E-ISSN: 2963-3699
P-ISSN: 2964-0121
Homepage: Homepage: https://return.publikasikupublisher.com

IMPLEMENTATION OF CONTENT BASED FILTERING METHOD IN RESTAURANT MENU ORDERING RECOMMENDATION SYSTEM

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ABSTRACT

Sales is one of the key factors in business. Failure to increase sales can lead to the collapse and bankruptcy of a business. Recommendation System is a system that is capable of predicting products desired by users. Personalized product recommendations effectively boost sales in a business. In this context, the recommendation system is a strategic tool to optimize the user experience and encourage further purchases. This research applies the content-based filtering method, which utilizes an item similarity-based recommendation approach. Three variables are used to determine the recommended product order: similarity value, sales quantity, and rating. Based on the trial, it was found that 77.3% of users were interested in the recommended products, while the remaining 22.7% preferred to purchase other products. Therefore, it can be concluded that the recommendation system can influence users to purchase the recommended products, thus impacting sales.

Keywords: *Content-based Filtering; Increasing Sales; Recommendation Systems*

INTRODUCTION

The government has now declared the COVID-19 pandemic as an endemic. However, the impacts and effects of the pandemic itself are still evident, one of which is the new habit of ordering food online, which previously people were skeptical about (Alteri et al., 2021; Gündeş et al., 2023; Suhaeri, 2020). This new habit formed because most people felt fear and concern about being exposed to the coronavirus during the pandemic. Additionally, the governmentimposed restrictions and urged people to reduce activities outside the home. This situation prompted people to conduct transactions online, including ordering food. Despite the situation and the government declaring it endemic, this habit still continues because people have become accustomed to it. Apart from being accustomed, the level of trust among people who were previously skeptical has also increased. Due to this new habit, alternative sales channels have emerged through online platforms. This situation can potentially drive digital economic transformation because business actors must adapt and find new strategies to follow the new habits of the community, namely by shifting to the use of digital ecosystems (Kusuma et al., 2024; Rosita, 2020).

The transformation from marketing and sales through conventional media to online media is one way restaurants compete in the digital era. The existence of food ordering applications can help increase sales at restaurants or restaurants (Lepkowska-White et al., 2019; Wulandari, 2022). This is evidenced by increased restaurant sales after using food ordering applications (Yudhistira & Sushandoyo, 2018). This increase in food orders will also impact increasing revenue from restaurants.

Fusia is a restaurant that already has several branches throughout Indonesia, namely Banjarmasin, Samarinda, and Surabaya. Previously, Fusia was a restaurant focused on offline sales, and it collaborated with third parties such as GoFood in its sales. But in July 2022, Fusia tried to put more effort into developing a business strategy and developing sales channels, namely by creating an application for food orders. The features in this application are not only food ordering features but also various other features such as reservations, vouchers, promos, and menu information. Unfortunately, there are shortcomings in this application, which is not yet able to offer food products that can adjust to users' wishes. From the launch of the application until now, sales through the application have increased very low. This is certainly not in accordance with the expectations of the designed business strategy. Making intelligent information systems using

recommendation systems is intended to provide product recommendations that are suitable and in accordance with user wishes.

The recommendation system has a significant role in assisting buyers in making purchasing decisions. This feature has a strong influence on users buying certain products. In this case, the recommendation system is an important tool to influence users to have an interest and desire to buy a product. In addition, the recommendation feature is one form of product promotion owned to increase sales (Hariri & Rochim, 2022). With the recommendation system, customers are facilitated in making purchasing decisions. There are three types of filtering methods in the recommendation system, namely *content-based filtering*, *collaborative filtering*, and hybrid filtering, which combine the two previous methods.

Based on data records from Statista, Amazon increased sales by 37% from 2019 to 2020, from an initial $280 billion to $386 billion (Krysik, 2021). Much of this success is due to Amazon's integration of recommendations into almost every step of the buying process. Currently, the recommendation system has played an important role in various online business industries (Maristha et al., 2021).

So, with the aim of increasing sales, a study was made to examine the impact of the recommendation system on sales by implementing a recommendation system on the Fusia application, titled "Fusia Restaurant Application Development Using the Recommendation System."

