SENTIMENT ANALYSIS ON REVIEWS OF WOMEN'S TOPS ON SHOPEE MARKETPLACE USING NAIVE BAYES ALGORITHM

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Abstract—*Reviews of women's tops in the market are valuable information if processed properly. Merchants can conduct product review analysis to obtain information that can be used to evaluate products and services. Product review analysis activities are not enough just to see the number of stars, it is necessary to see the entire content of the review comments to be able to know the intent of the review. Sentiment analysis system is a system used to automatically analyze online product reviews to obtain information including sentiment information that is part of online reviews. The data is classified using Naive Bayes. The data collected were 1,000 product reviews of women's tops as samples. The purpose of this study is to determine the sentiment analysis of female top product reviews using the Naive Bayes algorithm. The stages of this research include data collection, labeling, pre-processing, sentiment classification, and evaluation. In the pre-processing stage there are 6 stages, namely Cleaning emoticons & symbols, Case folding, Word Normalizer, Tokenize, Stopword Removal and Stemming. TF-IDF (Term Frequency - Inverse Document Frequency) method is used for word weighting. The data will be classified into 3 (three) classes, namely negative, positive and neutral. The data will then be evaluated using accuracy parameter testing. The test results show an accuracy value of 89%, this result shows that the product reviews of women's tops are more positive.*

Keywords*: Naive Bayes, Sentiment Classification, TF-IDF, Accuracy.*

Intisari—*Ulasan tentang atasan wanita di pasar adalah informasi yang berharga jika diolah dengan benar. Pedagang dapat melakukan analisis ulasan produk untuk mendapatkan informasi yang dapat digunakan untuk mengevaluasi produk dan layanan. Kegiatan analisis ulasan produk tidak cukup hanya dengan melihat jumlah bintang, perlu melihat keseluruhan isi komentar ulasan untuk dapat mengetahui maksud dari ulasan tersebut. Sistem analisis sentimen adalah sebuah sistem yang digunakan untuk melakukan proses analisis secara otomatis terhadap ulasan produk online untuk mendapatkan informasi termasuk informasi sentimen yang menjadi bagian dari ulasan online. Data tersebut diklasifikasikan dengan menggunakan Naive Bayes. Data yang dikumpulkan sebanyak 1.000 ulasan produk atasan wanita sebagai sampel. Tujuan dalam penelitian ini ialah untuk mengetahui sentimen analisis mengenai ulasan produk atasan wanita menggunakan algoritma Naive Bayes. Tahapan penelitian ini meliputi, yaitu pengumpulan data, pelabelan, pra-pemrosesan, klasifikasi sentimen, dan evaluasi. Pada tahap pre-processing terdapat 6 tahapan yaitu Cleaning emoticon & symbol, Case folding, Word Normalizer, Tokenize, Stopword Removal dan Stemming. Metode TF-IDF (Term Frequency - Inverse Document Frequency) digunakan untuk pembobotan kata. Data akan diklasifikasikan ke dalam 3 (tiga) kelas, yaitu negatif, positif dan netral. Data kemudian akan dievaluasi dengan menggunakan pengujian parameter akurasi. Hasil pengujian menunjukkan nilai akurasi sebesar 89%, hasil ini menunjukkan bahwa ulasan produk atasan wanita lebih banyak yang positif.*

Kata Kunci*: Naive Bayes, Klasifikasi Sentimen, TF-IDF, Akurasi.*

INTRODUCTION

The marketplace is a further development of e-commerce as an internet-based online medium for the process of conducting business activities and transactions between buyers and sellers. [1] Based on the Indonesian E-Commerce Map data issued by iPrice, Shopee is the marketplace with the highest number of visitors in Indonesia. [2] One of the products that are widely sold at Shopee is women's clothing. The quality of women's clothing products can be seen not only from the product photos and descriptions listed but also from product reviews from previous buyers. Product reviews are one source of information about product quality and have a significant impact on consumers. [3] In the activity of purchasing goods in the marketplace, buyers can submit reviews after getting the goods. Product purchase reviews consist of stars and the contents of review comments that contain feedback, appreciation, criticism, and input on the product that has been purchased. Review analysis can be easily done by looking at the number of stars given by buyers, but the number of stars cannot represent the content of the entire review. It is necessary to look at the entire content of the review comments to be able to know the whole intention of the review. It is possible to analyze reviews manually by looking at them one by one, but if you have a lot of reviews, it will be faster to use a sentiment analysis system [4].

