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SENTIMENT ANALYSIS TO IMPROVE THE QUALITY OF PUBLIC TRANSPORTATION SERVICES "SUROBOYO BUS"

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Abstract

Public transportation is a very important tool in improving and developing the economy of an area. The role of public transportation is very important in supporting mobility or community movement. Increased community mobility at the same time can have an impact on congestion. Congestion still occurs a lot and is a fairly complex problem in big cities, one of which is in Surabaya. The government is trying to reduce congestion in Surabaya by creating a safe and comfortable service innovation in the world of transportation, one of which is the Suroboyo Bus. This research is descriptive quantitative research. the method used is the random forest method. The tool used for data analysis is Rapidminer 10.3.1. The results of data analysis found several things that need to be improved by Suroboyo Bus to improve the quality of its services, namely those related to the words bus stops, routes, hours, applications, buses, etc. These words need to be considered to improve the quality of Suroboyo Bus services.

Keywords*:* Public Transportation, Quality Services, Sentiment Analysis

INTRODUCTION

Public Services according to Law Number 25 of 2009 Article 1 Paragraph 1 is "an activity or series of activities to fulfill service needs in accordance with statutory regulations for every citizen and resident for goods, services, and or administrative services provided by public service providers". Public services consist of several sectors such as education, finance, health, and transportation. Public services in the transportation sector are in the form of public transportation or public transportation which is an important component needed by the community to facilitate their mobility.

The role of public transportation is very important in supporting mobility or community movement. The function of one's personal place utility determines the need for passenger transportation (Putri Watung et al., 2020). Transportation is becoming more important as a result of increased community mobility. Increased community mobility at the same time can have an impact on congestion. Congestion still occurs a lot and is a fairly complex problem in big cities, one of which is in Surabaya. Congestion that occurs in Surabaya can be seen in Figure 1.

Figure 1
Congestion in Surabaya
Source: Instagram @sits_dishubsurabaya

One of the factors cause congestion is the increase in the number of private motorized vehicles each year, this can be seen in Table 1 below.

Table 1
Data on the Number of Motor Vehicles in Surabaya City 2018-2020 and 2024

Year	Passenger Car	Motorcycle	Bus
2018	469,276	2,342,887	3.620
2019	495,596	2,517,449	3.888
2020	503,066	2,599,332	3.965
2024	564.570	2.948.103	3.694

Source: jatim.bps.go.id dan rc.korlantas.polri.go.id

Based on the data shown in table 1.1 above, it is known that the number of motorized vehicles in each year has increased dramatically while the number of buses has decreased in the last year. This increase in the number of private vehicles is one of the causes of congestion in Surabaya. Public awareness is still lacking to use public transportation rather than their private vehicles, this occurs due to a lack of public knowledge about public transportation available in the city of Surabaya (Haqie et al., 2020).

The government is trying to reduce congestion in Surabaya by creating a safe and comfortable service innovation in the world of transportation, one of which is Suroboyo Bus (Kibthiah et al., 2023). Suroboyo Bus also has an online application “Gobis” which stands for Golek Bis. This application was launched to facilitate passengers in obtaining information such as tracking or tracking the position of Suroboyo Bus and bottle exchange places.

Suroboyo Bus has a social media platform, Instagram, as a place to express comments, suggestions, and criticisms on Suroboyo Bus services and as a means of connecting Suroboyo Bus operational information to the public. Users provide positive or negative reviews on Suroboyo Bus' social media. The reviews given by users are based on their experience in using the Suroboyo Bus.

The reviews given on social media illustrate the public's perception of the Suroboyo Bus service. Based on Figure 1.2, which shows some of the negative reviews of Suroboyo Bus users, this is thought to be a problem that occurs on Suroboyo Bus. These reviews or comments are submitted by users to provide criticism and suggestions regarding Suroboyo Bus services. These negative reviews can be minimized by improving the quality of service provided to Suroboyo Bus users so that they get an excellent experience and service.