RESEARCH METHOD

This study's object is Fusia Restaurant. The data that will be used includes transaction data, product data, rating data, user data, and branch data from Fusia. Researchers used observation, interview, and questionnaire methods to observe and collect data related to research. The recommendation system method used in this study is *content-based filtering*. Here is a flowchart of the recommendation system process using *content-based filtering*, as seen in Figure 1.

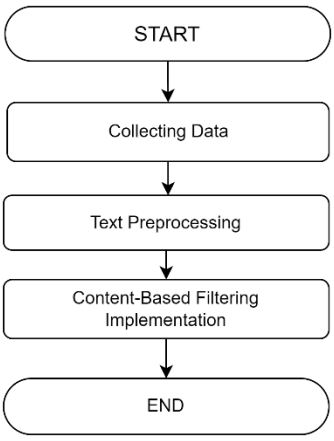

Figure 1 Diagram Alur Pemrosesan Sistem Rekomendasi

A. Collecting Data

In this process, the data needed to be used is called and declared. These data are such as product data, ratings, product data that will be searched for similarity and product name data that has been converted into data series types. Series itself is a one-dimensional data structure similar to an array or list, but has labels associated with each data element. Each element in the Series is called a "value" or "item", while each label is called an "index". Below is the table structure of the data before it is managed.

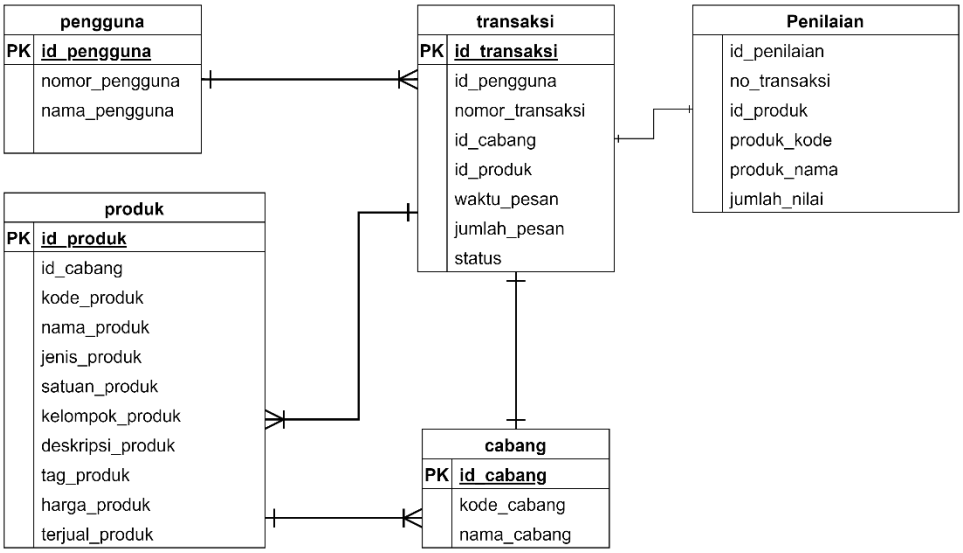

Figure 2 Entity-Relationship Diagram

B. Text Preprocessing

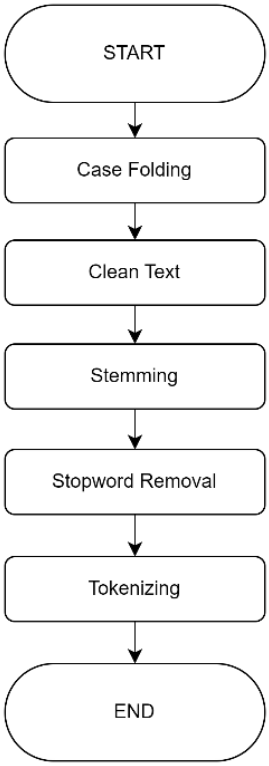

Figure 3 Diagram Alur Text Preprocessing

The flowchart in figure 2 is the stages of *Text Preprocessing*. In this *Text Preprocessing* process , text data processing is carried out in the product description before the data is processed. This process is done to select text data to be more structured and facilitate analysis and calculation (Rakhmawati et al., 2020). There are several stages in processing text in product descriptions. Here is an explanation of each process.

1) *Case Folding: Case folding* is one of the stages in text processing. Case folding is the process of changing and converting letters from documents to lowercase. For example, the

sentence without quotation marks "Nasi timbel is so delicious!" will be changed to "nasi timbel delicious!".