In this study, researchers conducted sentiment analysis on clothing product reviews on the Shopee marketplace. The product review section consists of comment content in free text format and a star rating from 1 to 5. The information submitted by buyers can refer to product features such as price, quality, material, color, shape, size, and quantity, as well as services provided such as packaging, delivery time, and seller response. The purpose of this research is to analyze the sentiment of reviews of clothing product purchases at Shopee using the naive Bayes algorithm with TF-IDF weighting and classify them into 3 classes (positive, negative, and neutral). Another goal is to find out what features are the focus of positive, negative, and neutral reviews on women's clothing products so that sellers can make improvements and improve the quality of products and services appropriately. Related research is used as a consideration in the research being conducted. The following research has been done before regarding sentiment analysis in the marketplace.

The first research was conducted by Utami, H., from the Department of Mathematics, Gadjah Mada University, Yogyakarta, Indonesia, in 2022, entitled "Sentiment Analysis on Shopee Applications Using the Recurrent Neural Network Method." This research discusses how sentiment analysis on unbalanced data will cause classification errors where the classification results tend to be in the majority class. In this study, a combination of synthetic minority oversampling techniques (SMOTE), the Tomek link method, and the recurrent neural network (RNN) method were used to analyze the sentiment of Shopee application users based on review data. The Shopee Indonesia app review data shows that around 80% of Shopee app users have positive sentiment and 20% have negative sentiment, which means the data is not balanced. In this research, a preprocessing process with a combination of Synthetic Minority Oversampling Technique (SMOTE) and the Tomek link method is used to handle these conditions. The performance of the results is quite good, namely 80% accuracy, 84.1% precision, 92.5% sensitivity, 30% specificity, and an 88.1% F1 score. This is better than the performance of sentiment analysis without preprocessing to handle imbalanced data. [5]

The second research was conducted by Elik Hari Mktafin, Kursrini, Emha Taufiq Luthfi from the Department of Amikom University Yogyakarta, Indonesia in 2020 which discusses Sentiment Analysis on Product Purchase Reviews in the Shopee Marketplace Using a Natural Language Processing (NLP) Approach. Sentiment analysis on the content of product reviews can provide deeper information about buyer ratings on products sold in the Shopee marketplace. The use of NLP approaches in data pre-processing to improve accuracy. Resulting in an accuracy value of 76.92%, precision of 80.00%, and recall of 74.07%, this result is higher than the classification that does not use NLP features which only produces an accuracy value of 69.23%, precision of 80.00%, and recall of 64.52%. The results of research for sentiment analysis on the shopee application using the Naive Bayes classification algorithm produced an accuracy value of 71.50% and an AUC (Area Under Curve) value of 0.500, and the Naive Bayes algorithm can be used to analyze sentiment in the shopee application. [6]

The third research was conducted by Siti Maspripah, and Lila Dini Utami from Bina Sarana Informatika University, Indonesia in 2020 discussing the Naive Bayes Classification Algorithm for Shopee Application Sentiment Analysis. This research discusses the shopee application, and how to see whether the application is a good or bad service is to see from the comments both positive and negative for the service and for the applications they have downloaded. Sentiment analysis uses the Naive Bayes classification algorithm, to produce new knowledge in the form of how accurate the results of sentiment analysis using the Naive Bayes

algorithm, so that after sentiment analysis of shopee comments results in an accuracy of 71.50% and an AUC of 0.500. So it can be said that the Naive Bayes classification algorithm can be used for sentiment analysis of the shopee application. [7]

