Jurnal Informasi dan Teknologi

https://jidt.org/jidt

2023 Vol. 5 No. 4 Hal: 325-330 e-ISSN: 2714-9730

Application of Support Vector Machine and Naive Bayes Method to Analyze Mobile Banking User Behavior Through social media Twitter

Dendy K Pramudito[1]✉, Munir Tubagus[2], Andy Ismail[3], Fransisca Dyah Anggraini[4], Catarina Cori Pradnya Paramita[5]

[1]Universitas Pelita Bangsa
[2]Institut Agama Islam Negeri Manado
[3]Universitas Darwan Ali
[4]Universitas Katolik Musi Charitas
[5]Universitas Krisnadwipayana

doktor.haji.dendy@pelitabangsa.ac.id

Abstract

The purpose of this research is to use Naive Bayes and Support Vector Machines (SVM) to determine sentiment analysis on social media related mobile banking. The author used a quantitative technique in this study. Data crawling and a review of the literature were two of the methods used in the collection process. Author using SEMMA technique. The process of defining and articulating the problem leads to this research phase. RapidMiner software is used in this study at every step of the data processing process while using the SEMMA approach. 580 positive and 650 negative feelings were produced by the Naïve Bayes classification approach, whereas 720 positive and 410 negative sentiments were produced by the Support Vector Machine (SVM) classification method. The Naïve Bayes approach yields 90% accuracy with a 1% margin of error, 91% precision for positive predictions, 89% precision for negative predictions, 90% recall for positive data, and 90% recall for negative data. An accuracy value of 89% with a margin of error of 3%, positive predictive precision of 67%, negative predictive precision of 99%, positive data recall of 95%, and negative data recall of 88% are obtained by the Support Vector Machine (SVM) approach. The data used is from the Naïve Bayes approach since it has a higher accuracy value of 90% than the Support Vector Machine (SVM) method, based on the accuracy, precision, and recall values of the two classification methods. Social media users tend to have more positive perceptions regarding mobile banking since positive sentiment outweighs negative sentiment.

Keywords: Social Media, Mobile Banking, Naïve Bayes, Support Vector Machine, Opinion.

1. Introduction

The influence of internet use is the only factor contributing to the rapid development of communication and information technologies. The increase in Indonesian internet users is directly correlated with the rapid advancement of information and technology [1]. By January 2023, there will be 213 million internet users in Indonesia. As of 2022, this number has climbed by 4% over the prior year. The number of internet users in Indonesia has been steadily rising for a number of years. Finally, the year 2018 saw the start of the internet user boom in Indonesia. Because of the internet, people's conventional lifestyle patterns are changing to more modern ones as a result of technical advancements [2]. Presently, the majority of businesses across diverse industries have kept pace with technological advancements, specifically by leveraging information technology and the internet to bolster their corporate operations. The banking industry is one that keeps up with the rapid advancements in technology to digitize corporate processes [3]. There is no denying that the banking sector, in general, contributes significantly to the growth of a nation's economy. The rise of new innovations in financial technology applications provides offers to make it easier for people to fulfill their financial activities with just one hand. With the existence of these fintechs, the process of sending money, purchasing credit, paying electricity, paying BPJS, and other financial activities can be done easily [4]. With this phenomenon, most conventional banking institutions are competing to create applications that can meet the needs of their customers, so the mobile banking application has emerged, which has changed the transaction process to the digital realm, where it can be done anytime and anywhere [5].

Mobile banking is a form of banking service that allows users to carry out financial transactions via mobile devices, such as cell phones. As of 2023, almost all banks in Indonesia will have implemented mobile banking applications, be they state-owned banks, state-owned banks, or private banks [6]. For example, one of them is a private bank that has implemented a mobile banking application, namely BCA Bank. It is the largest private bank in Indonesia and offers many banking solutions to help meet customer transaction needs [7]. In 2023, it is said that mobile

Diterima: 20-12-2023 | Revisi: 25-12-2023 | Diterbitkan: 07-01-2024 | doi: 10.60083/jidt.v5i4.462

banking will become the most popular application in Indonesia, with a Top Brand Index score of 48%, followed by BRI Mobile with a score of 20%, and other mobile banking [8]. Apart from that, based on comparison results by the Top Brand Award, which compared several mobile banking applications that are most frequently used in Indonesia when compared with other mobile banking, mobile banking has become the most stable in terms of increasing users, and there is no decline every year [9]. The mobile banking application has a higher number of downloads than other mobile banking applications. Users have downloaded this application more than 55 million times [10]. Mobile banking became a trending topic on Twitter and social media because an error occurred in the mobile banking service. In the application, when a customer wants to make a transaction, many errors found, which means that the transaction cannot be processed temporarily [11]. Please try again in a few moments. Apart from that, some customers are asked to re-register on the application. With this error problem, do people still feel comfortable and continue to use mobile banking or not? Based on the problems raised, researchers are interested in conducting research to find out the public's response based on sentiment on social media towards mobile banking [12].

