiences regarding the Shopeepay feature ranging from positive, neutral, and negative reviews. After the scraping process is complete, the next step is to analyze user sentiment. The following is a snapshot of the user review data table obtained from the scraping results.

Table 2. Scrapping result dataset

No	Content	Score
1	Nyaman ada aplikasi standalone Shopeepay…	5
2	Akun dibatasi padahal cuma telat beberapa hari pembayaran itupun sudah lunas…	1
…	…	…
499	Tolong adakan fitur top-up e-money, tarik tunak ke minimarket terdekat	3
500	Tolong akun saya sudah terverifikasi dengan NIK tetapi saya lupa NO. HP…	5

Sentiment Analysis

This research uses 500 reviews that have been labelled, resulting in 54 positive reviews, 440 neutral reviews, and 6 negative reviews. Review labelling is done using the help of Google Colab tools with the TextBlob library. The following is a table of review data snippets that have gone through the labelling process.

Table 3. Labelling result dataset

No	Content	Score	Sentiment
1	Nyaman ada aplikasi standalone Shopeepay…	5	Netral
2	Akun dibatasi padahal cuma telat beberapa hari pembayaran itupun sudah lunas…	1	Netral
…	…	…	…

499	Tolong adakan fitur top-up e-money, tarik tunak ke minimarket terdekat	3	Positif
500	Tolong akun saya sudah terverifikasi dengan NIK tetapi saya lupa NO. HP…	5	Netral

After labelling the reviews, the next stage is text preprocessing. In the text preprocessing stage, several steps are applied, namely Tokenizing, Filtering, Stemming, and Tagging.

Tokenizing is a process of breaking text into tokens in the form of words, phrases, symbols or entities that have meaning in text analysis. In natural language processing (NLP) and text analysis, tokenizing is an important process because it allows computers to understand and analyze text structure. Tokenizing is done before further processing stages such as Filtering, Stemming, and Tagging.

Filtering is a process of filtering data to remove irrelevant elements. The filtering process produces data that is considered important and is retained. Several steps in the filtering process, namely removing Stop Words, sorting data, and filtering words based on attributes. The Filtering process can help improve the quality and efficiency of analysis by ensuring that only relevant and useful data is analyzed.

Stemming is a natural language processing (NLP) process that converts inflected words to their basic form with the aim of reducing word variations that appear in the text. Multiple word forms of the same root can be identified as the same entity to reduce data redundancy to simplify word analysis. The following is a snapshot of the results of the Tokenizing, Filtering, and Stemming processes along with a diagram of the occurrence of the 20 most common words in the reviews.

```
(nyaman) (aplikasi) (standalon) (shopeepay) (aplikasi)
(akun) (batasi) (telat) (pembayaran) (itupun) (luna) (
(aplikasi) (nya) (membantu) (disayangkan) (penanganan)
(pembayaran) (spaylat) (telat) (gerai) (indomaretnya)
(fiturnya) (gak) (beda) (ama) (shopeepay) (aplikasi) (
(multi) (fungsi) (tp) (keamanan) (kenyamanan) (bilang)
```

Figure 2. Snippets of tokenizing, filtering, and stemming results

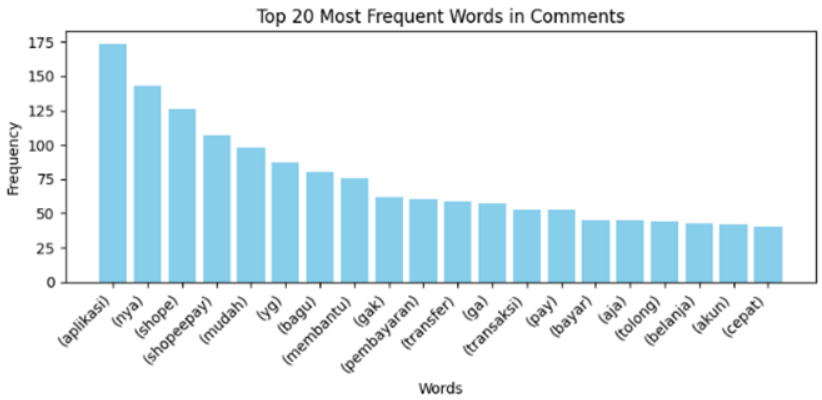

Figure 3. Diagram of top 20-word occurrences

Tagging is a natural language processing (NLP) process by assigning certain labels to words based on keywords to mark specific information. In this study, the researcher conducted the Tagging process by tagging words in the text with grammatical categories, such as noun, verb, and adjective. The following is a snapshot of the Tagging results from the reviews that have been conducted.