The fourth research was conducted by Billy Gunawan, Helen Sasty Pratiwi, and Enda Esyudha Pratama from the Informatics Department of Tanjungputra University Indonesia in 2018 discussing the Sentiment Analysis System on Product Reviews Using the Naive Bayes Method. This research discusses Indonesian online product reviews to obtain information including sentiment information which is part of online reviews. The data is classified using Naive Bayes. The sentiment analysis system is divided into 5 (five) stages, namely crawling, pre-processing, word weighting, model building, and sentiment classification. In word weighting, the TF-IDF (Term Frequency - Inverse Document Frequency) method is used. The existing data will be classified into 5 (five) classes, namely very negative, negative, neutral, positive, and very positive. The data will then be evaluated using confusion matrix testing with accuracy, recall, and precision parameters. The test results show that in testing 3 classes (negative, neutral, and positive) the best results are obtained at 90% training data and 10% test data with an accuracy value of 77.78%, recall of 93.33%, and precision of 77.78% and in testing 5 classes the best results are obtained at 90% training data and 10% test data with an accuracy value of 59.33%, recall 58.33% and precision 59.33%. The results of predicting the relevant test data class are compared between the sentiment class marked by the supervisor and the sentiment class generated by the sentiment analysis system even though it is not entirely accurate. [8]

The fifth research was conducted by Nur Khotimah from the Department of Statistics, Faculty of Mathematics and Natural Sciences, Muhamadiyah University Semarang, Indonesia 2019, discussing Sentiment Analysis of E-commerce Reviews with the Stochastic Gradient Descent Method. This research discusses internet users in Indonesia increasing every year until the end of 2018 reaching 171.17 million people, out of a total population of 264.16 million people. This development has an impact on various fields. One of them is the rise of shopping activities through Internet media. According to a survey conducted by APJII, 47.6% of Internet users in Indonesia know the Internet as a place to buy and sell goods and services, and 41.2% have made online transactions. The term is used in online buying and selling transactions in e-commerce. Indonesia has become the largest e-commerce market in Southeast Asia, with Indonesia's online sales reaching US$ 1.1 billion, higher than Thailand and Singapore. APJII in 2018

also surveyed the top two commercial internet content that is often used to buy goods or services online, namely Shopee 11.2% and Bukalapak 8.4%. Bukalapak and Shopee are Customer-To Customer (C2C) e-commerce models.

The Customer-To-Customer (C2C) market is currently still dominant in Indonesia's online retail market. Bukalapak and Shopee already have mobile phone applications and websites, which provide access to users to provide reviews related to the two e-commerce. The conclusion of this study is an overview of Bukalapak and Shopee reviews in June 2019, namely the comments given per day fluctuate and get the most reviews on June 11, 2019, which coincides with the promo day. As well as the majority of users have given positive ratings to the two e-commerce, the results of sentiment classification using the Stochastic Gradient Descent method with data division using 10 Fold Cross Validation obtained an accuracy rate of 95.09% for bukalapak and 89.89% for shopee. In addition, sensitivity is 96.9% for bukalapak and 92.4% for shopee and specificity is 79.3% for bukalapak and 79.3% for shopee.

This shows that the prediction ability using Stochastic Gradient Descent is good so that it can be used as a reference method for processing text data, Based on the results of the classification and text association carried out. in general, it can be seen that the majority of Bukalapak and Shopee application users talk about applications and transactions because they always appear in the negative sentiment class which shows the results of negative reviews that are often complained about including slow applications, need to be updated, complicated, easy errors, and heavy applications [9]. After describing previous research that uses naive bayes in its research, it can be concluded that the advantages of naive bayes in conducting sentiment analysis data are that this algorithm is suitable for probability data and large amounts of data.

Based on the above background, the authors try to conduct research on sentiment analysis with different objects, namely the results of reviews in the form of sentence levels and try to use different methods, namely in this study using the Naive Bayes method, where data is collected based on reviews on Shoope to provide information to prospective Shoope users.

MATERIALS AND METHODS

The research flow in sentiment analysis of reviews of purchases of women's tops at Shopee consists of several stages as shown in Figure 1.

