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Development of Mobile Application by Applying Content-Based Filtering

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Abstract: The rapid advancements in information technology have transformed modern lifestyles, driving changes in consumer behavior and expectations, especially in the retail industry. This study focuses on developing a mobile application for Ampu Mart, a newly established retail business in Indonesia, to optimize product recommendation systems using the Content-Based Filtering (CBF) approach. The research integrates CBF with string matching and cosine similarity algorithms to provide personalized product recommendations based on customer preferences, enhancing user satisfaction and supporting more efficient purchasing decisions. The methodology involves several stages, including problem identification through observation and interviews, data collection on product attributes and customer preferences, system design, prototype development, implementation, and testing. The application leverages advanced algorithms to analyze product characteristics, ensuring relevant recommendations by matching user preferences with product attributes. User Acceptance Testing (UAT) conducted with 30 participants—customers, administrators, and management—evaluated the application's functionality, usability, accuracy, and performance. Results indicate that the mobile application improves the shopping experience and boosts sales by offering accurate, user-centered recommendations. The findings highlight the strategic importance of integrating intelligent technology into e-commerce platforms to enhance competitiveness in the retail market. Future work recommends incorporating Collaborative Filtering techniques to further enrich the recommendation system by analyzing collective customer behavior.

Keywords: Content-Based Filtering; E-commerce; Mobile Application; Recommendation System

INTRODUCTION

Information technology has changed the lifestyle of modern, fast-paced people. People now rely on technology in various aspects of life, from communicating, shopping, and working to accessing health and education services (Shantilawati et al., 2024)(Fitriyani Yapan, 2022). Society's dependence on technology encourages companies to continue to innovate and adapt to remain competitive(Larasati & Februariyanti, 2021), one of which is in the retail business.

Retail business is selling goods or services directly to consumers for personal or household use, not for resale(Purwadisastra, 2021). The Badan Pusat Statistik (BPS) noted that in Indonesia, the number of modern stores is 1,131 stores or 7.06%, while the number of shopping centers is 708 or 4.42% of the entire market(Purwanto, 2021). Although Indonesia's retail business continues to advance and develop, the 2023 retail sales growth in Indonesia fell 1.5% compared to the same period last year(year-on-year/YoY)(CEIC, 2023).

This decline occurs due to several factors, one of which is that not all retail businesses adapt to technology(Rafanda et al., 2024). Many retail businesses still rely on traditional methods in their operations(Kusumatrisna et al., 2023), while consumers now increasingly rely on technology in their shopping experience through online applications and e-commerce platforms, which are considered more efficient and efficient (Ulya et al., 2023)(Nia Lefiani & Anggalia Wibasuri, 2021). Failure to adapt to digital technology has caused many retail businesses to lose competitiveness, as consumers prefer the comfort and convenience offered by online platforms(Alwendi, 2020).

Digital transformation has become one of the main pillars in the evolution of the retail sector(Larasati & Februariyanti, 2021), especially in the context of changing consumer behavior that increasingly relies on digital

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technology. In Indonesia, Ampu Mart, as a newly established retail business, realizes the urgency of implementing digital transformation as a strategic step to strengthen its position in an increasingly competitive market.

Mobile applications facilitate buying and selling transactions, allowing consumers to shop anytime and anywhere via the Internet(Lusni, 2021). It provides faster access, and mobile applications also improve the user experience by providing easy information on a product(Daffa Khairul Rakhmat et al., 2024). These advantages make mobile applications very popular because easy and flexible access allows applications to be used by business people anytime and anywhere(Apriliana et al., 2021). This opens up wider business opportunities to reach consumers without time or location restrictions.

In addition to applying digital technology through mobile applications, artificial intelligence (AI) also plays an important role in improving consumer shopping experience and optimizing sales. One of the implementations is the application of the content-based filtering method. The Content-Based Filtering method was chosen. It has advantages in the ability to provide recommendations that are very suitable for consumer interests because it focuses on the characteristics of products that users have previously enjoyed without requiring judgments from other users as a basis for providing recommendations(Ridwansyah et al., 2024)(Badriyah et al., 2018). For example, the Content-Based Filtering method analyses specific features of items that users have selected or liked, such as categories, descriptions, or characteristics. Then, it suggests products that have similarities with these items (Putri et al., 2022). In addition, this personalized recommendation approach can increase user convenience because the system can recognize and adjust the products offered according to each user's interests and needs with a small error rate(Negara & Mardiansyah, 2024).

