E-Wallet Sentiment Analysis Using Naïve Bayes and Support Vector Machine Algorithm

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Abstract. Nowadays most of consumers in urban areas are accustomed to using digital wallets. The habit of transaction in cashless has been widely applied to the transportation system, restaurants and shops in the mall or supermarket. Apart of the ease of conducting transactions, various promotions in the form of points and cashback offered from various digital wallet application developers or e-wallets have become very attractive to users. One of the most widely used e-wallets by the public is OVO and DANA. This phenomena encourages researchers to do a research and make it as an object of study due to both are widely discussed by various groups, especially in the capital of Jakarta lately. As it is used, many customers write product and service reviews based on their experience on the Google Play store. Sentiment analysis is a technique that can find the right solution in creating a system that can automatically analyse these reviews and extract information that is most relevant to users. Researchers collected OVO and DANA review data on the Google Play store with a total of 2000 datasets. In this study, researchers compared the two algorithms namely Naïve Bayes and Support Vector Machine (SVM). The stages carried out in this study are data collection, initial data processing, modelling with the chosen method, experimental & model testing as well as evaluation and validation of result. Evaluation is carried out using 10 Fold Cross Validation. The result showed that OVO is the most popular e-wallet application by the public with an accuracy measurement using the Confusion Matrix reaching 91.00% for the SVM algorithm. The ROC curve showed the best AUC result of 0.986 (Excellent Classification).

1. Introduction

Along with the digital transformation, nowadays payment by non-cash or better known as cashless is increasingly mushrooming in Indonesia. Various kinds of transactions can be done using only one hand. For example, credit payment transactions, paying utility bills, paying health insurance, online shopping and several other things that can be done with an Indonesian digital wallet (e-wallet). Nowadays, transactions through electronic money payments are increasingly popular in the community. Non-cash payments with digital wallets are increasingly in demand by the public. So, do not be surprised if the growth of mobile payment services is currently growing very rapidly. Moreover, e-wallets can be easily done using a smartphone [1]. Based on data from the Bank Indonesia (BI), there was an increase in the volume of electronic money transactions by the end of 2019, jumping 79.3% to 5.2 billion transactions compared to

2018 of 2.9 billion transactions [2]. Indonesia also has many e-wallets that can be used to make transactions. According to the Bank Indonesia as of 3 April 2020 there are 47 e-wallets that already have official permits. The number of e-wallet transactions in February 2020 reached Rp.15.1 trillion [3]. As stated from [2][3][4][5] e-wallet applications that are widely used by the community include OVO, GOPAY, DANA, LinkAja and Jenius. OVO and DANA are e-wallet applications that researchers choose to be the object of research because they are widely discussed by various groups, especially in the capital of Jakarta today [1], with datasets that researchers collected as many as 2000 datasets taken from user reviews on the Google Play Store.

Along with its use, many people who write reviews about the quality of services and products used through the Google Play Store in their experience using both e-wallet applications. Some write in the form of complaints about inadequate services, positive reviews related to good service quality, suggestions for service improvement or other experiences that can be shared with users or potential users who are interested in using e-wallet. Reviews written online continue to increase in popularity as more and more people seek advice from fellow users about services and products [6]. Finding the relevant and timely information from various reviews is very important [7]. This has led to increased research in the field of sentiment analysis and opinion mining, with the aim of providing a system that can automatically analyze user reviews and extract information that is most relevant to users [6].

Research of sentiment analysis has been done by many researchers. Previous research including, Sentiment analysis analysis of e-wallet sentiments on google play using Naïve Bayes algorithm based on Particle Swarm Optimization [1]. Sentiment analysis of smartphone product review using Support Vector Machine algorithm-based Particle Swarm Optimization [8], Sentiment analysis of cosmetic product reviews through feature selection comparison [9], Sentiment analysis of cosmetic product reviews using Support Vector Machine Algorithm and Particle Swarm Optimization as feature selection [10], Comparison of SVM & Naïve Bayes algorithm for sentiment analysis toward West Java Governor candidate period 2018-2023 based on public opinion on Twitter [11], sentiment analysis on restaurant reviews, where the review is written in Cantonese and classified using Naïve Bayes algorithm and Support Vector Machine [12]. Sentiment analysis at a destination review using the Naïve Bayes algorithm, Support Vector Machine, and Character Based N-gram Model [13]. Prediction of Indonesia presidential election result for the 2019-2024 period using twitter sentiment analysis [14]. Optimizing the Particle Swam Optimazion usage for predicting Indonesia presidential election result period 2019-2024 [15]. Some of the most related research topics raised by researchers include Sentiment analysis of Malayalam tweets using machine learning techniques [16], in this study using the NB, SVM and Random Forest algorithms, the accuracy of research results with NB reaches 94.4%, SVM 94.5% and RF 95.6%. Then Sentiment Analysis Using SVM And NB Algorithm [17], the accuracy obtained with the NB algorithm is 79.66%, SVM 83.59% and NB + K-Means 89%. Furthermore, Comparative studies of NB, SVM and Random Forest Classifiers in Sentiment Analysis of Twitter feeds [18], the results of using the algorithm NB 89%, SVM 88% and Random Forest Classifiers 85%.

