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Performance Measurement Of Machine Learning (Support Vector Machine, K-Nearest Neighbors, And Naive Bayes) In Crypto Wallet Applications

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Abstract

This study aims to compare the performance of three classification algorithms, namely Support Vector Machine (SVM), K-Nearest Neighbor (KNN), and Naïve Bayes Classifier (NBC) in analyzing user review sentiment on crypto wallet applications available on the Google Play Store . The dataset used includes 1,500 reviews from three popular crypto wallet apps, namely Trust Wallet, MetaMask , and Bitget Wallet. Each review is grouped into three sentiment categories: positive, negative, and neutral. The results of the analysis show that Bitget Wallet got the most positive reviews, while MetaMask and Trust Wallet tended to get less favorable reviews. The study evaluated the performance of each algorithm based on several performance metrics, including accuracy, precision, recall, and F1 score. The results obtained show that the SVM algorithm provides the best performance with an accuracy of 90.5%, followed by KNN with an accuracy of 85.3%, and NBC with an accuracy of 82.1%. In addition, SVM also excels in other metrics, such as precision and recall, showing that SVM is more effective at classifying user review sentiment than the other two algorithms. Based on these results, it can be concluded that SVM is the most suitable algorithm for sentiment analysis in crypto wallet applications, which can provide deeper insights into user perceptions of these applications. This research makes an important contribution to the application of machine learning algorithms for sentiment analysis in the financial technology sector, especially for crypto wallet applications.

Keywords : Comparison , Crypto Wallet, Machine Learning, Sentiment Analysis, Text Mining

INTRODUCTION

In recent years, cryptocurrency wallet applications have become increasingly vital tools in financial transactions, especially with the growing adoption of cryptocurrency. In Indonesia, the use of cryptocurrencies for transactions began in 2013, although government attention only emerged in 2017 when the value of Bitcoin rose by up to 1,300% and Ethereum by up to 13,000%. By August 2018, Indodax , the largest cryptocurrency exchange in Indonesia, recorded 1,350,000 customers, with daily transaction values reaching tens to hundreds of billions of rupiah .

At that time, Indonesia traded only 21 types of cryptocurrencies, significantly fewer than international exchanges such as Binance, with 144 coins, or HitBTC , trading 324 coins. This highlighted the need for applications providing up-to-date and comprehensive cryptocurrency information . Currently, over 11,000 types of cryptocurrencies are traded worldwide. However, in Indonesia, only 229 crypto assets have been officially registered by the Commodity Futures Trading Regulatory Agency (Bappebti). This data reflects the global market capitalization according to information from CoinMarketCap . The significant increase in cryptocurrency adoption has also been accompanied by the demand for reliable and secure cryptocurrency wallet applications. Such wallets are not only used to store digital assets but also enable users to send, receive, and interact with various blockchain services. Users require applications that offer an intuitive interface, stable performance, and high-level security. Additionally, cryptocurrency wallets serve as a bridge for users to access the broader blockchain ecosystem, including decentralized applications (dApps) and NFT (Non-Fungible Token) marketplaces .

Applications like Trust Wallet, MetaMask , and Bitget Wallet provide solutions for users to store, send, and receive cryptocurrencies easily. The popularity of these applications is evident from the numerous user reviews on the Google Play Store, reflecting their experiences and opinions . Trust Wallet is Binance's official crypto wallet, enabling users to securely send, receive, and store Bitcoin and various other cryptocurrencies on mobile devices. Bitget Wallet, on the other hand, is the largest non-custodial Web3-based wallet, supporting over 250,000 cryptocurrencies and 20,000 dApps across more than 100 mainnets . Meanwhile, MetaMask is a free crypto wallet available on the web and mobile devices, allowing users to store, exchange cryptocurrencies, and interact with the Ethereum blockchain ecosystem and decentralized applications (dApps). While each application has a different focus, all three simplify crypto asset management for users.