Figure 1. Research Methods

A. Data

In this study, the data that will be used is a collection of reviews of purchases of women's top clothing products at Shopee.

1. Dataset

A dataset is a collection of objects and their attributes. Other names for objects that are often used include record, point, vector, pattern, event, observation, case, sample, instance, and entity.[10] In this study, review data related to the topic of reviews of buying tops at Shopee is used.

Table 1. Product Data and Reviews

No	Product Name	Reviews
1	*Atasan Crinkle Giovani/Blouse Crinkle/kemeja Wanita*	*Bagus bisa dipadukan dengan berbagai warna jilbab*
2	*Kemeja Flanel Wanita Lengan Panjang Best Seller Atasan Wanita*	*Terjangkau*

2. Labeling

The manual labeling process can produce accurate data because humans can distinguish correctly. The first dataset describes the sentiment of a comment. In this dataset, each comment is labeled positive, negative, and neutral based on the sentiment represented by the comment. For comments that have a negative sentiment (bad) will be labeled 0 (zero), comments that have a positive sentiment (good) will be labeled 1 (one), and comments that have a neutral sentiment will be labeled 2 (two).

Table 2. Labeling Example

Reviews	Label
Bahan tidak sesuai dengan deskripsi	0
Bagus bisa dipadukan dengan berbagai warna jilbab	1
Lumayan sesuai harga	2

3. Preprocessing

The preprocessing stage is carried out to process raw data into a collection of data that is ready for use. Broadly speaking, there are two stages of preprocessing in this research, namely preprocessing in general and text processing.[11] Preprocessing here is the general initial stage before a collection of documents is clustered. The purpose of preprocessing, among others, is to homogenize the dataset so that it is easier to process.[12] Some of the preprocessing stages carried out in this study are:

a. Cleaning emoticons and symbols: In this research, emoticons and symbols in the reviews are discarded because this research only focuses on the text contained in the reviews. The discarded symbols are "~", " `", " !", " $", " %", " ^", " &", " *", " (", ")", " _", "-", "+", "=", ":", "" ", """, "comma", "period", "?", "/", "\", "#", and "|". Reviews that contain symbols such as *"bajunya bagus dan aku suka kak :)"* after processing it becomes " *bajunya bagus dan aku suka kak* ".

b. Case folding: The stage of converting the text in the document into a standardized form, namely lowercase. The comment "*Barang sesuai dengan gambar*" becomes "*barang sesuai dengan gambar*", the capital "B" is changed to a lowercase "b".

c. Word Normalizer: Used to correct the words in the review so as to produce good and correct sentences in accordance with Indonesian grammar rules. This improvement is needed to make it easier for readers to understand the meaning of the sentence. The comment "*warna bajunya cantik bgt*" then after the Word Normalizer process becomes "*warna bajunya cantik banget*". The word "bgt" is changed to "*banget*" so that it is easier to understand.

d. Tokenize: The process of breaking text into words, with punctuation and space restrictions. For example, the sentence "barangnya bagus banget" is then converted into "*barangnya*", "*bagus*", "*banget*".

e. Stopword Removal: In this stage, word removal will be carried out based on the words contained in the stoplist. Words that enter stopwords such as "*yang*", "*dan*", "*di*",

"*dari*" so as to leave important words. For example, the sentence "*barang yang warna hijau dan biru bagus*" is then changed to "*barang warna hijau biru bagus*".

f. Stemming: The process of decomposing a word into its root form. For example, the sentence "*bahannya halus dan tidak membuat kegerahan*" is then changed to "*bahan halus dan tidak buat gerah*".

4. TF-IDF Weighting
    The next stage is TF-IDF weighting which is used to evaluate how important a word is in a document. Term Frequency (TF) is the higher the term that appears in the document, the greater the weight of the term itself. while the Inverse Document Frequency (IDF) process is the opposite of the TF process.[13] In IDF, the higher the frequency of term occurrence, the smaller the weight value of the term itself will be. The following TF-IDF equation is used in this research (1):

$$w_{i,j} = tf_{i,j} \log\left(\frac{N+1}{df_{i+1}}\right) + 1 \qquad (1)$$

Description:

$w_{i,j}$ = weight of i-th document against j-th word.