	0	1	2	3	4	5	6	7	8	9
0	((, ()	(nyaman, NN)	(),))	((, ()	(aplikasi, NN)	(),))	((, ()	(standalon, NN)	(),))	((, ()
1	((, ()	(akun, NN)	(),))	((, ()	(batasi, NN)	(),))	((, ()	(telat, JJ)	(),))	((, ()
2	((, ()	(aplikasi, NN)	(),))	((, ()	(nya, NN)	(),))	((, ()	(membantu, NN)	(),))	((, ()
3	((, ()	(pembayaran, NN)	(),))	((, ()	(spaylat, JJ)	(),))	((, ()	(telat, JJ)	(),))	((, ()
4	((, ()	(fiturnya, NN)	(),))	((, ()	(gak, NN)	(),))	((, ()	(beda, NN)	(),))	((, ()

Figure 4. Snippet of tagging results

KNN Algorithm Analysis and Testing

This research uses the KNN algorithm with K = 5 to determine the evaluation of the level of accuracy of user comment sentiment on the Shopeepay feature in the Shopee application. To test the KNN algorithm, it is necessary to measure the weight of a word in the review, known as TF-IDF testing. The following is an excerpt from the TF-IDF test results in this research.

	10	100	100rb	10rb	10x	12	15	16	18	1jam
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5. Snippet of TF-IDF results

I After conducting TF-IDF testing, the next step is to conduct Cosine Similarity testing. The purpose of Cosine Similarity testing is to calculate the degree of similarity between two vectors based on the cosine angle. Based on the tests that have been carried out, the results show that the most similar comments are comment 6 and comment 6 with a cosine similarity value of 1. Meanwhile, the most different comments are comment 1 and comment 2 with a cosine similarity value of 0. The following is a snippet of the Cosine Similarity test results.

	Comment 1	Comment 2	Comment 3	Comment 4	Comment 5	Comment 6
Comment 1	1.000000	0.000000	0.017898	0.000000	0.025075	0.031444
Comment 2	0.000000	1.000000	0.014989	0.122950	0.000000	0.043212
Comment 3	0.017898	0.014989	1.000000	0.000000	0.039369	0.024090
Comment 4	0.000000	0.122950	0.000000	1.000000	0.000000	0.000000
Comment 5	0.025075	0.000000	0.039369	0.000000	1.000000	0.034346

Figure 6. Snippet of cosine similarity test results

After testing TF-IDF and Cosine Similarity, the last step is to test the KNN algorithm. In KNN testing, data is divided into training data and testing data. In this test, the training data and testing data used amounted to 6. The training data used are 10%, 20%, 30%, 70%, 80%, and 90%. Meanwhile, the testing data used are 90%, 80%, 70%, 30%, 20%, and 10%. Based on these 6 tests, the highest accuracy rate result is 91% and the lowest accuracy rate is 86%.

The highest accuracy rate of 91% indicates that the results are in optimal condition that is, the KNN model can classify sentiment very well. Meanwhile, the lowest accuracy rate of 86% indicates that there are certain conditions where the model is not as effective as other combinations. For more complete results such as Precision, Recall, and F1-Score values can be seen in the figure below.

```
Training size: 10, Testing size: 90
Training Time: 0.0015 seconds
Prediction Time: 0.0310 seconds
Accuracy: 0.91
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         6
     neutral       0.91      0.99      0.95       399
    positive       0.85      0.24      0.38        45

    accuracy                           0.91       450
   macro avg       0.92      0.41      0.44       450
weighted avg       0.90      0.91      0.88       450
```

```
Training size: 20, Testing size: 80
Training Time: 0.0010 seconds
Prediction Time: 0.0219 seconds
Accuracy: 0.91
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         6
     neutral       0.91      0.99      0.95       355
    positive       0.83      0.26      0.39        39

    accuracy                           0.91       400
   macro avg       0.91      0.42      0.45       400
weighted avg       0.90      0.91      0.88       400
```

```
Training size: 30, Testing size: 70
Training Time: 0.0009 seconds
Prediction Time: 0.0199 seconds
Accuracy: 0.90
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         5
     neutral       0.90      1.00      0.95       306
    positive       1.00      0.23      0.38        39

    accuracy                           0.90       350
   macro avg       0.97      0.41      0.44       350
weighted avg       0.91      0.90      0.87       350
```

```
Training size: 70, Testing size: 30
Training Time: 0.0012 seconds
Prediction Time: 0.0118 seconds
Accuracy: 0.91
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         3
     neutral       0.91      1.00      0.95       134
    positive       1.00      0.15      0.27        13

    accuracy                           0.91       150
   macro avg       0.97      0.38      0.41       150
weighted avg       0.92      0.91      0.87       150
```

```
Training size: 80, Testing size: 20
Training Time: 0.0012 seconds
Prediction Time: 0.0091 seconds
Accuracy: 0.89
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         3
     neutral       0.89      1.00      0.94        89
    positive       1.00      0.00      0.00         8

    accuracy                           0.89       100
   macro avg       0.96      0.33      0.31       100
weighted avg       0.90      0.89      0.84       100
```

```
Training size: 90, Testing size: 10
Training Time: 0.0013 seconds
Prediction Time: 0.0063 seconds
Accuracy: 0.86
Classification Report:
              precision    recall  f1-score   support

    negative       1.00      0.00      0.00         2
     neutral       0.86      1.00      0.92        43
    positive       1.00      0.00      0.00         5

    accuracy                           0.86        50
   macro avg       0.95      0.33      0.31        50
weighted avg       0.88      0.86      0.80        50
```

Figure 7. KNN algorithm testing results

From the test results above, a diagram is obtained that illustrates the results of the accuracy value with the general training data tested, along with a diagram of the results of the accuracy value with the training data according to the value of each sentiment, as follows.