The act of determining and classifying viewpoints that are still in text form into positive or negative sentiments is known as sentiment analysis. Finding out a writer's actions and viewpoints on a certain subject is the aim of sentiment analysis [13]. The public uses a variety of social media sites to share their thoughts and reactions. Twitter is one of the best social media platforms for gathering feedback or answers from users. Social media users typically communicate with one another by sending brief messages [14]. This is a medium for collecting opinions to find out what sentiments arise regarding someone's opinion, whether in the form of positive or negative opinions. Social media is used for sentiment analysis in case studies in various fields because it is widely used as a data source. Social media is the center of trending in Indonesia [15]. Compared to other media, social media offers the fastest and most accurate distribution of information. Another advantage of social media is that access is open to anyone, its appearance is easy to understand, and it is fast at conveying the user's thoughts, feelings, and opinions on something [16]. Social media is an ideal tool for analyzing public sentiment because of its advantages, making it easier for researchers to analyze the opinions of users who express their opinions freely through social media [17]. Based on the advantages that have been explained, it encourages writers to use social media to collect data, which will later be carried out by sentiment analysis [18].

The accuracy of the models during the preprocessing stage was compared by the researchers using the Naïve Bayes technique and Support Vector Machine (SVM). Because it is so simple to apply, the Naïve Bayes approach is frequently employed in research [19]. The Naïve Bayes technique is used in many different fields. One way to widen the gap between two classes is to use the Support Vector Machine technique [20]. The Support Vector Machine and Naïve Bayes techniques are recognized for their superior classification accuracy based on prior studies. These two techniques are widely used by researchers to perform sentiment analysis on social media. These two techniques have been used in numerous studies by researchers [21]. Sentiment analysis is the study of opinions, arguments, attitudes, assessments, and feelings regarding many things, including events, goods, services, problems, themes, and other connected things, using computerized technology [22]. Sentiment analysis is the process of extracting, converting, and interpreting opinions from a text and categorizing them into positive, negative, or neutral sentiments using Natural Language Processing [23]. The scientific discipline of natural language processing studies how computers can function and think like people. Natural Language Processing is part of artificial intelligence [24]. In general, sentiment analysis involves categorizing or grouping text data based on labels or classes. The focus of sentiment analysis is to identify the values contained in a text, such as popularity (positive, negative, or neutral sentiment), feelings and emotions (such as anger, happiness, etc.), level of importance (very important or not), and intent or interest [25]. The advantage of sentiment analysis is that it saves time and energy when conducting research with large amounts of data [26].

Customers can use mobile devices or cell phones to conduct a variety of banking operations thanks to a service provided by banks and other financial institutions called mobile banking. Mobile banking offers many services, such as transfers, payments, histories, and more [27]. One benefit of mobile banking technology is that it can fulfill a variety of demands for customers without requiring them to visit a bank branch or ATM. In the current period, mobile banking is a banking service that keeps up with advancements in communication and technology [28]. Because mobile banking services on cellphones are constantly on and make it simple for users to conduct financial transactions whenever and wherever they choose, there is a significant market opportunity for their use. Customers can consistently access banking services via mobile banking through electronic media or when applying to open a new bank account [29]. Most banking sectors in Indonesia have implemented the use of mobile banking to help facilitate their business processes. Social media in this era of globalization is very viral in Indonesia. Currently, social media has become an obligation that, according to teenagers, they must have, and it cannot be denied. Social media has quite a big influence on each individual in helping to communicate [30]. Social media is a connecting bridge that helps its users be involved in information sharing activities, creating content or messages to be conveyed to other people, conveying opinions, and so on [31]. This can be done in real time and without any time limits. Twitter is a website in the form of a microblog that was founded in 2006 by Jack Dorsey and is now managed

by Twitter, Inc. Users can send and receive messages, commonly known as tweets, through the microblog service provided by Twitter [32]. A microblog is a form of digital communication that allows users to convey news, activity updates, opinions on events, and so on by writing text messages. Twitter has a limit on writing characters, namely only 280 characters, while other social media have no limit. Twitter is public, so statuses shared can be seen by other people even if they are not followers. However, tweets can also be shared only with friends or followers.