2) Clean Text: Clean text is the process of cleaning text data from unwanted characters. This process aims to obtain maximum text data by leaving only important words or terms.
3) Stemming: Stemming is the process of simplifying words that were originally affix words and then changed to root words (Ula et al., 2021).
4) Stopword Removal: Stopword removal is the process of removing terms or words in the text of a document such as hyphens, conjunctions, pronouns or other types of words that do not have an important role in describing a document.
5) Tokenizing: Tokenizing is the process of separating each sentence in a document into words or terms so as to get the final result in the form of a series of tokens.

C. Content-Based Filtering Implementation

After the text data of products is processed, the next step is content-based filtering. The process of content-based filtering itself consists of several stages depicted in Figure 4.

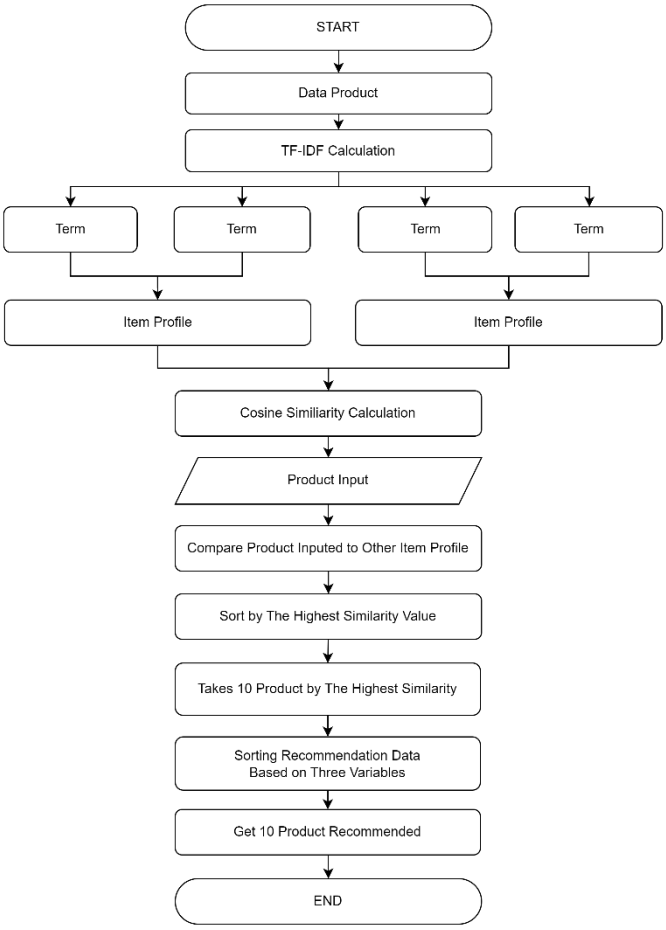

Figure 4 Content-Based Filtering

1) TF-IDF calculation

TF-IDF calculation method. Term Frequancy-Inverse Document Frequency or commonly abbreviated as TF-IDF is a weighting technique for each word in a document TF-IDF is a method used in text processing and data modeling to give weight to words in a document based on the frequency of those words in the document and in the entire document collection. The use of TF-

IDF calculation in the Content-Based *Filtering* method is as the formation of a profile of an item. TF-IDF itself is a combination of two calculations, namely TF and IDF. The TF or *Term Frequency* technique is used to count and measure how often a word appears in a document. If a word appears more often in a document, it is concluded that the word is an important word in the document, so the higher the TF value. However, the high frequency of a word that appears from a document is not necessarily an important word if it turns out that the word also often appears in many documents. So, to calculate the probability, IDF calculations are used to subtract the value or weight of a word if it happens. IDF has the opposite way of calculating TF, that is, the less often a word appears from all documents, the greater the value of the IDF (Pramesti & Santiyasa, 2022). Then, to get the maximum weight value, a combination of two calculations between TF and IDF was carried out, which was then called TF-IDF. By applying the TF-IDF method, words that have a high TF-IDF score in a document are most likely unique and important words for the document. Here is the formula of the TF-IDF calculation.

$$w_{x,y} = tf_{x,y} \quad \text{x} \quad log(\frac{N}{df_x}) \qquad (1)$$

Information:
$tf_{x,y}$: Frequency of *x* at *y*
df_x : Number of document containing *x*
N : Total number of documents

By this method, the system can map the weighting of each term present in the item and obtain its value. After that, the system will convert each term and combine them into an item profile.