However, manually understanding user opinions from thousands of reviews is a complex and time-consuming task. Sentiment analysis using machine learning algorithms offers a solution by efficiently categorizing user reviews into positive, negative, or neutral sentiments. Algorithms such as Support Vector Machine (SVM), K-Nearest Neighbor (KNN), and Naïve Bayes Classifier (NBC) have been widely used for this task. Each of these algorithms has its unique characteristics and strengths that can be adapted to specific analytical needs. Sentiment analysis, a branch of Natural Language Processing (NLP), aims to identify and categorize opinions or emotions expressed in text. In this context, sentiment analysis helps not only to understand user satisfaction levels but also to gain deeper insights into their perceptions and needs regarding crypto wallet applications. By analyzing sentiment patterns, application developers can make more informed decisions to improve their product quality.

Although these three algorithms have distinct advantages, they employ different approaches to solving classification problems. Support Vector Machine is a supervised machine learning classification method introduced by Vladimir Vapnik . This algorithm predicts classes based on patterns formed during the training process, working by constructing a hyperplane that separates positive and negative opinion classes. The optimal hyperplane is the one with the largest margin to the nearest training data points from each class, as a larger margin typically indicates better generalization. The margin is defined as the distance from a vector point of a specific class to the hyperplane .

In contrast, the K-Nearest Neighbor algorithm is a supervised learning technique where the classification for a new instance is based on the majority category of its closest neighbors. KNN offers advantages such as very fast training processes, simplicity, and ease of implementation. Additionally, KNN is robust against noisy training data and effective for large datasets. These strengths make KNN an attractive choice for many classification cases, although its performance can degrade in high-dimensional datasets without proper feature reduction .

Meanwhile, Naïve Bayes is a probabilistic classification algorithm that is simple yet often delivers high performance and accuracy . The classification process in Naïve Bayes involves calculating prior probabilities by summing detailed cases based on data attributes. Then, posterior probabilities are calculated to determine the class of new cases during data processing. Although the independence assumption among features in NBC is fully rarely met, the algorithm remains reliable and is frequently used in text and sentiment analysis .

This research focuses on evaluating the performance of Support Vector Machine (SVM), K-Nearest Neighbor (KNN), and Naïve Bayes Classifier (NBC) algorithms based on accuracy, precision, recall, and F1-score metrics . The evaluation was conducted on three top cryptocurrency wallet applications selected based on high download counts and favorable ratings on the Google Play Store. Choosing applications with significant user base ensures that the analysis encompasses representative and relevant data. This approach aims to provide deeper insights into the effectiveness of algorithms in assessing the quality and user satisfaction of these applications.

The purpose of this study is to compare the accuracy, precision, recall, and F1-score of the SVM, KNN, and NBC algorithms in sentiment analysis of crypto wallet application reviews. The novelty of this research lies in its focus on popular cryptocurrency wallet applications and comprehensive evaluation using actual datasets from Google Play Store reviews. This research is expected to provide practical insights for application developers in selecting the most suitable algorithm for sentiment analysis.

RESEARCH METHODS

This research uses Google Colab as the main tool to collect data through scraping techniques. The data is taken from the reviews of three crypto wallet apps, namely Trust Wallet, MetaMask , and Bitget Wallet, which are available on the Google Play Store. The total dataset collected consists of 1,500 reviews, with each app having 500 reviews.

The data collection process will be carried out in December 2024 using the Python library. The dataset was then classified into three sentiment categories: positive, negative, and neutral. The sentiment labeling process is carried out by using review scores (ratings) taken directly from the app review dataset on the Google Playstore . The review score ranges from 1 to 5, which is generally used to represent user satisfaction with the app. In this study, sentiment labeling is carried out using the following categories:

TABLE 1.
CATEGORIES OF SENTIMENT EATERS

Categories	***Information***
Positive	Review Score 4 and 5
Negative	Review Score 1 and 2
Neutral	Review Score 3

The data was then classified into three categories: positive, negative, and neutral opinions. All Indonesian reviews have been processed using data preprocessing techniques, such as Cleaning , and case folding tokenization, stemming, and removal of non-essential words (stop words).

Research procedure

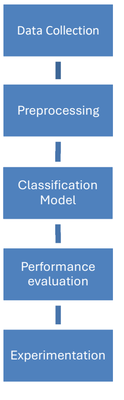

FIGURE 1. RESEARCH FLOWCHART

The research process is carried out through several stages as follows:

Data Collection

Datasets are downloaded from reviews of digital wallet apps such as Trust Wallet, MetaMask , and Bitget Wallet. The data is selected based on the highest number of downloads to ensure significant user representation.