The Naïve Bayes algorithm is very simple and efficient [19]. In addition, the Naïve Bayes algorithm is a popular machine learning technique for text classification, and has good performance in many domains [13]. However, Naïve Bayes turned out to have flaws which are very sensitive in feature selection [19]. Too many features for the classification process will lead to not only increase calculation time but also decrease precision [20]. Support Vector Machine has been used efficiently in many text classification studies because of its main benefits such as robust in high-perspective areas, each function is suitable, strong when there is a set of samples sporadically, and most of the problems of linear free text classification. Moreover, Support Vector Machine has gotten good result in opinion mining and this method has exceeded other machine learning methods. But Support Vector Machine has a disadvantage, namely the accuracy is

influenced by the selection of the appropriate parameters [21]. Based on the above problem, the researchers will compare the Naïve Bayes algorithm and Support Vector Machine to find out people's sentiments towards the OVO and DANA e-wallet applications. Researchers believe that the success of any enterprise depends on their consumers' reactions and therefore researchers have tried to analyze which payment companies have been successful in providing them efficient services [22]. Therefore, this study aims to determine the best algorithm in e-wallet sentiment analysis.

2. Method

Below are the stages for the experimental research method applied by the researchers:

a. Collecting the Data

The researchers collected the data on the Google Play Store from March 2019 to January 2020 based on user reviews namely OVO and DANA applications consisting of a total dataset of 2000 for both positive and negative reviews in English text.

b. Initial Data Processing

The processing stage of dataset must go through 3 following steps:

1) Tokenization

The researches collected all noticeable words and removed punctuations which were not letters.

2) Stemming

At this stage the researchers get the basic word by removing the affixes on each word such as prefix, suffix, and insert.

3) Generate N-grams

Researchers combine adjectives that often perform to show sentiment like the word "very" and "helpful". The word of "helpful" has indeed shown the sentiment of a form of positive perception. While the word of "very" will be no meaning without combining with other words. So, if the two words are put together into "very helpful" will strengthen the positive perception. The researchers employ two words combination known as 2-grams (Bigrams).

c. The Method Used

Researchers did a method comparation for both the Naïve Bayes algorithm and Support Vector Machine. Both methods are very famous and mostly employed in sentiment analysis, text classification, and opinion mining.

d. Experimentation and Assessing Method

Rapid Miner Studio is used to proceed data of data experiments.

e. Evaluation and Result Validation

To evaluate the data, the researchers use 10 fold cross validation. However, the assessment of precision is done with a confusion matrix and curve of ROC to assess the value of AUC.

3. Result and Discussion

Researchers describe the result and discussion as follows:

a. Result

For the training data employed in classifying the English text is 500 positive and 500 negative reviews from each OVO and DANA e-wallet application. The data itself is still in the original form as sets of separated text in the document. Before doing a classification and grouping the text, the data have to go into several processes. Once the data in the classification process, it is useful to determine which a sentence is associated to a positive or negative class by referering to the probability calculation of the larger Bayes formula. If the probability result of the sentence that associate to a positive class is greater than the negative one, the sentence is included in the positive class. If the probability for a positive class is smaller than the negative class, the sentence is included in the negative class.

Table 1. Confusion Matrix Naïve Bayes Algorithm for OVO

NB Accuracy: 94.90% +/- 2.03% (mikro: 94.90%)	True Negative	True Positive	Class Precision
Negative Prediction	478	29	94.28%
Positive Prediction	22	471	95.54%
Class Recall	95.60%	94.20%	

Table 2. Confusion Matrix Naïve Bayes Algorithm for DANA

NB Accuracy: 94.70% +/- 2.01% (mikro: 94.70%)	True Negative	True Positive	Class Precision
Negative Prediction	491	44	91.78%
Positive Prediction	9	456	98.06%
Class Recall	98.20%	91.20%	

Table 3. Confusion Matrix Support Vector Machine Algorithm for OVO

SVM Accuracy: 91.00% +/- 2.85% (mikro: 91.00%)	True Negative	True Positive	Class Precision
Negative Prediction	422	12	97.24%
Positive Prediction	78	488	86.22%
Class Recall	84.40%	97.60%	