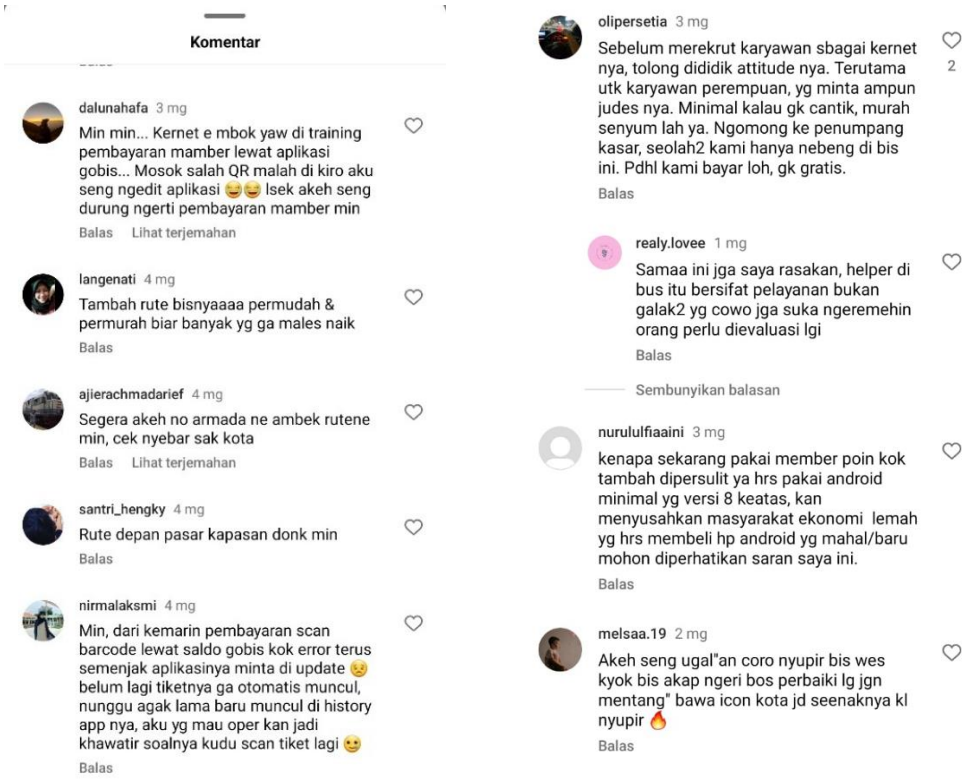

Figure 2
User Reviews on Suroboyo Bus Instagram
Source: https://www.instagram.com/p/C4zFYY3vpnj/

Research related to sentiment analysis has been conducted by (Riskania & Thalib, 2020) which explains passenger opinions via Twitter regarding the quality of public transportation services. Research conducted by (Arista, 2023) which shows that the use of naïve Bayes algorithm and Support Vector Machines is successfully implemented in the sentiment analysis of Gobis application reviews. These two studies show that the sentiment analysis carried out can be known as positive and negative sentiment classes that can be used as a basis to find out how public sentiment towards public transportation, can also be used to improve service quality.

Further research will be conducted using different methods to conduct sentiment analysis, namely by using the Random Forest method as a tool to determine user or public sentiment towards public transportation which can then be used to improve the quality of Suroboyo Bus public transportation services.

REVIEW OF LITERATURE

Public Services

According to (Suryantoro & Kusdyana, 2020) public services include all types of services provided by the government, both by the government itself and by non-governmental institutions, to meet the needs of the community and fulfill predetermined conditions with all facilities and equipment through certain work procedures. According to Law Number 25 of 2009 Article 1 Paragraph 1, "Public service is an activity or series of activities to fulfill service needs in accordance with statutory regulations for every citizen and resident for goods, services, and/or administrative services provided by public service providers"

Service Quality

Service quality is an ongoing intellectual evaluation of a company's service customers. Public service quality is defined as the activity of organizing public services carried out by government agencies to meet the wants and needs of the community for services, products, goods, or administrative services. Good public service quality is expected to increase public trust in government officials (Rusfiadi et al., 2021).

According to Parasuraman in (Kotler & Armstrong, 2021) service quality has five (5) main dimensions, namely tangibles, reliability, responsiveness, assurance, and empathy. Physical evidence that can be seen and felt, such as the neat appearance of employees, the attractiveness of the company's physical facilities, and all equipment and materials used. Reliability is the capacity to provide accurate service without making mistakes and delivering service information according to the scheduled time. The ability and willingness of staff to help customers, as well as their capacity to respond promptly to customer requests, provide information about service times, and deliver services promptly, are all aspects of responsiveness. Assurance, or more specifically, the behavior of staff members, has the power to increase a customer's or consumer's sense of security and trust in the business. Empathy, is the ability of a business to understand clients' problems and act in their best interest, in addition to providing individualized attention and a comfortable working environment.