The focus of this research is to develop a mobile-based shopping application supported by the Content-Based Filtering method. This application is expected to provide convenience for consumers in online purchases and can encourage sales optimization at Ampu Mart.

LITERATURE REVIEW

Digital transformation is becoming a key strategy in the retail sector to face the increasingly fierce market competition. Digital technologies, including mobile applications, enable businesses to reach consumers more efficiently. This research highlights the importance of mobile technology in supporting business activities such as product search, transactions, and sales data management. Integration of digital technologies helps improve customer experience and business competitiveness(Fitrotun Hasanah, Jamilah, 2024).

The Content-Based Filtering method effectively improves product recommendations' accuracy on e-commerce platforms. They found that this approach excels in providing recommendations matching users' preferences. The algorithm analyses the attributes of previously interested products, such as description, category, and other features. The results showed a low error rate compared to other recommendation methods(Ridwansyah et al., 2024).

Rizkyria Angelina et al. collected, evaluated and analysed previous research on string-matching algorithms. This study highlights that algorithms such as string matching improve recommendation precision by analysing specific product attributes(Angelina et al., 2023).

Cosine Similarity is an algorithm often used to measure the level of similarity between two documents based on text vectors. It can search for relevant documents with a high degree of similarity by analysing user-entered keywords. Its performance is demonstrated by the ability to find relevant documents accurately, making it an efficient method for implementation in various text-based systems(Kurniadi et al., 2020).

Research from Robertus Laipaka shows how mobile apps are a solution to support digital transformation in retail businesses. Mobile applications provide flexibility for consumers to shop anytime and anywhere. In addition, mobile applications enhance the customer experience by delivering personalization features, such as product recommendations based on user preferences(Angelina et al., 2023).

Xinyue He et al. examined the effect of recommendation systems on user satisfaction levels. The results showed that personalized recommendations based on user preferences significantly improved user experience and their loyalty to the platform(He et al., 2024).

METHOD

The research steps taken in this study are as follows:

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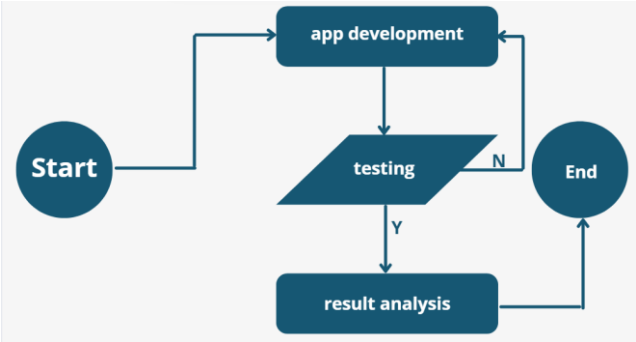

Fig 1. Research Phase

1) *App Development*
System development using a prototype model is carried out to test and validate the concepts, features, and main functions of the Ampu Mart mobile application before the final version is released. Development with a prototype model can minimize the risk of design errors and speed up the process of developing a final product that meets user needs(Fridayanthie et al., 2021). Ampu Mart Mobile Application, by Applying the Content-Based Filtering Method, is designed to solve the problem of optimizing product recommendations for consumers with the primary objective of increasing sales. Ampu Mart Mobile Application with Content-Based Filtering can be implemented on various mobile devices. In contrast to recommendation systems based on external data, the Content-Based Filtering approach analyses the similarity of product characteristics that consumers are interested in, such as category, brand, and price. With this analysis, the application can identify user preference patterns and provide appropriate product recommendations without requiring judgment from other users. The reasons for using this method are that content-based filtering is easy to understand, that the content-based filtering method provides personalized recommendations with a small error rate, and that the content-based filtering method can provide the reasoning behind the recommendations.
2) *Testing*
The application prototype will be thoroughly tested through user trials and performance evaluations. We will measure the effectiveness of product recommendations and user satisfaction levels.
3) *Result Analysis*
The test data was analysed to evaluate the e-commerce application's success in improving user experience and sales revenue. We also evaluated the impact of the recommendation technology by comparing the application's performance without implementing user-based recommendation techniques.