Data Preprocessing : The collected data is then processed using the following techniques:

1) **Cleansing** : In this step, the text should be cleaned of unwanted characters, such as punctuation, numbers, and other special symbols that are not important for analysis.

2) **Case Folding** : To avoid duplication of the same word with uppercase and lowercase, this process converts all letters in the text into lowercase.
3) **Tokenization** : Breaking text into units of words.
4) **Stemming** : Converting a word to a basic form.
5) **Stopwords removal** : Common words that do not provide analytical information are discarded through this process, such as. "running", "running around" and "running" will be reduced to "running".

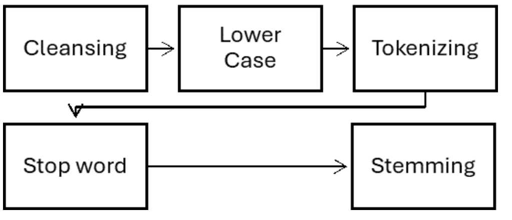

FIGURE 2PREPROCESSING FLOW

Model Classification :
1) **SVM (Support Vector Machine):** Used with the RBF kernel to capture non-linear relationships.
2) **KNN (K-Nearest Neighbor):** The K parameter is tested in the range of 3-10 to get the best results.
3) **NBC (Naïve Bayes Classifier):** Uses a probabilistic approach to classification.

Performance Evaluation : Evaluations are conducted based on metrics:
1) **Accuracy** : The percentage of correct predictions.
2) **Precision** : Accuracy of classification against positive classes.
3) **Recall** : The ability of the algorithm to find all positive class samples.
4) **F1-Score** : Harmonious average between precision and recall.

Experiment

Each algorithm is tested on the same dataset to ensure a fair comparison. The training and testing process is carried out by the k-fold cross-validation method to reduce the bias of the results. The key parameters of each algorithm are optimized using grid search to achieve the best performance. The results of the experiment were then evaluated based on metrics such as accuracy, precision, recall, and F1-score to ensure an objective interpretation.

RESULTS AND DISCUSSION

Data Preprocessing

Presents some of the results of the data pre-processing process on Trust Wallet, Metamask , and Bitget Wallet applications which include the cleanup stage, namely URL removal, mentions, hashtags, next characters, punctuation, additional spaces, emoticons, comments, and duplicates. Next, the case folding, stopword removal, tokenization, and stemming stages are carried out with special settings, which include the use of Indonesian dictionary files and slang words.

TABLE 2. RESULTS OF PREPROCESSING TRUST WALLET APPLICATION

Input	output
Very good Lots coin crypto which can be selected NPT etc. anyway complete oh yeah Excellent easy used can understood which lay 👍👍👍👌❤	good crypto coins choose complete points steady easy to understand layman
can top up balance, but can't transfer and send tokens let alone send to the bank. then the existing balance suddenly disappears and reappears when you open the application 😭🙄	can top up balance but can't transfer, send tokens, let alone send to a bank, then the balance suddenly disappears and appears when you open the application

TABLE 3. METAMASK APPLICATION PREPROCESSING RESULTS

Input	*output*
fast response,i Like metamask this 👍👍👍	fast response I Like metamask
worst wallet which Once I use , most bugs , nominal assets often No read , import phrase to new device always failed even though the phrase already yes , my crypto lost in wallet because of metamask ca n't import phrase, really very disappointing 🤬👎	worst wallet Once I use many nominal assets often read import phrase device always fail even though the phrase already exists that's right my crypto lost wallet because metamask import phrase really very disappointed

TABLE 4. BITGET WALLET APP PREPROCESSING RESULTS

Input	output
Can buy coins but can not sell apk rubbish not clear profit only fifty five , want Send to other platforms failed Mouth with reason for insufficient gas fee, increase the gas fee cheap , the gas fee is only 160 USD . I don't care where to go Enough make 4x transactions Again what is this apk This	Can buy coins but can not sell rubbish not clear profit only five hundred send other platform failed Mulu Alas Insufficiency Mendinkalo cheap price 160usd which one is only a box Enough for transaction Again
biitget wallet indeed good,n	biitget wallet indeed Good

But Darling There is A little constraint for I as user.every Send asset must there is a memo. no all element There is memo . want follow projects in wallet only deposit is difficult, because there is no memo. that 's all Thanks	But Darling A little constraint for I as use each Send asset must memo no all memo element join wallet project only deposit difficult because of the memo so many Thanks

Sentiment Results

Here are the results of Figure 4's sentiment labeling of 500 Bitget Wallet app reviews, where 149 comments were found to be negative, 32 were neutral and 319 were positive.