Social Media

Social media is a means of exchanging information and has a strong influence in all sectors of public life. Social media is a tool used to interact between humans online or in networks without space and time restrictions (Maulana et al., 2020).

According to Van Dijk mentioned in (Ginting et al., 2024) social media is a platform that emphasizes the presence of people who help other users engage in activities and collaboration. As a result, social media can be understood as an online media (facilitator) that improves user relationships and social ties.

Instagram

Instagram is an image-based social media that offers users access to various types of photos and videos available online (Feroza & Misnawati, 2020). Instagram was created by Kevin Systrom and Mike and launched in 2010 (Armayani et al., 2021). One example of the use of Instagram social media is to improve business transformation through wide and rapid data dissemination (Nurriqli & Risanta, 2021).

Sentiment Analysis

Sentiment analysis is an analytical technique used to determine the audience's feelings or perspectives on events that occur. using automated purposes to process text data to gain insight and feelings that exist in comments (Permatasari et al., 2021). Sentiment analysis is a technique or process used to evaluate and identify feelings, emotions, or sentiments contained in text such as documents, articles, reviews, or social media messages. The results of sentiment analysis can be positive, negative, or neutral sentiments (Manullang et al., 2023).

Text Mining

Text mining is an analytical technique or method used to explore and extract important information from several texts or documents. It uses algorithms and statistical approaches to process, organize, and present text data in a form that can be understood and analyzed by humans or computer systems. Text preparation or preprocessing techniques (case folding, normalization, tokenizing, filtering, and stemming), sentiment analysis (sentiment class labeling, and classification), and feature selection are some of the approaches in text mining (Rukmana & Handayani, 2023).

Random Forest

The Random Forest method was used to classify the review results. This method was chosen for several reasons. One of them is that Random Forest combines predictions from many decision trees in one model, reducing the possibility of overfitting, which is if the model is too dependent on one dataset so that the results will be very different if used on another dataset (Jihad et al., 2021).

Confusion Matrix

The Confusion Matrix table known as the fusion matrix is used to evaluate the performance of classification systems or prediction models (Valdis Tjahjadi & Santoso, 2023). The Confusion Matrix is used to find the value of several points needed at the evaluation stage such as accuracy, precision, and recall (Jihad et al., 2021). This table compares the prediction results with the actual values to see how well the model performs in the test dataset.

Table 2
Confusion Matrix

Predicted values	Actual values	
	Positive (1)	Negative (0)
Positive (1)	True Positive (TP)	False Positive (FP)
Negative (0)	False Negative (FN)	True Negative (TN)

Visualisation Data

Data visualization is carried out after all stages from preprocessing to evaluation have been carried out. Word cloud visualization helps provide a visual overview of the most talked about topics and facilitates the analysis of emerging sentiments (Tupari et al., 2023). The size of text images in Word Cloud correlates with data frequency, so the more words used, the larger the displayed word size (Pradana, 2020).

