

SENTIMENT ANALYSIS DESIGN OF PRODUCT REVIEWS IN THE MARKETPLACE USING NAIVE BAYES CLASSIFIER METHOD; A CASE STUDY IN TOKOPEDIA

Widnyani, N.M.,^{1*}, Aristayudha, A.A.N.B², Sugianta, I.K.A³

Program Studi Bisnis Digital, Fakultas Bisnis Sosial Teknologi dan Humaniora Universitas Bali Internasional

ARTICLE INFO

ABSTRACT

Keywords:

Naive Bayes Classifier, sentiment analysis,

This study aimed at analyzing sentiment of product purchase reviews on the Tokopedia marketplace using the Naive Bayes Classifier (NBC) algorithm. It was a qualitative study which was done in Bali International University. Two types of data contained in this study namely, primary data and secondary data. Product review became the primary data and information from reference books and journals became the secondary data. It was a qualitative study which focused on sentiment analysis of product reviews in Tokopedia by using Naive Bayes Classifier (NBC) method. The NBC method is commonly used as a probabilistic learning method to find the highest probability value in classifying the data and getting the appropriate category. There were some stages to be followed such as problem analysis and data collection, library research of sentiment analysis by using NBC method, sentiment analysis process by using NBC method, NBC method testing, and conclusion. The data were collected from research study, observation, and questionnaires. From the three data collection models, data analysis was carried out with the following models such as data reduction, data display, and conclusion. The result of this study showed that the result of respondents answered, or sentiment matched to the sentiment classification system designed.

E-mail:
nimadewidnyani90@gmail.com

Copyright © 2022 Economic Journal. All rights reserved is
Licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License \(CC BY-NC 4.0\)](https://creativecommons.org/licenses/by-nc/4.0/)

1. INTRODUCTION

In the industry 4.0 era, public sentiment or opinion is increasingly widespread and freely expressed in various media. Sentiment can be a big potential for companies that want to know their public feedback from their trademark. Brand has been considered as one of the most valuable intangible assets and brand management is an important priority for the management of a company or organization (Keller and Lehmann, 2006).

The number of active users in online communication has a very large amount of data and create a big data that can be used for product sentiment analysis. The existence of big data technology, which is a large collection of data, complicated, and unstructured

quantities become one of the major resources that can be processed to obtain more accurate sentiment results.

In purchasing goods by using marketplace, buyers can provide reviews after receiving the purchased goods. Product purchase reviews consist of stars and the contents of review comments that contain feedback, appreciation or criticism and input on the product that has been purchased. The more stars it has means the better reputation of the product. Product purchase reviews have a significant influence on buying interest from other buyers. Reviews of product purchases can be used by sellers to obtain information of the products and services to create customer satisfaction. Customer satisfaction is an important thing and one of the company's goal (Muktafin, Kusri and Luthfi, 2020).

Sentiment analysis design of product reviews in the marketplace using naive bayes classifier method; a case study in tokopedia- Widnyani, N.M, Aristayudha, A.A.N.B, Sugianta, I.K.A

Review analysis can be seen 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 comment to be able to understand the overall intent of the review. It is possible to analyze reviews manually by looking at one by one, but if you have many reviews it will be faster to use a sentiment analysis system (Samith, 2019).

In this study, sentiment analysis was carried out on product reviews in the Tokopedia marketplace. The product review section consists of the content of comments in free text format and a rating of the number of stars from 1 to 5. The content of review comments is used to find out information which become the focus of buyers in providing reviews. The content of review comments can contain more than one rating of product attributes, while each review has only one rating of the number of stars, so the number of stars cannot represent every product feature that is rated by buyers. Information submitted by buyers is referred to product features such as price, quality, material, color, shape, size, taste, quantity, as well as to services provided such as packaging, delivery time, and seller responses.

In this study, sentiment analysis on product reviews in the Tokopedia marketplace uses classification with the Naive Bayes Classifier (NBC) algorithm. The main feature of the Naive Bayes algorithm is a very strong (naive) assumption of the independence of each condition or event. The advantage of Naive Bayes is that the data classification process can be adapted to each nature and needs (Gunawan, Pratiwi and Pratama, 2018).

The purpose of this study is to analyze the sentiment of product purchase reviews on the Tokopedia marketplace using the Naive Bayes Classifier (NBC) algorithm. NBC can be used to classify opinions into positive and negative opinions. The results of the classification will represent the number of negative and positive opinions on the online marketplace. This analysis is needed to find out the sentiment from customer reviews of the products offered on the Tokopedia Marketplace. This research is able to provide an overview of what features are the focus of positive and negative reviews on a product, so that sellers can make improvements and improve the quality of products and services appropriately.