2. Research Methods

In this research, the author adopted a quantitative approach. The author used Microsoft Word to compile the research report and RapidMiner to process the collected data. The author used Mendeley Desktop as a tool to enter references for this research. In this stage, the author collects available data and information. Data crawling and a literature review are two of the procedures used in this crucial data collection phase, which supports the research project. The SEMMA approach is employed by the author since it can be used for both creation and maintenance in structured data mining projects due to its easily comprehensible stages. The process of defining and articulating the problem leads to this research phase. Proceed with the data processing through the five stages of the SEMMA method: sample, explore, modify, model, and assess. Data crawling and a review of the literature make up the sample step. The crawled data and attribute columns that will be utilized for the data set are defined during the explore step. The next step in the process is to alter the data by cleaning, tokenizing, converting cases, removing stop words, and adding filters to make the data more organized. In the fourth stage, a model employs the Naive Bayes and Support Vector Machine techniques to assign class labels to the data set. Making recommendations and inferences from the research is the last step. In this research, each stage of data processing in applying the SEMMA method uses RapidMiner software.

3. Results and Discussion

Crawling data is the first step in collecting data that will be processed in the text mining stage. Social media is used as a tool in data crawling to retrieve data in the form of tweets. After getting the data and saving it in Excel format, the next step is to carry out text processing, which aims to reduce interference (noise), making the next steps easier. Explore: this stage selects data attributes that have been obtained from crawling data. The modification in this research is in the form of text preprocessing. To process the results of data collection from the previous stage and prepare it for use, the next step in sentiment analysis is taken. The tokenize stage is the process of breaking sentences into pieces of words, or tokens, to find out where the words come from. The transform case stage is the stage for mapping capital letters to lowercase letters and vice versa. The data set used in this research has been converted to all lowercase since the majority of the collected tweets are in lowercase. The stop word removal stage is the stage for removing words that are widely used but do not influence the sentiment of a sentence. Stop word removal in this study used a dictionary obtained from Kaggle, a corpus of Indonesian language stops words. The filter stage is the stage for removing words that have letters that are too short or too long; the limit for the shortest letters is a minimum of three letters, and the maximum length of letters is 40 letters.

The following step involves applying Naïve Bayes and Support Vector Machine machine learning modeling with the Term Frequency-Inverse Document Frequency (TF-IDF) feature extraction technique. Training and testing data are the two categories into which this study splits the text preprocessed tweets. After that, a feature extraction procedure is used to the recovered tweets, allowing a machine learning modeling process to use the training data on the test data to predict sentiment tweet labels. Two hundred and fifty of the 800 data points were chosen for testing, while the remaining 250 were used for training. Machine learning algorithms are trained using manual labeling as training data. Previous studies have shown that machine learning is trained by manual labeling functions to comprehend sentence patterns that would be subject to automated labeling. Tweets' text patterns will be used via manual tagging to identify whether or not they contain hate speech or support language. This study split the data set into test and training segments, with a test-to-train ratio of 32% training and 68% testing, just like the naive Bayes approach does.

After going through the training and testing stages of the models produced by each algorithm, the next step is to select the best results from each algorithm, which will be used as a representative for comparison. The evaluation of these two methods produces a confusion matrix value that includes accuracy, precision, and recall obtained from test data. This research uses the k-fold cross-validation method with a value of k = 10 to ensure the resulting value has the maximum level of model validation. The cross-validation process in the Naive Bayes algorithm involves training and testing stages (apply model and performance-Naive Bayes). The training stage includes a learning process that utilizes the Naive Bayes algorithm, while the testing stage involves evaluating the model trained through the Apply Model and Performance Test processes. After that, a modeling process was carried out using the Naive Bayes algorithm to obtain accuracy, precision, and recall values based on the performance vector (performance-NB). This process consists of two main stages, namely the training stage and the testing stage. In the training stage, the data is processed using the Naive Bayes algorithm to understand the patterns and

characteristics of the dataset. Then, in the testing stage, the data is tested using a model that has been trained through the Apply Model process, and then its performance is evaluated through the Performance Test. This entire process helps to determine and select the best model for each algorithm, which will later become a representation or reference in carrying out further analysis and implementation related to research objectives.

The cross-validation process using the Support Vector Machine algorithm includes training and testing processes (apply model and performance-SVM). After that, a modeling process was carried out using the Support Vector Machine algorithm to obtain accuracy, precision, and recall values based on the performance vector (performance-SVM). This process consists of two stages, namely the training and testing stages. The SVM algorithm trains the data in the training stage. After that, in the testing stage, the data is processed through the Apply Model and Performance Test. Support Vector Machine (SVM) classification produced 720 positive sentiments and 410 negative sentiments. The accuracy value is 89%, the margin of error is 3%, positive predictive precision is 67%, negative predictive precision is 99%, positive data recall is 95%, and negative data recall is 88%.