RESULT

In developing the Ampu Mart Mobile Application, the research team designed a workflow as a systematic guideline to ensure that application functionality is effectively integrated with user needs, especially customers. This workflow is designed to describe the operational flow of the application from the user's perspective, including the process of searching, ordering, and product recommendations, to order management by the admin, as shown in Figure 2.

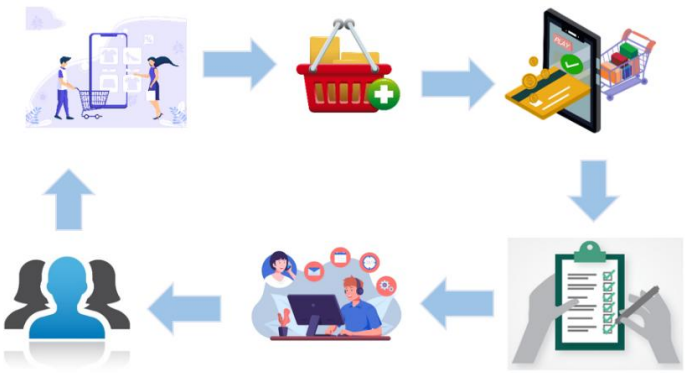

Fig 2. Workflow Ampu Mart

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To support this flow, a use case diagram was designed to visualise the interaction between the main actors and the application functions. The use case diagram has three main actors: Customer, Admin, and Management.

1) Admin manages the system, including creating promos, adding new products, updating stock, and validating customer and working order status.
2) Customers can create an account, search for products, order products, request recommendations, and confirm order pickup via barcode or QR code.
3) as the primary manager, management can conduct detailed analyses of the performance of products sold.

This use case diagram identifies the key functions relevant to each actor, enabling purposeful application development and meeting users' needs at every operational level. It also forms an essential basis for application testing to ensure that all usage scenarios are optimally accommodated.

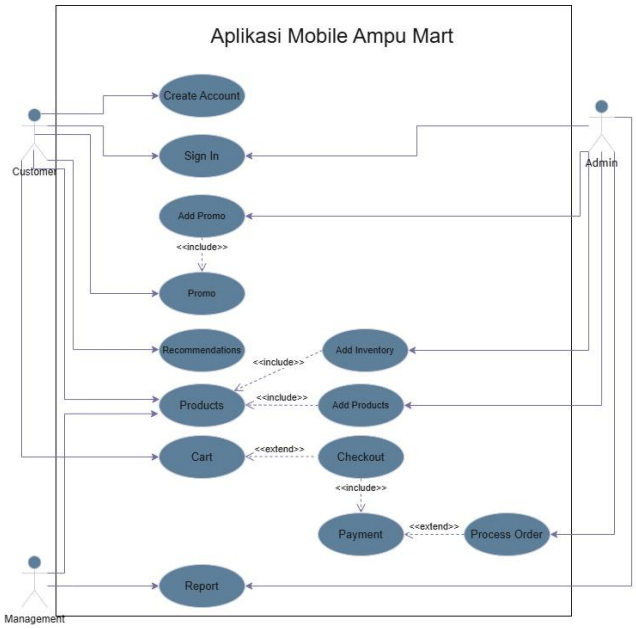

Fig 3. Ampu Mart Use Case Design

Ampu Mart application is developed with a prototyping approach to ensure design flexibility and feature validation based on user needs. This strategy enables iterative development where each prototype version is comprehensively tested to evaluate User Experience (UX). The main focus in the evaluation includes ease of navigation of product search, efficiency in the ordering process, and accuracy of product recommendation features.

This approach is integrated with applying the content-based filtering (CBF) method as a key element in providing relevant product recommendations to customers. The CBF algorithm utilises product attributes, such as name, brand, price, and previous purchase preferences, to build a recommendation model responsive to customer needs. With this method, customers can obtain product recommendations that match their preferences, increasing the likelihood of repeat purchases and shopping experience satisfaction. The design of the CBF model is depicted in Figure 4.