2. METHOD

1. Sentiment Analysis

Sentiment analysis is a technique or method used to identify how a sentiment is expressed using text and how that sentiment can be categorized as positive sentiment or negative sentiment. The results of the prototype system achieve high precision (75-95% depending on the data) in finding sentiments on web pages and news articles (Nasukawa and Yi, 2003).

Sentiment analysis or mining opinion refers to a broad field of natural language processing, computational linguistics and mining text which aims to analyze opinions, sentiments, evaluations, attitudes, judgments and emotions of a person whether a speaker or writer in accordance with the topic, product, service, organization, individual, or certain activities (Rusdian and Rosiyadi, 2019). The purpose of sentiment analysis is to determine the behavior or opinion of a writer based on a particular topic. Behavior can indicate reasons, opinions or judgments, and tendency conditions. Sentiment analysis can also be in the form of feelings of anger, joy or sadness.

Sentiment analysis is very useful in comments analysis to be proceed into something more meaningful like a rating form. By using sentiment analysis, we can try to apply comments to the rating system. Sentiment Analysis is a combination of data mining and text mining, or a method used to process various opinions given by consumers or experts through various media of the product service or an agency. Sentiment analysis is a method used to understand, extract opinion data, and automatically process textual data to get a sentiment contained in the opinion. Sentiment analysis consists of 3 types of opinions, namely positive opinions, negative opinions and neutral opinions. That is why company or related agencies can find out the community's response to a service or product, through community or experts' feedback.

Sentiment focus to the particular topic because statements on a topic may have different meanings with the same statement on different subjects, therefore in some studies, especially in product reviews, work is preceded by determining the elements of a product being discussed before starting the process sentiment analysis. There are various types of sentiment analysis that can be used to identify user responses. Starting from looking at the polarity of opinions in identifying user intentions. Some types of sentiment analysis such as:

Sentiment analysis design of product reviews in the marketplace using naive bayes classifier method; a case study in tokopedia- Widnyani, N.M, Aristayudha, A.A.N.B, Sugianta, I.K.A

- a) Fine-Grained Sentiment Analysis
Sentiment analysis is one of the most common types. The focus is on the level of polarity of opinion. This type of sentiment analysis will classify responses or opinions into several categories such as very positive, somewhat positive, neutral, slightly negative, and negative.
- b) Intent Sentiment Analysis
This type of sentiment analysis aims to identify and explore the motivation behind a user's message to see if it includes a complaint, suggestion, opinion, question or appreciation for a product or service.
- c) Aspect - Based Sentiment Analysis
In this type of sentiment analysis is focused on more specific elements of a product or service. This aspect-based sentiment analysis also makes it possible to relate specific sentiments to different aspects of a product or service.
The data collection in sentiment analysis can be divided into three steps, namely classification, evaluation, and visualization of results.
 - a) Classification
First, the machine needs to classify the data that is categorized as an opinion of a text. There are three classifications in the sentiment analysis method that can be done, namely:
 - Machine learning: the features in it can identify sentiment (someone's point of view) in a text. Machine learning methods are now increasingly popular because they can be considered as a representative.
 - Lexicon-based: using various words that are rated with a polarity score to find out the response of the public/users/consumers about a topic. The advantage is it does not require training data, but the disadvantage is many words are not included in the lexicon.
 - Mixed: combines machine learning and lexicon methods. Although it is rarely used, this method usually gives more promising results.
 - b) Evaluation
After the data is classified, the next method of sentiment analysis is to use evaluation metrics such as precision, recall, f-score, and accuracy. This process also involves measures of averages such as macro, micro, and weighted F1 scores to handle data that can identify into two or more classifications. The metrics used are based on the balance of data classifications. In general, the schema is as follows: data set review, pre-processing, tokenizer, stop words deletion, transformation, classification, and evaluation.
 - c) Data Visualization
The next step in the sentiment analysis method is data visualization. Data visualization is done by using charts according to the needs of the company or anyone who uses this data. Most people usually use familiar techniques, such as graphs, histograms, or matrices. However, the results of sentiment analysis can vary widely. Existing data may appear with other domains involved. For this reason, data visualization techniques in the form of word cloud, interactive maps, and sparkline styles are also quite effective for displaying analysis results.