Framework of Thought

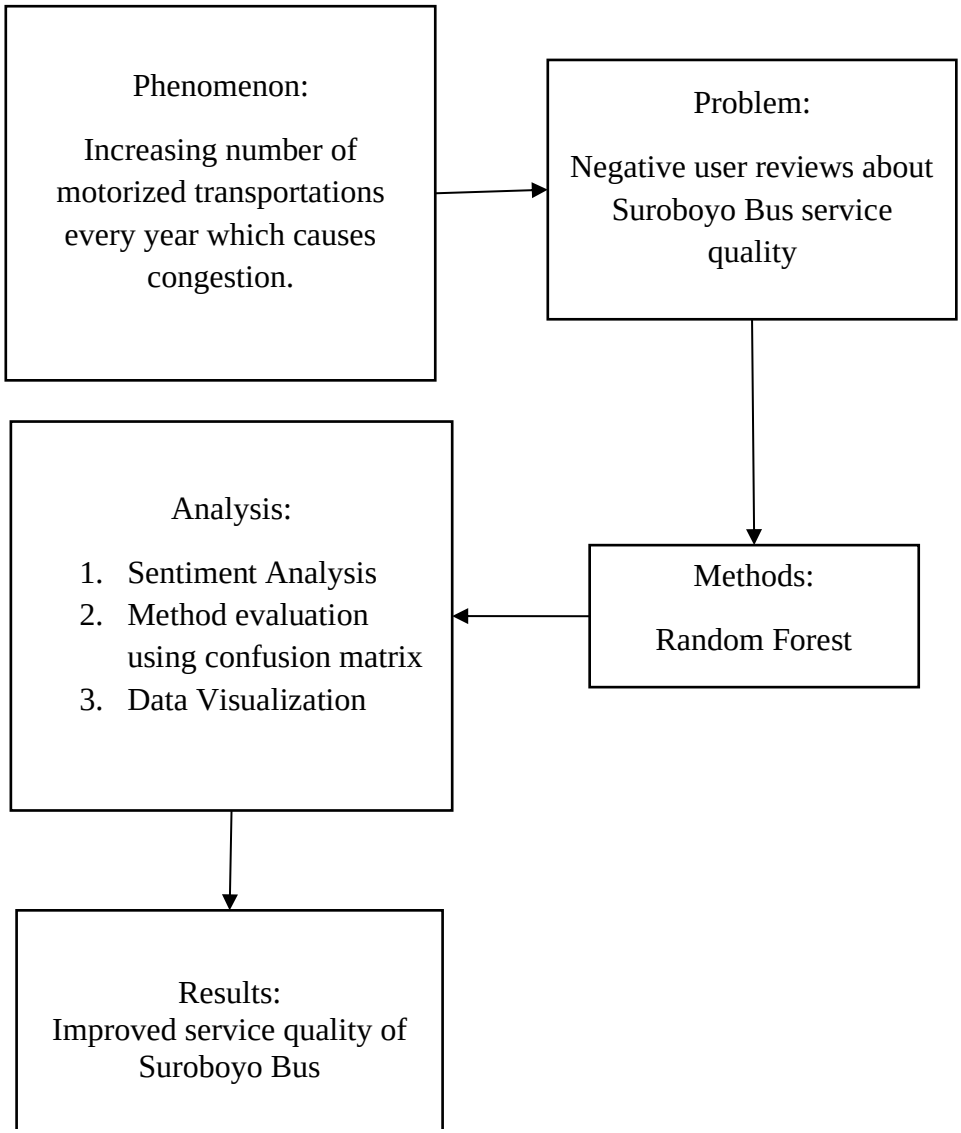

Figure 3
Conceptual Framework

RESEARCH METHOD

In this study, the approach used is a descriptive quantitative approach. The data used in this study is supported by some data obtained to produce a valid conclusion. Review data is obtained through crawling data using the Google Chrome extension, IG Comments Export. Reviews on Suroboyo Bus' social media pages will be downloaded and then all data will be extracted into CSV format that will be used to process data.

The data analysis technique that will be used in this study is Random Forest. The analysis tool used to perform Random Forest is using Rapidminer 10.3.1 software. Rapidminer software is independent software that can be integrated with various programming languages and used for data mining and data analysis engines (Prasetyo et al., 2021). Here are some of the data analysis techniques used in this study:

1. PreProcessing data

Data preprocessing or initial data processing is a process carried out to change the form of initial data collected into a more structured form of data. The stages in data preprocessing are as follows:

a. Cleansing

In the cleaning process, the data will be cleaned of noise or diversity. This includes removing punctuation, URLs, mentions, hashtags, and unneeded characters or symbols.

b. Case folding

In the case folding or transformation stage, all text in the data will be converted to lowercase. The goal is to avoid irrelevant differences when comparing words or in language modeling.

c. Tokenize

This stage divides the text in the data into word units. Tokenize is the process of dividing text data into smaller parts called tokens.

d. Filtering/stopword

At this stopword stage, the process carried out is to remove words that are not important or general. Stopwords are words that commonly appear in a language and do not have significant descriptive meaning. Filtering is also done to filter words with a certain number of characters.

e. Stemming

The stemming stage is the process of converting words into basic words or forms, without affixes. Stemming aims to reduce variations in word forms to become more general forms.

2. Labelling

The results of the preprocessing stage will then be labeled using the labeling method manually which is then done automatically using rapidminer software by carrying out several stages. Labeling is done manually based on the dictionary of positive and negative sentiments in the form of .csv obtained through the GitHub website.