Table 4. Confusion Matrix Support Vector Machine Algorithm for DANA

SVM Accuracy: 86.60% +/- 3.79% (mikro: 86.60%)	True Negative	True Positive	Class Precision
Negative Prediction	373	7	98.16%
Positive Prediction	127	493	79.52%
Class Recall	98.20%	98.60%	

The model testing for this study was performed using techniques of 10 cross validation. This process randomly separates data into 10 sections. It's started by forming a model in which data put into the first section. After that, the formed model is assessed in the remaining 9 data sections. The process of precision is calculated by looking how the data is grouped correctly. The model testing result will be done through a confusion matrix to show how the model is made correctly. Tables 1 and 2 display the Confusion Matrix Naïve Bayes algorithm for OVO and DANA. Tables 3 and 4 display the Confusion Matrix for Support Vector Machine algorithm for both OVO and DANA.

The ROC curve from the data test results can be seen in the following figure. Figures 1 and 2 are the ROC curves of the Naïve Bayes algorithm for OVO and DANA. Figures 3 and 4 are the ROC curves of the Support Vector Machine algorithm for OVO and DANA.

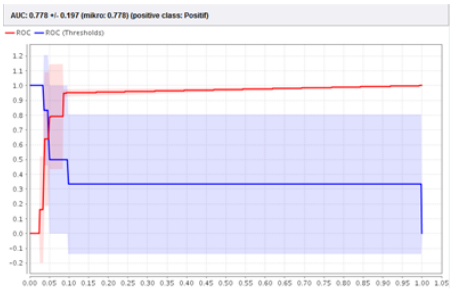

Figure 1. ROC Curve from the Naïve Bayes algorithm for OVO with AUC 0.778

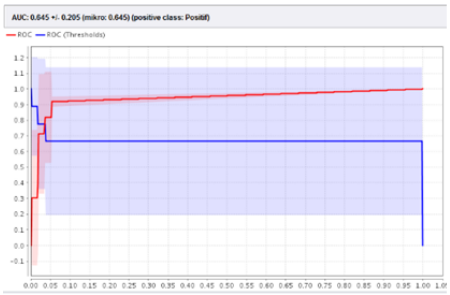

Figure 2. ROC Curve from the Naïve Bayes algorithm for DANA with AUC 0.645

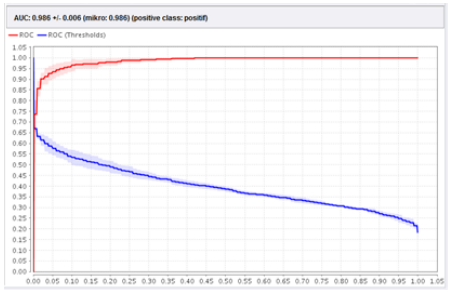

Figure 3. ROC Curve from the Support Vector Machine algorithm for OVO with AUC 0.986

Figure 4. ROC Curve from the Support Vector Machine algorithm for DANA with AUC 0.979

b. Discussion

In classifying the text, both the algorithm of Naïve Bayes and the Support Vector Machine are very famous specifically in sentiment analysis research. High performance and high precision result. Due to each experiment study employ different data, the result of precision also varies.

In this study, the use of 2-gram makes the data tested is better than before. So, it is clearly understandable why the Naïve Bayes algorithm is superior 94.90% in precision. However, the Support Vector Machine algorithm able to produce a precision only of 91.00%. Precision at the level of 0.80-0.90 is considered a good classification. It can be interpreted, in this study Naïve Bayes algorithm also Supports Vector Machines into a good classification, with examination result above 0.80 or 90%. But it can be seen in the ROC curve, the AUC (Area Under the Curve) that occurs Support Vector Machine Algorithm is superior to 0.986, while Naïve Bayes only reaches 0.778. Both of them achieved the highest result for OVO e-wallet compared to DANA.

4. Conclusion and Suggestion

By looking at the data processing, it shows that algorithm for the Naïve Bayes and the Support Vector Machine are both superior to classify OVO and DANA e-wallet user reviews with English texts. Based on the two e-wallet products, OVO gets quite high accuracy from the two agreed algorithms. The precision of the Naïve Bayes reaches 94.90%, while the Support Vector Machine is quite high which results in an accuracy of 91.00%. The difference in precision is very close, at 3.90%. However, compared to the AUC obtained, the AUC for the superior Support Vector

Machine algorithm reaches 0.986 (reaches perfect). So, the researchers concluded that the Support Vector Machine Algorithm was able to work well in analyzing sentiment reviews in English. In order to overcome problems that arise where the accuracy value is high but the AUC value is low, the researchers suggest for further research to be able to use feature selection techniques such as PSO, GA, PCA or others to be able to produce accuracy and AUC values that are equally high.

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