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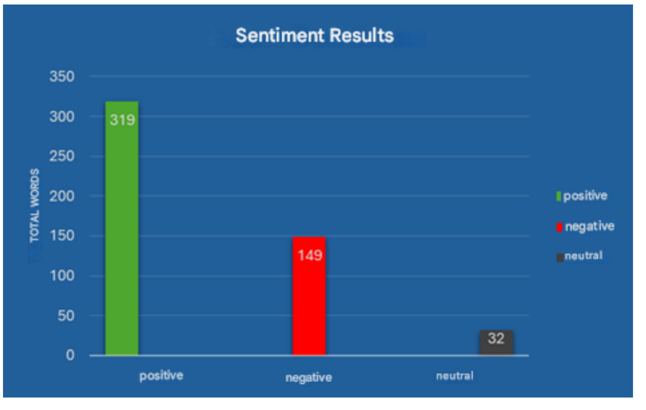

FIGURE 3. VISUAL GRAPH OF BITGET WALLET APP SENTIMENT

The following are the results of Figure 4's sentiment labeling against 500 Metamask app reviews, Generating 357 comments with negative emotion levels, 48 comments with neutral emotion levels and 95 comments with positive emotion levels.

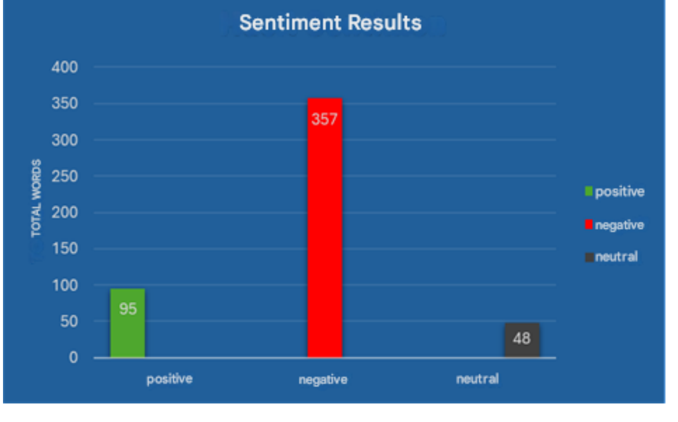

FIGURE 4. METAMASK APP SENTIMENT VISUAL GRAPH

The following are the results of the sentiment labeling Figure 5 against 500 Metamask app reviews, Generating 290 comments with negative emotion levels, 51 comments with neutral emotion levels and 159 comments with positive emotion levels

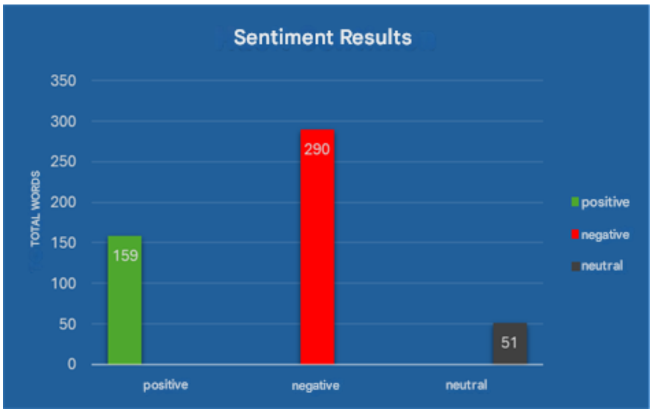

Figure 5. Trust Wallet App Sentiment Visual Graph

Performance Results

The performance results in Table 4 show the support vector machine (SVM), K-Nearest Neighbor (KNN), and Naïve Bayes Classifier (NBC) algorithms in analyzing the sentiment of crypto wallet applications on the accuracy, recall, and F1-score of each algorithm tested on the dataset.