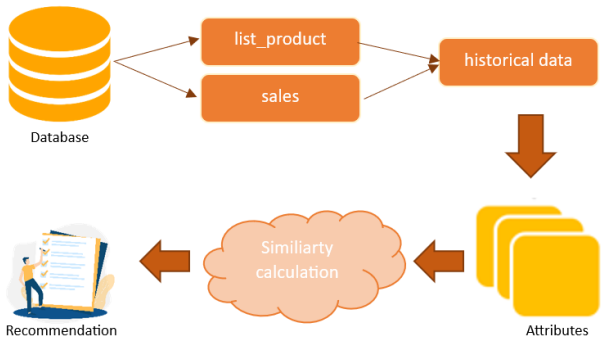

Fig 4. Product Recommendation Model

In developing a product recommendation system for the Ampu Mart Mobile application with a Content-Based Filtering (CBF) approach supported by string matching and cosine similarity algorithms, the aim is to provide

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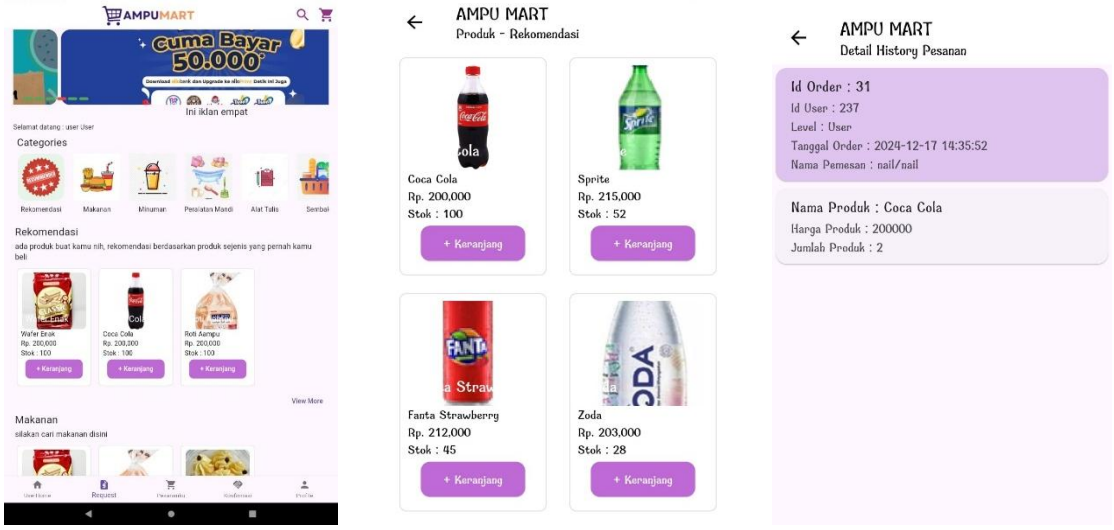
relevant recommendations based on user preferences and to support faster and more precise purchasing decisions. The following steps are applied:

1) Researchers compiled a list of primary attributes and additional attributes that would be used to provide relevant recommendations for user needs. The main qualities used are product name, brand, variant, price, and consumer purchase preferences as additional attributes. These attributes provide essential information about the products that users are interested in.
2) Researchers incorporated string-matching techniques to process and analyze textual data related to products. This involves removing punctuation, converting to lowercase, and removing stop words.
3) The researcher applied the cosine similarity algorithm to compare textual attributes between product items.
4) Based on the pre-processed textual data, the researcher constructs a feature vector for each product item, incorporating numerical attributes derived from the string-matching algorithm.
5) This feature vector represents the characteristics of the product item, capturing user-specific attributes and similarity scores obtained through the string-matching algorithm.
6) The researcher used the cosine similarity algorithm to determine the similarity between different products.
7) We sort the product items based on the calculated similarity score, considering user-specific attributes and textual similarity obtained through string matching. This sorting process allows us to prioritize the most similar product items and rank them accordingly.
8) Finally, based on the sorted list, researchers created a list of suggested products for users.

By integrating the string matching algorithm into the Content-Based Filtering approach, the researcher improved the recommendation system's ability to capture textual similarities and provide more accurate and personalized product recommendations based on user preferences.