3. Random Forest Classification

This classification stage data is collected or classified according to the labels that have been carried out in the previous stage, namely the labeling stage. This classification stage is carried out using K-Fold Cross Validation which consists of two stages. First, the data is divided into K-partitions of equal size. The second stage makes the partition i corresponding to the i-i-iteration the test data, and the rest becomes the training data.

4. Confusion Matrix Evaluation

Models are evaluated using test data to measure model accuracy and performance. Confusion matrix is a matrix table used to evaluate the performance of classification models (Syafira & Harianto, 2020):

a. The accuracy evaluation matrix describes how accurate the results of the classification model have been made. The accuracy evaluation matrix can be calculated using the following formula:

$$Accuracy = \frac{TP+TNR+TN}{TP+FP+TNR+FNR+TN+FN}$$

b. The precision evaluation matrix is a comparison of the number of true with the total number of predicted results. This precision evaluation matrix can be calculated by the following formula:

$$Precision = \frac{Correct\ amount}{Predicted\ amount} = \frac{TP}{TP+FP}$$

c. The recall evaluation matrix is a comparison of the correct number with the total number of actual results. The recall evaluation matrix can be calculated using the following formula:

$$Recall = \frac{Correct\ amount}{Actual\ amount} = \frac{TP}{TP+FN}$$

d. Data Visualization

The data visualization stage uses a word cloud which is used to find out what words often appear in Suroboyo Bus social media reviews. This word that often appears will be larger than other words.

RESULTS AND DISCUSSION

Research Object Description

Suroboyo Bus is a public transportation in the city of Surabaya and is owned by the Surabaya city government. This public transportation was launched by Mrs. Tri Rismaharini on April 07, 2018. Suroboyo Bus is one of the efforts of the Surabaya City government to reduce the problems that occur in the city of Surabaya, namely congestion. The Suroboyo Bus fleet has completed and modern facilities that make traveling comfortable and safe. Each fleet of buses is guided by an assistant or so-called helper who works as a ticket conductor and assists passengers.

Suroboyo Bus can accommodate 67 passengers and has three types of seats. The three-seat colors serve specific purposes. Pink seats are intended for female passengers, while older and disabled passengers have red seats. The orange seats are meant for general passengers. The bus has modern features such as automatic sensor doors, indoor air conditioning, twelve CCTV cameras (inside and out), emergency alarms, glass breakers, fire extinguishers, and chargers. Surabaya Mayor Regulation (Perwali) Number 56 of 2021 sets the price of the Suroboyo Bus service. The fare for the general public is Rp5,000, and the fare for students is half that, at Rp2,500.

Research Result Description

The data that has been collected in this study is primary data obtained from the results of crawling review data on the Suroboyo Bus Instagram social media page. This data crawling process is carried out using the help of Google Chrome Extension, namely IG Comments Export. Reviews on the Suroboyo Bus social media page will be downloaded and then all data will be extracted into .csv format which will then be used to process the data.

The initial processing results are text preprocessing and Random Forest modeling which are used to determine the problems felt by Suroboyo Bus users. One form of the results of this processing is word cloud. Worldcloud is used to find out what words often appear in

Suroboyo Bus's Instagram social media reviews. The resulting word cloud will be able to be used as a basis for improving the quality of Suroboyo Bus services.

Data Processing

1. **Preprocessing Text**

   a. Cleansing

Remove Username

Input	Output
@zarawij bantu jawab ya kak. ini banyak kok bis nya, mungkin jeda 10-15 menit sudah ada bis datang lagi. biasanya ini bis koridor r1	*bantu jawab ya kak. ini banyak kok bis nya, mungkin jeda 10-15 menit sudah ada bis datang lagi. biasanya ini bis koridor r1*

Source: data processing result

Remove Symbols

Input	Output
@zarawij bantu jawab ya kak. ini banyak kok bis nya, mungkin jeda 10-15 menit sudah ada bis datang lagi. biasanya ini bis koridor r1	*bantu jawab ya kak ini banyak kok bis nya mungkin jeda 10 15 menit sudah ada bis datang lagi biasanya ini bis koridor r1*

Source: data processing result

Remove Number

Input	Output
@zarawij bantu jawab ya kak. ini banyak kok bis nya, mungkin jeda 10-15 menit sudah ada bis datang lagi. biasanya ini bis koridor r1	*bantu jawab ya kak ini banyak kok bis nya mungkin jeda menit sudah ada bis datang lagi biasanya ini bis koridor r*