TABLE 5.COMPARISON OF ALGORITHM PERFORMANCE METRICS

Algorithm	*Accuracy (%)*	*Precision (%)*	*Recall (%)*	*F1-Score (%)*
SVM	90.5	88.7	89.2	89.0
KNN	85.3	82.5	84.1	83.2
NBC	82.1	80.0	81.3	80.6

Evaluation of the experiment

Figure 6 shows the performance evaluation results of several machine learning algorithms, including Support Vector Machine (SVM), Naive Bayes Classifier (NBC), and K-Nearest Neighbors (KNN) with various K values (number of neighbors). This evaluation includes six key metrics: training time (fit_time), evaluation time (score_time), test accuracy (test_accuracy), precision (test_precision), recall (test_recall), and F1 value (test_f1). SVM shows the best performance with high accuracy, precision, recall, and F1, which is around 96.67% each. Meanwhile, KNN with K=4 or K=5 produces performance that is almost equivalent to SVM. On the other hand, NBC has the lowest performance with an accuracy of 94.67%, but excels in training and evaluation time efficiency.

SVM stands out as a highly reliable algorithm with a balance between accuracy and other metrics, although its training time is slightly longer compared to KNN or NBC. KNN, especially with K=4 and K=5 values, also provides highly competitive results with an accuracy of up to 96.67%, but its performance tends to decline at larger K. NBC, despite its lower accuracy, is still worth considering for scenarios that requires high computational efficiency due to its very fast training and evaluation times.

	fit_time	score_time	test_accuracy	test_precision	test_recall	test_f1	algorithm
0	0.002944	0.012411	0.966667	0.969495	0.966667	0.966515	SVM
1	0.001550	0.018326	0.953333	0.955606	0.953333	0.953047	KNN (K=3)
2	0.001467	0.015693	0.966667	0.967273	0.966667	0.966650	KNN (K=4)
3	0.001333	0.014733	0.966667	0.967273	0.966667	0.966650	KNN (K=5)
4	0.001741	0.015697	0.960000	0.961077	0.960000	0.959933	KNN (K=6)
5	0.001335	0.014078	0.960000	0.961077	0.960000	0.959933	KNN (K=7)
6	0.001373	0.014292	0.953333	0.955017	0.953333	0.953250	KNN (K=8)
7	0.001260	0.017551	0.960000	0.963434	0.960000	0.959832	KNN (K=9)
8	0.001334	0.016109	0.960000	0.961212	0.960000	0.959967	KNN (K=10)
9	0.002472	0.014672	0.946667	0.948822	0.946667	0.946533	NBC

Figure 6. Overall evaluation of the experiment

Result Analysis

Support Vector Machine (SVM) SVM algorithms produce the best performance with the highest accuracy, which is 90.5%. This is due to the ability of SVM to separate data using an optimal hyperplane with maximum margins. High precision and recall demonstrate SVM's reliability in classifying positive and negative sentiment.

K-Nearest Neighbor (KNN) KNN shows a competitive performance with an accuracy of 85.3%. However, its performance is slightly lower than that of SVM due to KNN's sensitivity to data distribution and parameter selection K. The use of k-fold cross-validation helps minimize bias in results.

NBC's Naïve Bayes Classifier (NBC) performs well on datasets with a balanced class distribution. However, the 82.1% accuracy shows its limitations in handling data with complex relationships between features. Nonetheless, NBC's probabilistic approach still provides consistent results.

CONCLUSION

The results of the experiment show that the SVM algorithm is the best choice for sentiment analysis of crypto wallet applications, based on accuracy, precision, recall, and F1-score. The advantage of SVM lies in its ability to capture non-linear patterns, which results in more consistent performance compared to KNN and NBC. The KNN algorithm is better suited to applications where simplicity and training speed are priorities, but its performance can be degraded on high-dimensional datasets. On the other hand, NBC is more effective for initial analysis or on datasets with balanced class distributions, although it is less optimal in handling complex data. This research also opens up opportunities for further exploration in improving classification accuracy, such as through the use of hybrid algorithms or more in-depth data processing. In addition, expanding the research object to include various other applications or platforms can also be done. The follow-up research plan will focus on developing more efficient models and utilizing more diverse data to produce more accurate and comprehensive sentiment analysis.

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