1. Text Processing

Text preprocessing refers to the process in changing the unstructured data form into structured data according to needs, for further mining processes (sentiment analysis, summarization, document clustering, etc.). An existing text must be separated which can be done on several different levels. Changing the shape can be in the form of breaking paragraphs into sentences and finally sentences into words and can eliminate numbers, symbols or other characters. The preprocessing stages are based on: case folding, tokenizing/parsing, filtering, stemming (Triawati, 2009).

a) Case Folding

Case folding is changing all letter characters in a sentence to lowercase and eliminating invalid characters, such as numbers, punctuation marks, and Uniform Resources Locator (URL) (Indraloka and Santosa, 2017). An example of the word "COMPUTER" would be "computer".

b) Tokenizing

Tokenizing is cutting a sentence based on each word that composes it (Indraloka and Santosa, 2017). For example: the sentence "I love language" is cut into the word: I | Love | language.

c. Filtering

Filtering is the stage of taking important words from the tokenizing results. The filtering process can use a stop list algorithm (removing unimportant words) or wordlist (saving important words). Stop lists/stop words are non-descriptive words that can be discarded in the bag-of-words approach. Examples of stop words are "which", "and", "at", "from" and others (Triawati, 2009).

d. Stemming

Stemming is mapping and parsing various forms of words process into basic word forms (Putra and Made Sudarma, 2016). The stemming process for each language is different with others. For example, the stemming process of English and Indonesian is certainly different because of different word formation and word change (Agusta, 2009).

2. Naive Bayes Classifier

Classification refers to the determination of objects into a category or class. Determination of objects will use several models (Han, 2006). The Naïve Bayes Classifier is a simplification of the Bayes theorem, the inventor of this method is a British scientist named Thomas Bayes. The algorithm in the Naïve Bayes method is based on a classification technique (Kusumadewi, 2009). The Naive Bayes method with the principle of Bayes' theorem has attributes that are interconnected with each other. The approach used by the Bayes theorem is to calculate the probability of an event under certain conditions (Lukito and Chrismanto, 2015). The basis of the Bayes theorem is stated in the equation (Bustami, 2014).

3. Marketplaces

Marketplace is an electronic product marketing platform that confront sellers and buyers to transact with each other (Apriadi and Saputra, 2017). Sellers can sell their product online by registration on the marketplaces. All processes have been borne by the marketplace team. Sellers only need to improve services and promotions. The possibility of selling product will increase because it is the place of sellers and buyers confront together.

Another source states that E-marketplace is an inter-organizational information system where buyers and sellers in the market communicate information about prices, products and are able to complete transactions through electronic communication channels. An e-marketplace represents a social structure, the concept of a market economy, and the use of technology. E-marketplaces can provide opportunities to do business and carry out transactions through electronic channels, usually on internet-based platforms (Marco and Ningrum, 2017).

Marketplace is a new business model that is run in line with the rapid development of information technology infrastructure. This marketplace is designed to minimize complex business processes so as to create efficiency and effectiveness. With the Marketplace, everyone can carry out buying and selling activities easily, quickly and cheaply because there are no limits on space, distance and time. Conventionally, the market has several roles including facilitating transactions and providing infrastructure. Indicators of Marketplace activity are determined by the ability of the Marketplace to facilitate transactions, confront sellers and buyers, and provide infrastructure. While the efficiency indicators relate to the conciseness of time and costs provided by the marketplace. If the conventional market requires a physical market as a meeting place for sellers and buyers, the marketplace requires virtual facilities as a place for transactions to occur. Marketplace is an online business transaction platform that provides an electric method to facilitate commercial transactions such as selling goods, services, or information online between buyers and sellers.

Marketplace is an application or website that provides online buying and selling facilities from various sources. The owner of the website or app doesn't own any product and only sell other people's products to others as well as facilitates it. The product is not only promoted but also connected between the seller and buyers. It is widely used in Indonesia because it can facilitate online shopping. It also provides a variety of product choices and the consumers can choose based on their needs. Marketplace can be divided into 3 (three) types, namely:

a. Vertical Marketplace

It is a type of Marketplace that sells products from various sources but only consist of one type of product. For example, a marketplace that only sells car products from used to new cars.

b. Horizontal Marketplace

This type of Marketplace also sells various type of product, but the products are related to each other like a Marketplace that sells various brands of computer with its accessories and spare parts.

c. Global Marketplace

Sentiment analysis design of product reviews in the marketplace using naive bayes classifier method; a case study in tokopedia- Widnyani, N.M, Aristayudha, A.A.N.B, Sugianta, I.K.A

Global marketplace is a type of marketplace that sells various types of product and may not related to one another. The examples of global marketplace are Tokopedia, Olx and Bukalapak.