$tf_{i,j}$ = the number of word i searched for in document j.

df_i = the number of documents containing the i-th word

If the frequency of term occurrence is equal to the number of documents, then the result of IDF calculation j = 0. To avoid the result wij = 0, then the IDF calculation result will be added with a value of 1 (one). Sckit-Learn (Sklearn) library is one of the Python libraries used to help the TF-IDF weighting process. The addition of value 1 (one) to the IDF calculation results can be anticipated in the sklearn library.

B. Classification Method

The machine learning method used in this research is supervised learning. In making predictions using supervised learning, a training dataset is needed as a basis for learning. The supervised learning algorithm that will be used is the Naive Bayes Classifier[14]. Naive Bayes Classifier is a machine learning model that uses probabilistic methods in classifying. This classification algorithm is based on Bayes Theorem proposed by Thomas Bayes [15].

RESULTS AND DISCUSSION

The output data of the women's tops product review process in Shopee is reviewed. The labeling stage of women's top shirt review data is done manually by two annotators. Annotator 1 is responsible for manually classifying positive, negative, and neutral sentiments, while annotator 2 cross-checks the sentiment classification results of annotator 1. This study consists of three polarities. Namely, "negative" for consumers who do not like the product or service, "positive" comments, which mean good comments and customer satisfaction with the product being sold, and "neutral" for ordinary consumers of the product being sold. From the labeling process, 861 positive reviews, 50 negative reviews, and 89 neutral reviews were obtained (shown in Figure 2). Meanwhile, Figure 3 shows an example of the labeling results done by the annotator.

Figure 2. Positive, Negative and Neutral Sentiment Labeling Results

A. Text Processing Output

Text processing is the most important stage of sentiment analysis, this process determines the quality of data which is the computing The text processing output is presented in the image format below.

Figure 3. Positive, negative and Neutral sentiment review data

It can be seen that the content of product reviews tends to appear in sentiment label 1 or reviews with a postitive rating. This means that customers who use the Shopee marketplace to make purchases of women's tops feel happy with Shopee marketplace product transactions and women's tops and can provide more feedback and comments.

B. Word Count Using TF-IDF

This process uses TF-IDF (term frequency-inverse document) weighting to manually calculate word weights in review data documents using Python. The result of the TF-IDF calculation in one document is shown in Figure 5 below.

```
[ ] X_train = vectorizer.fit_transform(X_train)
    X_test = vectorizer.transform(X_test)

    print(X_train.shape)
    print(X_test.shape)

    (900, 699)
    (100, 699)
```

Figure 4. TF-IDF Calculation Result

C. Sentiment Classification

After distributing the training and test data, as well as TF-IDF weighting, then perform the sensory classification process using the Naive Bayes algorithm model, as shown in Figure 5. The Naive Bayes algorithm model can provide a fairly good accuracy of up to 89%.

```
-------------------- confusion matrix --------------------------
[[ 4  0  1]
 [ 1 83  2]
 [ 6  1  2]]
-------------------- classification report --------------------
              precision    recall  f1-score   support

           0       0.36      0.80      0.50         5
           1       0.99      0.97      0.98        86
           2       0.40      0.22      0.29         9

    accuracy                           0.89       100
   macro avg       0.58      0.66      0.59       100
weighted avg       0.90      0.89      0.89       100
```

Figure 5. Classification Result

D. Frequency of Word Occurrence

Words that have a high frequency of occurrence in reviews can describe the general state of market acceptance of the product. The words that are frequently used in giving reviews on Shopee on the product "women's tops" are shown in Figure 6, Figure 7, and Figure 8.

Figure 6. Results Frequency of Negative Reviews

The visualization above is a Word Cloud of words that most often appear in the content of reviews that have a negative sentiment label. The words that appear most often and lead to negative reviews discuss around: *"tipis", "tidak sesuai", "kurang", "kurang rapi"* and so on. So that from these words can be input for sellers and marketplace shopee to improve the quality of goods (women's top clothing products), prices, quality of delivery or packaging, and the quality of women's top clothing products that are most mentioned by customers in the results of negative sentiment review analysis.