The evaluation of the performance of the Naive Bayes algorithm shows solid and consistent performance. With an accuracy rate of 90%, the system has succeeded in providing predictions that are very close to those obtained from human evaluation. The superiority of this system can be seen from its high positive precision value, reaching 91%, indicating an excellent ability to identify data as true positives. Even though there was a slight error in classifying the data as true negative with a precision of 90%, the system's ability to recall positive data (positive recall), which reached 95%, shows the effectiveness of the Naive Bayes model in predicting positive data very well. Solid performance can also be seen from the negative recall value, which reached 90%, indicating a strong ability to predict negative data. Although there were several weaknesses identified, overall, this system managed to maintain very satisfactory performance with strong capabilities in predicting both classes of data, both positive and negative categories. The reliable performance of the Naive Bayes algorithm strengthens its reliability and potential in a wide range of applications, providing a strong foundation for its use in more complex data analysis.

Although the Support Vector Machine (SVM) algorithm demonstrated a satisfactory accuracy rate of 89%, evaluation of its performance revealed variations in predictive ability between the positive and negative classes. There is a significant difference in precision between the positive and negative classes; positive precision only reached 67%, indicating that there were limitations in identifying data as true positive. However, the advantage of the system lies in its high negative precision, reaching 98%, indicating an excellent ability to classify data as true negatives. Although there is a striking difference in precision, it should be noted that a positive recall value of 90% indicates a strong ability to predict positive data, and a negative recall value of 87% also indicates a fairly good ability to predict negative data. Even though there is an imbalance in precision between the two classes, SVM overall still offers decent capabilities for predicting both classes of data, both positive and negative. However, the stronger focus on negative precision suggests a priority on avoiding misclassification of negative data. Nevertheless, the performance evaluation of SVM shows strong potential for predicting and classifying data in various scenarios, although there is an emphasis on negative precision to reduce errors in the classification of negative data.

Through sentiment analysis, it was found that in the context of positive sentiment regarding mobile banking applications, words often appeared such as happy, service, and connected. Happy reflects the public's satisfaction and joy with the services provided by the bank, especially the swift service from customer service. They feel the speed and responsiveness of the service provided, providing a positive experience of interaction with employees. The word 'service' describes the positive experience of users regarding the convenience provided by the mobile banking application, especially in terms of transactions using the QRIS feature, which shortens time and increases efficiency. Meanwhile, connected reflects ease of access and connectedness with the bank, especially through mobile banking activation, which can be done anytime and anywhere via video call service, as well as the wide availability of branches to make it easier for users to resolve problems. However, amidst the many positive sentiments, there are also negative sentiments that emerge in the analysis. Words such as 'failure', 'interruption', and 'error' represent negative sentiment from users towards mobile banking. People experience discomfort when they experience technical problems or errors in the application, such as difficulty logging in or failure to carry out the desired transaction. From the sentiment analysis, it can be seen that although there are positive aspects expressed by users regarding the convenience and service of mobile banking, technical problems such as glitches and errors in using the application are also part of the user experience and need to be considered to improve the quality of the application service.

4. Conclusion

Based on the results of the classification discussion, the following conclusions can be drawn from this research: After going through text preprocessing, 800 structured data tweets were produced, which were then labeled using both Naive Bayes and Support Vector Machine methods. The results of the Naïve Bayes classification method produced 580 positive sentiments and 650 negative sentiments, while the Support Vector Machine (SVM) classification method produced 720 positive sentiments and 410 negative sentiments. Based on the sentiment

results from the Naïve Bayes method, the positive sentiment results were 580 and the negative sentiment was 650. So, positive sentiment is superior to negative sentiment, which means that social media users give more positive opinions about mobile banking. With words that often appear in the positive class, happy, service, connected express the public's feelings of pleasure for the services provided, starting with customer service and services provided on the application, because the response from the bank is very fast and alert in the conditions whatever. Apart from that, in the negative class, words that often appear are failure, interruption, and error. The existence of trending topics on social media does not change the bad views of users, but users still feel happy when using mobile banking and will continue to use it. Based on the results of the research conducted, researchers have several suggestions that can be used as input and consideration for further research, as follows: For further research, you can use sources from other social media sites, such as Instagram or Facebook. For further research, you can use other applications, such as the Python programming language or the R language. For further research, you can add a neutral sentiment variable.

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