The approach used in this study is a qualitative approach, namely an approach in the form of collecting data, processing, and analyzing and interpreting it qualitatively. This qualitative approach is often termed qualitative research, which is one of the methods to obtain the truth which is classified as scientific research that is built on a theory that develops from controlled research on an empirical basis.

The types of data contained in this study are primary and secondary data. Primary data is the main data used in this study in the form of a product review dataset in the Tokopedia Marketplace application. While secondary data is data obtained from reference books and journals that can be directly used for this research. The data analysis technique used in this research is adjusting to the data collection methods used, namely literature study, observation, and questionnaires. From the three data collection models, data analysis was carried out with the following model:

a. Data Reduction

Reducing data means summarizing, choosing the main things, focusing on the things that are important. The reduced data will provide a clearer picture, and make it easier for the author to carry out further data collection, and look for it when needed.

b. Data Display

The next step after the data is reduced is data display or presenting data. The presentation of the data is done by grouping the data according to their respective sub-chapters. Data that has been obtained from observations, questionnaires, or from library sources.

c. Conclusion Drawing/Verification

The last step in qualitative data analysis is drawing conclusions and verification. The initial conclusions put forward are still tentative, and will change if no strong evidence is found to support it at the next stage of data collection.

3 RESULT AND DISCUSSION

Pada hasil penelitian ini, penulis memberikan penjelasan hasil dari penelitian yang dilakukan pada metodologi penelitian. Hasil tersebut akan dijelaskan secara terperinci dan jelas sebagai pembuktian dalam penelitian dan juga kedepannya dapat dikembangkan sehingga dapat berguna bagi masyarakat khususnya pengguna Marketplace. Dalam penelitian ini terdapat beberapa tahapan diantaranya tahap identifikasi data masukan, pra-proses/preprocessing, klasifikasi dengan metode naïve naves classifier (NBC) dan keluaran.

This part showed the finding of this study. It was explained in some stages such as data input, data processing, data classification by using *Naïve Bayes*, sentiment classification system design, and result evaluation. Data input refers to the initial data that was used before pre-processing and classification. It was taken from product reviews on the Tokopedia marketplace, as in the example:

“PRODUKNYA BAGUS DAN MANTAP SEKALI, SESUAI DENGAN HARAPAN 😊😊”

Next was data processing. There were some stages in data processing. The first one was case folding. In this process the letters in the document were converted to lowercase. Only letters 'a' to 'z' were accepted and deleted the others because it was considered as delimiters. The case folding was as follows:

Table 1. Case Folding Process

Data		Case Folding Result	
Input	<i>PRODUKNYA BAGUS DAN MANTAP SEKALI, SESUAI DENGAN HARAPAN 😊😊</i>	Output	produknya bagus dan mantap sekali sesuai dengan harapan

Furthermore, tokenizing became the second process in data processing. It was done by cutting the input string based on each word that composed it and distinguishing certain characters that can be used as word separators or not. It was done after the input of data test passed the case folding stage.

Table 2. Tokenizing Process

Case Folding Result		Case Folding Result	
Input	produknya bagus dan mantap sekali sesuai dengan harapan	Output	produk nya bagus dan mantap sekali sesuai dengan harapan

The next process was filtering or stop-word removal. In this process, every word contained in stop-word list especially for those that were contained in Indonesian particular stop-word list like “pun, dan, juga, sekali, atau, maupun, dengan, and others. The result of filtering process as follows:

Table 3. Filtering Process

Tokenizing Result		Filtering Result	
Input	produknya bagus dan mantap sekali sesuai dengan harapan	Output	produknya bagus mantap sesuai harapan

Furthermore, Indonesian stemming process was done. Indonesian affixes were deleted in this process. Indonesian stemming process in this study used the Nazief & Adriani Algorithm. The result of this process was as follows:

Table 4. Stemming Process

Tokenizing Result		Stemming Result	
Input	produknya bagus mantap sesuai harapan	Output	produk bagus mantap sesuai harapan

After data processing was finished, data classification by using *Naïve Bayes* was done. The result obtained in preprocessing text were as follows:

| produk | bagus | mantap | sesuai | harapan |

Sentiment analysis design of product reviews in the marketplace using naive bayes classifier method; a case study in tokopedia- Widnyani, N.M, Aristayudha, A.A.N.B, Sugianta, I.K.A