Figure 7. Results Frequency of Positive Reviews

The visualizations above, it is clear that the Word Cloud is the most frequently viewed review with positive sentiment labels. For example, the words that appear most frequently and generate positive reviews are *"sesuai", "baik", "cantik"*, and "*adem*". You can incorporate these words into Shopee sellers and marketplaces to maintain the quality or improve the quality of goods (women's tops products) so that the quality is reasonable and safe. The positive analysis result is that the seller's reaction is the most common.

Figure 8. Results Frequency of Netral Reviews

The visualization above, it is clear that the Word Cloud is the most frequently viewed review with a neutral sentiment label. For example, the words that appear most often and generate neutral reviews are "*tipis", "sesuai",* and so on. These words can be incorporated into Shopee sellers and marketplaces to maintain the quality or improve the quality of goods (women's tops products) so that the quality is reasonable and safe. The positive analysis result is that the seller's reaction is the most common.

E.   Evaluation
The research method based on review data collection, pre-processing and calculation using Naive Bayes Classifier still has various obstacles that make the system in this study work not optimally:

1. Missing Training Data
The training data used in this study is somewhat insufficient because only 1000 data is used so when the test data entered is not recognized in the training data, the prediction results and the actual label do not match. The more training data used, the higher the accuracy produced, and the accuracy of the system recognizing test data will be better because the system can recognize many varied sentences and vocabulary that are used as learning by the system.

2. Inaccurate Datasets Exist
There were errors in the system's classification process due to the use of an inaccurate dataset. This situation leads to the fact that many data display features that do not belong to the category are found in the test data used. For example, the dataset used in the positive data contained the word "*bagus*", and in the negative data there was also the word "*bagus*" which was derived from the word "*tidak bagus*". The same word in the positive and negative datasets is what causes errors in the data classification process. The sentence "*maskernya sangat bagus,*" which is actually classified as a positive sentence,

will be recognized by the system as a negative sentence because when the system works, the sentence will be included in the negative classification because in the sentence there is the word "*bagus*" and the word "*tidak bagus*" is in the negative dataset. So it can be concluded that the problem of using datasets in which there are the same words will affect the classification process in the system. This problem also affects the accuracy of the system and can result in poor system performance.

3. Limited Understanding of Sentiment Classification
When understanding sentences processed by the mood classification process, the first sentence is often limited. It conveys the perception that the sentence is a positive sentence, and then at the end of the sentence, the perception that the sentence is a negative sentence. The sentence that first gives the recognition that the sentence is a negative sentence, and then the sentence that gives the recognition that the sentence is a positive sentence at the end of the sentence. This constraint results in the system's performance not running optimally because the system detects sentiment classification in sentences that are at the beginning only. An example is the training data statement. "*Kualitas baju bagus, tapi untuk pelayanan kurang*" In the manual data classification, the sentence belongs to the negative emotion category, but if the classification uses the system, the sentence belongs to the positive emotion category because it begins with a word containing positive emotions.

CONCLUSION

The results showed that an accuracy value of 89% was obtained from a survey using the Naive Bayes algorithm method to determine the sentiment of user reviews classified into three classes negative, positive and neutral using TF-IDF weighting. In addition, the shopper market sentiment analysis shows that the product reviews of women's tops are more positive. This means that the services and products of women's tops offered by Shopee Marketplace are very good. From the results of the analysis above, it can be concluded that the manual results that we get from the search for women's tops on shopee display data that shows positive reviews are more dominant than the results of negative or neutral reviews, for negative reviews the words that appear most often are about the quality of thin products, colors that do not match, less quality, long delivery and for positive analysis the words that appear most often are about the quality of products that are appropriate and neat, good, good, very good, and seller response. For neutral reasons, the

words that appear most often are about goods sent accordingly and the quality of goods is relatively decent.

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