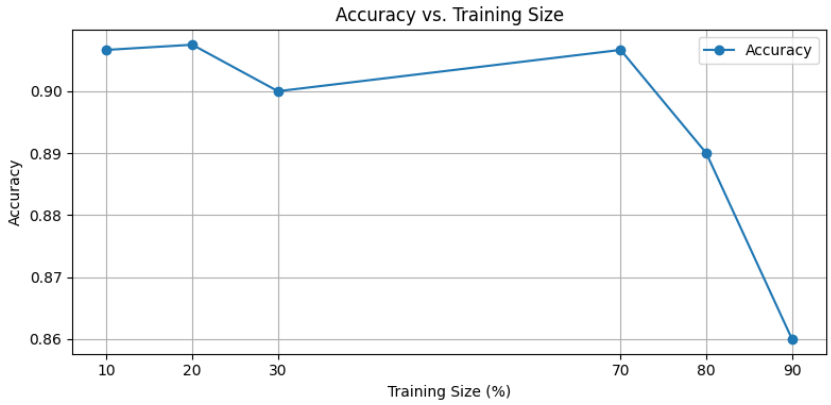

Figure 8. Diagram of accuracy and training data

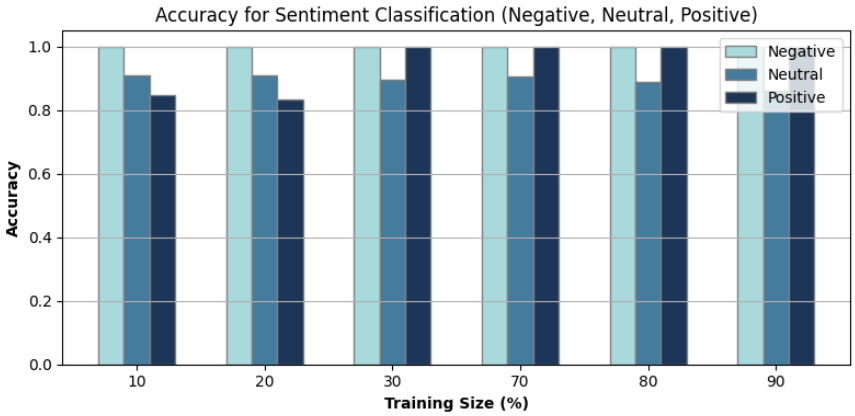

Figure 9. Diagram of accuracy and training data per sentiment

Based on testing the sentiment analysis of Shopeepay feature comments on the Shopee application, the results show that the process can provide important insights for Shopee on how users view the Shopeepay feature. Based on the accuracy rate that has been obtained, Shopee can provide several evaluations and developments to the Shopeepay feature in it.

With an accuracy rate of 91%, Shopee should be more confident in understanding user sentiment towards Shopeepay. Indicated positive sentiments can help strengthen existing features, while negative sentiments can be addressed with more targeted improvements. In

addition, by knowing the specific areas that get negative sentiment, Shopee can focus more on service improvements in those areas to increase user satisfaction both with service improvements and effective marketing campaigns.

Frequency of Word Occurrence

Words that appear frequently in reviews can reflect an overview of how the market receives a product. The frequency of occurrence is usually depicted on a Word Cloud. A Word Cloud is a visual representation of the most used words in reviews and can provide insight into how users perceive the feature. The larger the size of a word in the Word Cloud, the more frequently it appears in user reviews. The following is an image of the Word Cloud of user comments on the Shopeepay feature on the Shopee app.

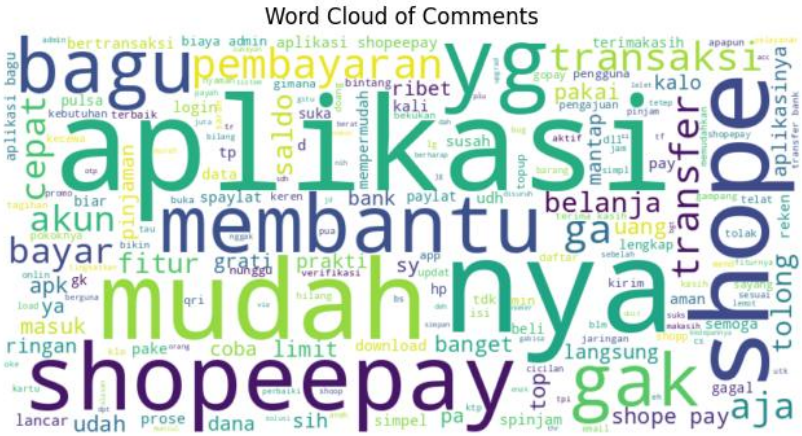

Figure 10. Word cloud user review

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