2) Cosine Similarity calculation.

Cosine Similarity calculation is a method for calculating the similarity between two vectors by finding the cosine from that angle. Here is the formula of cosine similiarity.

$$similiarity\ (A,B) = \frac{A\ .B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i\ B_i}{\sqrt{\sum_{i=1}^{n} A_i^2}\ \sqrt{\sum_{i=1}^{n} B_i^2}} \qquad (2)$$

Information:
A = Vector A to be compared similar
B = Vector B to be compared similar
In the cosine similarity calculation method, it produces similarity values between each pair of items.

3) Product Input

This input data will be used to compare the entire data with the input data and find the data that has the highest similarity value.

4) Compare Product Inputed to Other Item Profile

After the data to be searched for similarity is inputted, the system will start processing the data by comparing the input data with other data to find which data has similarities.

5) Sort by The Highest Similiarity Value

After the comparison process is completed, the system successfully maps which products have similarities and assigns a value to each comparison. Next, the system will sort these similarity values from highest to lowest to obtain the products that are most similar to the input data.

6) Takes Top 10 Products with The Highest Similarity

After the sorting process is completed, the top 10 products will be selected and become the ten product data to be further processed for sorting with the additional variables of sales and ratings.

7) Sorting Data Based on 3 Variables

To get 10 products in the best order, sorting is done based on 3 variables, namely similarity value, number sold, and rating.

8) Get 10 Recommended Products

After going through a sorting process based on 3 variables, 10 recommended products are obtained with users.

RESULT AND DISCUSSION

Research shows that the content-based filtering method can be applied to recommendation systems for the Fusia restaurant application case study. The similarity of item profiles influences the recommendation results. For example, if a user selects "Fried Duck", then the recommended items will be "Ayam Goreng", "Tempe Goreng", and "Tahu Goreng dan Tempe Goreng", which respectively have similarity scores of "0.6", "0.2", and "0.1". Products like "Kakap" or "Beef Burger" are not recommended because they have similarity scores of "0.0" or in other words, no similarity at all.

Based on the recommendation results, user interest in the recommended products is tested. The test results show that 77.3% are interested in and purchase the recommended products, while the rest are not.

A. Recommendation Result

This subchapter will discuss the results of the recommendation process. Here is an example of the product input to be searched for similarity is "Fried Duck." Because users make transactions or purchases of "Fried Duck" food. The system will perform the process in figure 1 and then will output recommendations as in figure 3.

	produk_id	urutan	produk_nama	nilai_kemiripan	produk_terjual	rating
0	34	1	Bebek Goreng	1.0	37	0.000000
1	31	2	Ayam Goreng	0.6	155	0.000000
2	23	3	Ayam Goreng per 1 Ekor	0.4	179	0.000000
3	10	4	Tempe Goreng	0.2	1147	5.000000
4	17	6	Bebek Goreng per 1 Potong	0.2	553	5.000000
5	67	7	Gurame Goreng	0.2	412	0.000000
6	39	8	Jeroan Mix	0.2	189	0.000000
7	29	5	Bebek Goreng per 1 Ekor	0.2	34	0.000000
8	211	10	Ayam Paha	0.1	39322	4.888889
9	195	9	Tahu dan Tempe Goreng	0.1	117	0.000000

Figure 5 Process Results Recommendation System

Figure 3 is the result of a recommendation system process with "Fried Duck" input. The recommendation results shown in figure 3 are the recommendations that will be displayed on the app.

B. Display on Application

This sub-chapter will discuss the results of the recommendation process displayed on the application.

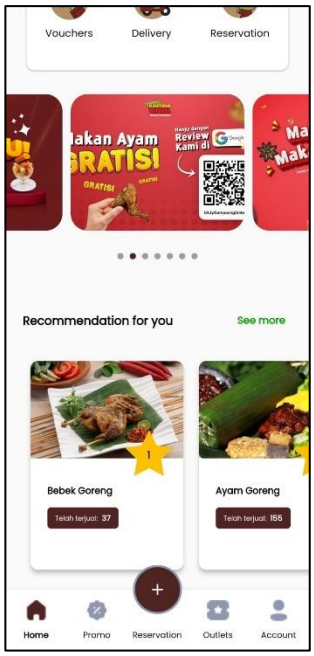

Figure 6 Recommendations Display on Home Dashboard Page

Figure 4 is the result of the recommendations displayed on the home dashboard page of the application. Recommendations placed on the home page serve to make it easier for users to see recommended products.