Source: data processing result

Case Folding

Input	***Output***
Nunggu di halte dukuh menanggal sejam lebih gak bisa naik full semua Armada e kurang kayak e	*nunggu di halte dukuh menanggal sejam lebih gak bisa naik full semua armada e kurang kayak e*

Source: data processing result

Remove Whitespace

Input	**Output**

Sama barusan naik scan gk bisa, tp kmrin naik bisa	*Sama barusan naik scan gk bisa tp kmrin naik bisa*

Source: data processing result

Table 3
Filter Example

No.	Comment Text
1.	?
2.	?
3.	?
4.	?
5.	?
6.	?
7.	?
8.	?
9.	?
10	?
11.	?
12.	?
13.	?
14.	?
15.	?
16.	?
17.	?
18.	?
19.	?
20.	?
21.	?
22.	?
23.	?
24.	?
25.	?
26.	?
27.	?
28.	?
29.	?
30.	?
31.	?
32.	?
33.	?
34.	?

b. Tokenize

Input	Output

kenapa sekarang pakai member poin kok tambah dipersulit ya hrs pakai android minimal yg versi keatas kan menyusahkan masyarakat ekonomi lemah yg hrs membeli hp android yg mahal baru mohon diperhatikan saran saya ini	*'kenapa', 'sekarang', 'pakai', 'member', 'poin', 'kok', 'tambah', 'dipersulit', 'ya', 'hrs', 'pakai', 'android', 'minimal', 'yg', 'versi', 'keatas', 'kan' 'menyusahkan', 'masyarakat', 'ekonomi', 'lemah', 'yg', 'hrs', 'membeli', 'hp', 'android', 'yg', 'mahal', 'baru', 'mohon', 'diperhatikan', 'saran', 'saya', 'ini'*

Source: data processing result

Based on Table, it can be seen that after carrying out the tokenize process, a total of 3,485 tokens were obtained from the initial data of 1,584 review data.

c. Filtering

At the filtering stage this is done using stopwords, filtering reduces the dimension of words in a corpus or collection of text. This can be done by using stopword operators (discarding words that are not important). At this stage the operator used is the stopword operator (dictionary) using a dictionary from the GitHub website with a total of 785 Indonesian stopwords.

Removal Stopwords

Input	Output
'kenapa', 'sekarang', 'pakai', 'member', 'poin', 'kok', 'tambah', 'dipersulit', 'ya', 'harus', 'pakai', 'android', 'minimal', 'yang', 'versi', 'keatas', 'kan' 'menyusahkan', 'masyarakat', 'ekonomi', 'lemah', 'yang', 'harus', 'membeli', 'hp', 'android', 'yang', 'mahal', 'baru', 'mohon', 'diperhatikan', 'saran', 'saya', 'ini'	*'member', 'poin', 'tambah', 'dipersulit', 'android', 'minimal', 'versi', 'keatas', 'menyusahkan', 'masyarakat', 'ekonomi', 'lemah', 'membeli', 'hp', 'android', 'mahal', 'mohon', 'diperhatikan', 'saran'*

Source: data processing result

Filter token by length

No.	Word	In document
1.	ya	216
2.	yg	119
3.	ga	66
4.	fd	37
5.	dr	36

6.	e	34
7.	tp	30
8.	dm	24
9.	sb	24
10.	gk	21
11.	g	19
12.	ta	19
13.	jd	18
14.	bu	17
15.	kl	16
16.	r	15
17.	n	14
18.	d	13
19.	rp	13
20.	sy	12

Source: data processing result

d. Stemming

Input	Output
"Selama", "tidak", "mengganggu", "penumpang" "lainnya", "boleh saja"	*"Selama", "tidak", "ganggu" penumpang "lain", "boleh", "saja"*

Source: data processing result

2. Labelling

Labeling in this research is done manually by assigning sentiment class labels according to personal opinion with the help of a sentiment dictionary obtained from the GitHub website. The dictionary dataset from the GitHub site consists of two sentiment classes, namely positive and negative with the number of words in the negative sentiment dictionary totaling 3,610 while the number of positive dictionaries totals 6,610 words. Reviews on Suroboyo Bus Instagram social media have more positive sentiment class values than negative sentiment analysis, this is because neutral sentiment analysis is included in the positive class. The number of positive sentiment classes is 760 data while the negative class is 308 sentiment data.