Then, data classification using Naïve Bayes algorithm was applied. First, data training was created for each sentence which contained positive and negative sentiment. The result was presented as follows:

Table 5. Training Data Classification Process

No	First Word	Second Word	Third Word	Comments
1	Produk	Kualitas	Tinggi	Positif
2	Tidak	Sesuai	Asli	Negatif
3	Produk	Sesuai	Harapan	Positif
4	Kualitas	Produk	Bagus	Positif
5	Kualitas	Produk	Mantap	Positif
6	Tidak	Sesuai	Harapan	Negatif
7	Kualitas	Produk	Kurang	Negatif
8	Layanan	Produk	Bagus	Positif
9	Layanan	Kurang	Bagus	Negatif
10	Layanan	Baik	Cepat	Positif

The next step was counting the data test by looking at the result of preprocessing text such as: | produk | bagus | mantap | sesuai | harapan | by using Naïve Bayes algorithm based on data training as follows:

P (positive)	= 6/10 = 0.60
P (negative)	= 4/10 = 0.40
P (produk positive)	= 5 / 6 = 0.83
P (bagus positive)	= 2 / 6 = 0.33
P (mantap positive)	= 1 / 6 = 0.17
P (sesuai positive)	= 1 / 6 = 0.17
P (harapan positive)	= 1 / 6 = 0.17
P (produk negative)	= 1 / 4 = 0.25
P (bagus negative)	= 1 / 4 = 0.25
P (mantap negative)	= 0 / 4 = 0
P (sesuai negative)	= 2 / 4 = 0.50
P (harapan negative)	= 1 / 4 = 0.25

Positive Sentiment:

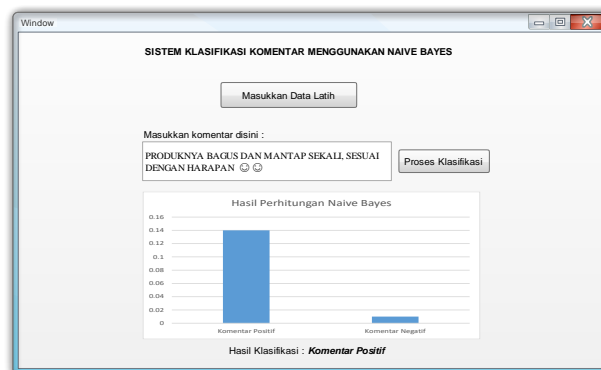
$P(\text{positive}) \times P(\text{produk} \mid \text{positive}) \times P(\text{bagus} \mid \text{positive}) \times P(\text{mantap} \mid \text{positive}) \times P(\text{sesuai} \mid \text{positive}) \times P(\text{harapan} \mid \text{positive}) : 1.67 \times 0.83 \times 0.33 \times 0.67 \times 0.67 \times 0.67 = 0.14$

Negative Sentiment:

$P(\text{negative}) \times P(\text{produk} \mid \text{negative}) \times P(\text{bagus} \mid \text{negative}) \times P(\text{mantap} \mid \text{negative}) \times P(\text{sesuai} \mid \text{negative}) \times P(\text{harapan} \mid \text{negative}) : 0.40 \times 0.25 \times 0.25 \times 0 \times 0.50 \times 0.25 = 0$

Based on the result of Naïve Bayes algorithm, positive sentiments were higher than negative sentiments. So, it could be classified as positive sentiment.

After counting the data test by using Naïve Bayes algorithm, a sentiment classification system design could be made as follows:



Picture 1. Sentiment Classification System Design

The sentiment classification system design above shows that there are several features can be used, namely entering training data, entering comments, the classification process, and the results of classification calculations using Naive Bayes. This system can classify sentiment as positive or negative based on the previously training data entered and calculate it by using Naive Bayes classification.