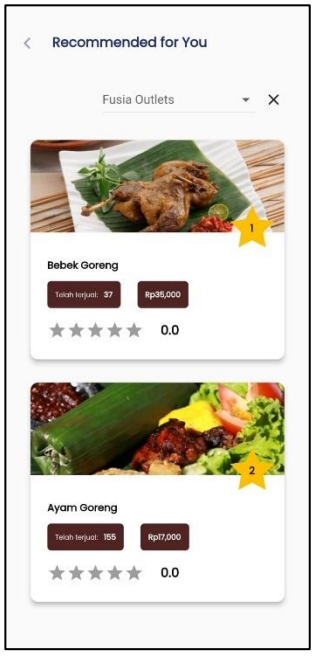

Figure 7 *Recommendations Display on the Recommendations Page*

Figure 5 is a view of the recommendation page that users can access when users click "see more". This page is used to make it easier for users to see more freely the recommended products. On

this page, users can also *filter* recommended products by branch of Fusia.

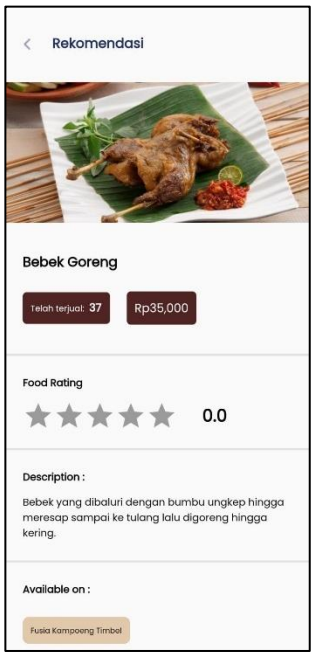

Figure 8 Product Detail Page View

Figure 6 is a view of the product detail page. This page can be accessed when the user selects one of the recommended products. This page will help users by providing more detailed information about a product.

C. User Interest Testing

This subchapter will discuss the results of user interest testing

Table 1 Traceability Test Results

No	Number of Users	Number of Transactions	Information
1	69	85	Interested
2		25	Not Interested

Seen in table I, the results of the user interest test on recommendations from a total of 110 transactions and a total of 69 tested users. There were 25 product transactions that were not interested in the recommended product and 85 transactions that showed interest. Here is a diagram visualization of the test results.

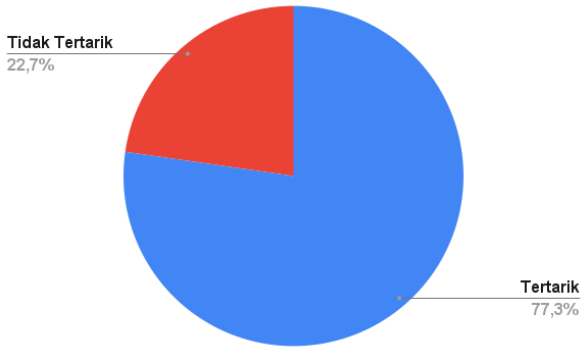

Figure 9 Visualization of Test Results

Figure 7 shows the results of comparing transactions with recommended products by matching the time range. In the test results, 22.7% of transactions showed disinterest, and 77.3% showed interest. The visualization shows that transactions that show interest are far more than transactions that show disinterest.

CONCLUSION

This study applied a recommendation system using the content-based filtering method. In this study, a trial was conducted to determine whether the recommendation system can influence user interest in determining the product to buy. Based on the results of the tests that have been carried out, it was found that 23.8% of transactions made by users were not in accordance with the recommended products in the same time frame. However, as many as 76.2% of transactions made by users still follow the recommended product. So, based on the results of the study, it can be concluded that the recommendation system can help or attract users to buy and determine recommended products.

It is highly recommended that business practitioners or entrepreneurs in the F&B industry implement a recommendation system within their application systems. However, the impact to be considered is the cost expansion for implementation and the security concern regarding user data. In the future, to add variations to the managed data to make user profiles more detailed and comprehensive, researchers could attempt to combine content-based filtering with collaborative filtering, called hybrid filtering.

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