Comment Text	Sentiment
Sama ini juga saya rasakan helper di bus itu bersifat pelayanan bukan galak yang cowo juga suka ngremehin orang perlu dievaluasi lagi	Negative
tenang aja tarifnya sudah sangat murah Cumc	*Positive*

5k pelajar 2,5k Bahkan lebih murah ketimbang angkot yang kadang narik 10k

Source: data processing result

3. Classification

The validation partitioning method simply divides the dataset randomly into two separate data sets, namely training data and test data, with a ratio of 70:30. The iterative validation partitioning method divides the dataset into many subsets of training and test data. In cross-validation, the data subset is the number of iterations used to validate or test one subset of data with the remaining subset as training data.

The k-fold cross-validation method was used in this study to train a model with a subset of training data and was validated by a validation subset (test data) as much as k, k used in this study was k = 10. The accuracy values obtained from this test are 71.27% and 0.00%. The recall of each prediction is also low at 100% and 0%.

4. Evaluation

This evaluation is used to represent the predictions and actual conditions of the data generated by the algorithm used. Based on Figure 4.1, it can be seen that in the Suroboyo Bus user review data, 759 data are correctly predicted to be in the positive sentiment class and 306 positive data that are wrongly predicted to be in the positive sentiment class because in actual circumstances the data is in the negative class.

5. Visualisasi data

Figure 4
Evaluation Confusion Matrix

accuracy: 71.27% +/- 0.00% (micro average: 71.27%)

	true Positif	true Negatif
pred. Positif	759	306
pred. Negatif	0	0
class recall	100.00%	0.00%

Source: data processing result

Wordcloud data visualization helps provide a visual overview of the most talked about topics and facilitates the analysis of emerging sentiment. The word cloud below shows 26 words that are often discussed by the public and Suroboyo Bus users

Figure 5
Wordcloud
Source: data processing result

Discussion of Service Quality

Reliability

Reliability is the ability to provide timely and consistent services, such as on-time bus arrival, accurate route estimation, and efficient staff. Suroboyo Bus service quality is influenced by several factors, including time management, response, assurance, empathy, and technology. Time management includes providing accurate information to customers, timely service, and ensuring service quality.

Response

This includes providing information to clients about service delivery times, providing timely assistance, offering assistance to clients, and demonstrating readiness to accommodate client needs. Included in response is the ease of accessing information and the ease of making payments using QRIS. Suroboyo Bus users can pay only by using non-cash, namely with e-money and QRIS. Payment is free for LANSIA who are 60 years old by showing their KTP.

Assurance or Guarantee

Assurance is the ability to maintain trust and confidence in service, as demonstrated by the CCTV system on Suroboyo Bus. Service quality is also influenced by transportation costs, in accordance with Mayor's Regulation No. 56 of 2021, which outlines public transport tariffs and education and training.

Empathy

Empathy is the individualized attention given to each customer, ensuring their needs are met and their requirements are met. Service quality is also influenced by visual product availability, professional staff, and efficient communication.

Tangibles

Technology, such as Gobis, can also improve service quality, as it enables faster and more efficient service delivery. Overall, service quality in Suroboyo Bus is influenced by various factors, including time management, response, assurance, empathy, technology, and physical evidence.

CONCLUSION

This study was conducted using the Random Forest algorithm to classify the sentiment analysis of Suroboyo Bus on the Instagram account. The sentiment analysis data from Instagram social media is then divided into two categories: positive sentiment and negative sentiment. The results show that Suroboyo Bus has many positive and negative feelings on its Instagram social media account. Our classification results with the Random Forest algorithm for public sentiment analysis on the market showed an accuracy value of 71.27%.

Visualization of wordcloud data included in the order of twenty-six words that are widely discussed by the public and Suroboyo Bus users are bus stop, route, get off, application, clock, ios, bus, terminal, feeder, oper, QRIS, fleet. These words are some of the things that Suroboyo Bus needs to improve its service quality. Improving the quality of Suroboyo Bus is expected to further increase customer satisfaction so that more people are interested in using Suroboyo Bus for their mobility needs.

Further research is needed with a larger amount of data and using datasets on other social media so that the results obtained better describe the opinions of the public or users of Suroboyo Bus services. At the labeling stage, it is done with the help of linguistic experts or using machine learning assistance to get more accurate results.

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