The recommendation design is illustrated as follows: ‘when customer A buys a Coca Cola branded soft drink product, the recommendations on the system will show all soft drinks sold at Ampu Mart’. The design that displays the diversity of brands of products purchased before illustrates the state of good recommendation accuracy. The recommendation results are shown in a series of images in Figure 5.



(a) (b) (c)

Fig 5. Key features of Ampu Mart App

The main feature of the recommendation system is to recognise and extract its main attributes: category (soft drink), brand (Coca-Cola), type or variety, and packaging. The system then compares the characteristics of the products that customers buy with other products in the Ampu Mart catalogue using algorithms such as String Matching and Cosine Similarity. The String Matching algorithm matches the product attributes that customers buy with other products in the Ampu Mart catalogue, such as Kacang Garuda, Kue Kering, Roti Ampu, Aqua, Pristine, Teh Botol Sosro, Fruit Tea, Sprite, Fanta, and so on.

String matching will eliminate products with a low level of attribute similarity or irrelevant to the product being purchased by the customer to get a list of products that match the product attributes purchased by the customer. The Cosine Similarity algorithm is used to numerically calculate the level of product similarity by considering each attribute's weight. This algorithm produces a likeness score that indicates how relevant a product is to the other products analysed, as shown in Table 1.

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Table 1. Similarity Score Result

Id	Product	Similiarty Score
1	Fanta Strawberry	0.88
2	Sprite Original	0.93
3	Zoda	0.91

By applying these two algorithms, the recommendation system can compile a list of customers' most relevant products based on the degree of attribute similarity.

DISCUSSIONS

User Acceptance Testing (UAT) was conducted by 30 participants, including customers, admins, and management teams. This process aims to evaluate the performance and functionality of the Ampu Mart mobile application to ensure that the features developed are to user needs and provide an optimal user experience. UAT is carried out using test indicators covering four main aspects: application functional suitability, ease of use, recommendation accuracy, and application performance. Each indicator is measured through questionnaires and direct tests to obtain quantitative and qualitative data on user satisfaction with the system, as shown in Figure 6.

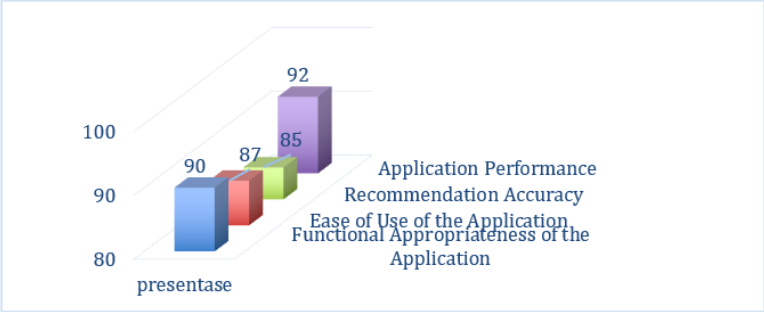

Fig 6. Test Results of Ampu Mart Mobile application

The use of the Content-Based Filtering algorithm in the Ampu Mart application recommendation system has a positive impact on improving user experience and operational efficiency. This system makes it easier for customers to find products that suit their needs and helps the management team optimise sales strategies through relevant product recommendations. Thus, integrating innovative technology in e-commerce applications such as Ampu Mart proves to be a strategic solution to increase customer satisfaction while driving increased sales.

Although the UAT results show good application performance, there is an opportunity for further development by incorporating the Collaborative Filtering (CF) method. This method will enrich the recommendation system by analysing collective customer behaviour patterns so that the recommendations generated become more dynamic, accurate, and by more diverse customer preferences. Thus, this development is expected to make the Ampu Mart application more competitive and optimal in supporting user needs and long-term business strategies.

CONCLUSION

Overall, the development of the Ampu Mart application with the Content-Based Filtering approach has successfully improved user experience and operational efficiency while positively impacting increasing sales. By applying string matching and cosine similarity algorithms, the recommendation system can compile a list of the most relevant products for customers based on the similarity of attributes.

This success demonstrates the importance of innovative technology integration in e-commerce applications as an effective strategy to improve competitiveness in the market. Future recommendations include extending the system's functionality by incorporating collaborative filtering methods to generate richer recommendations based on customers' collective behaviour.

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