4. CONCLUSION

Sentiment analysis design of product reviews in the marketplace using Naive Bayes Classifier method; A case study in Tokopedia produced a sentiment calculation classification design which consisted of several process including the identification of data input, pre-processing, classification by using Naive Bayes Classifier method and output data. It showed that the result of respondents answered, or sentiment matched the sentiment classification system designed. It was expected that the result of this study makes it easier for users to classify sentiment in the Tokopedia application. Then, future researchers are expected to improve this study's design by implementing it into a mobile-based application program that is integrated with the Tokopedia application

REFERENCES

- [1]. Agusta, L. (2009). Perbandingan Algoritma Stemming Porter dengan Algoritma Nazief & Adriani Untuk Stemming Dokumen Teks Bahasa Indonesia', in *Konferensi Nasional Sistem dan Informatika*.
- [2]. Apriadi, D. and Saputra, A. Y. (2017). E-Commerce Berbasis Marketplace Dalam Upaya Mempersingkat Distribusi Penjualan Hasil Pertanian', *JURNAL RESTI*, 1(2).
- [3]. Bustami (2014). Penerapan Algoritma Naive Bayes Untuk Mengklasifikasi Data Nasabah Asuransi. *Jurnal Informatika*, 8(1). 884–898. Retrieved from: doi 10.26555/jifo.v8i1.a2086.
- [4]. Gunawan, B., Pratiwi, H. S. and Pratama, E. E. (2018). Sistem Analisis Sentimen pada Ulasan Produk Menggunakan Metode Naive Bayes. *Jurnal Edukasi dan Penelitian Informatika (JEPIN)*, 4(2). Retrieved from: doi 10.26418/jp.v4i2.27526.
- [5]. Han, J. K. (2006) *Concept and Techniques*. Morgan Kaufmann.

Sentiment analysis design of product reviews in the marketplace using naive bayes classifier method; a case study in tokopedia- Widnyani, N.M, Aristayudha, A.A.N.B, Sugianta, I.K.A

- [6]. Indraloka, D. S. & Santosa, B. (2017). Penerapan Text Mining untuk Melakukan Clustering Data Tweet Shopee Indonesia. *Jurnal Sains dan Seni ITS*, 6(2). 6–11. Retrieved from: doi 10.12962/j23373520.v6i2.24419.
- [7]. Keller, K. L. & Lehmann, D. R. (2006). Brands and branding: Research findings and future priorities. *Marketing Science*, 25(6), 740–759. Retrieved from: doi10.1287/mksc.1050.0153.
- [8]. Kusumadewi, S. (2009). Klasifikasi Status Gizi Menggunakan Naive Bayesian Classification', *CommIT (Communication and Information Technology) Journal*, 3(1). Retrieved from: doi 10.21512/commit.v3i1.506.
- [9]. Lukito, Y. & Chrismanto, A. R. (2015). Perbandingan Metode-Metode Klasifikasi untuk Indoor Positioning System. *Jurnal Teknik Informatika dan Sistem Informasi*, 1(2). 123–131. Retrieved from: doi 10.28932/jutisi.v1i2.373.
- [10]. Marco, R. & Ningrum, B. T. P. (2017). Analisis Sistem Informasi E-Marketplace Pada Usaha Kecil Menengah (UKM) Kerajinan Bambu Dusun Brajan. *Jurnal Ilmiah DASI*, 18(2).
- [11]. Muktafin, E. H., Kusrini, K. & Luthfi, E. T. (2020). Analisis Sentimen pada Ulasan Pembelian Produk di Marketplace Shopee Menggunakan Pendekatan Natural Language Processing. *Jurnal Eksplora Informatika*, 10(1). 32–42. Retrieved from: doi 10.30864/eksplora.v10i1.390.
- [12]. Nasukawa, T., & Yi, J. (2003). Sentiment Analysis: Capturing Favorability Using Natural Language Processing. *Proceedings of the 2nd International Conference on Knowledge Capture*.
- [13]. Nazief, B., & dan Adriani, M. ConfixStripping: Approach to Stemming Algorithm for Bahasa Indonesia, Faculty of Computer Science University of Indonesia.
- [14]. Putra, G. W. & Sudarma, M. S. K. (2016). Klasifikasi Teks Bahasa Bali dengan Metode Supervised Learning Naive Bayes Classifier. *Teknologi Elektro*, 15(2).
- [15]. Rusdaman, D. & Rosiyadi, D. (2019). Analisa Sentimen Terhadap Tokoh Publik Menggunakan Metode Naive Bayes Classifier Dan Support Vector Machine. *Journal of Computer Engineering System and Science*, 4(2), 230–235.
- [16]. Samith, K. S. (2019). Sentiment Analysis System for Product Review: A Survey. *ICETET*, 1(1).
- [17]. Triawati, C. (2009). *Metode Pembobotan Statistical Concept Based untuk Klastering dan Kategorisasi Dokumen Berbahasa Indonesia*. Bandung: Institut Teknologi Telkom Bandung.