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Customer Relationship Management Strategy for Enhancing Customer Loyalty at MM Beauty Clinic Using the K-Means Algorithm

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Abstract

MM Beauty Clinic is one of the beauty service providers in North Sumatra Province that still carries out most of its service processes manually. This condition has the potential to reduce service quality and increase the risk of customers switching to other clinics. This study aims to design and implement a web-based Customer Relationship Management (CRM) system to strengthen customer loyalty. The system was developed using the PHP programming language and a MySQL database. The approach used is Recency, Frequency, and Monetary (RFM) analysis combined with the K-Means algorithm to segment customers based on their transaction patterns. The data used are patient transaction data for April 2026. The segmentation results are used as the basis for determining appropriate service strategies for each customer group. The implementation of this CRM system is expected to improve the effectiveness of customer relationship management, as well as facilitate transaction processing, consultation services, complaint submission, and access to service information more quickly, effectively, and efficiently.

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INTRODUCTION

In today's increasingly competitive business environment, information technology plays a crucial role in supporting operational growth and improving service quality. For service-based industries such as beauty clinics, building customer loyalty through the effective utilization of information technology has become a key strategy for sustaining competitiveness. However, not all beauty clinics have adopted technology to its full potential. Fundamental services, including customer consultations, product information services, and complaint management, are still performed manually, resulting in less efficient service delivery and increasing the risk of customer retention decline.

MM Beauty Clinic, managed by Dr. Tika and located in Kota Pinang, South Labuhanbatu Regency, North Sumatra, Indonesia, currently faces this challenge. The absence of an integrated system for monitoring customer behavior increases the likelihood of customers switching to competing clinics. To address this issue, implementing a Customer Relationship Management (CRM) strategy is essential. CRM is an organizational approach to establishing and maintaining long-term relationships with customers by comprehensively managing customer interaction data to improve customer satisfaction and business profitability (Ramadian et al., 2025). Through CRM, the clinic can obtain customer analytical information quickly, accurately, and

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efficiently (Management, n.d.), thereby making a significant contribution to improving customer loyalty (Keuangan et al., 2025).

Customer loyalty refers to customers commitment and continued preference for a particular product or service. In the field of computer science, customer loyalty and customer characteristics are no longer assessed intuitively but are analyzed based on historical transaction patterns using customer segmentation techniques, one of which is the Recency, Frequency, and Monetary (RFM) model (Afdal & Marsal, 2024). Proposed by Arthur Hughes, the RFM model is a widely adopted method for categorizing customers according to three key attributes: Recency (the most recent transaction), Frequency (the number of transactions), and Monetary (the amount of money spent) (Fauzan & Alfian, 2024; Shodikin & Taniasari, 2025; Yusak et al., 2024). In addition to identifying loyal customers, the RFM model is also effective in detecting customers who are likely to churn (stop using the service).

To obtain objective and accurate customer segmentation, the RFM model is frequently combined with clustering algorithms in data mining (Nugraha et al., 2025). Data mining is the process of extracting valuable information from large datasets by applying Machine Learning techniques (Azhari et al., 2023). One of the most widely used techniques is clustering, which groups data according to the similarity of their characteristics (Hendrastuty, 2024). Among various clustering algorithms, the K-Means algorithm is the most widely used non-hierarchical clustering method because of its simplicity, efficiency, and ability to process transaction data rapidly by measuring the distance between data objects and the centroid (cluster center) (Bahtiar et al., 2023; Yahya & Kurniawan, 2025).

A previous study conducted by Fadhillah, M. F., Suyoso, A. L. A., and Puspitasari, I. in 2025 empirically evaluated the use of the RFM model combined with the K-Means algorithm to support CRM strategies using transaction data from PT SID East Java Region. The study successfully classified customers into three specific clusters, namely loyal customers, adequate customers, and lost customers, which served as the basis for determining CRM strategies (Homepage et al., 2025). In the same year, Jihan and Prihartono applied a similar approach to customers of the Pasarmu.id e-commerce platform and identified three main customer segments: Golden Customers, Platinum Customers, and Silver Customers (Jihan et al., 2025).

Based on the foregoing, this study focuses on implementing a CRM strategy for customer segmentation at MM Beauty Clinic using the RFM model and the K-Means algorithm. To ensure that the segmentation results can be practically utilized by management, the clustering results are implemented in a CRM system developed using the PHP programming language and a MySQL database and modeled using the Unified Modeling Language (UML) (Abdillah, 2024; Polgan et al., 2025; Wibawa et al., 2025). Through this web-based system, MM Beauty Clinic is expected to automatically identify the characteristics of each customer segment and implement personalized marketing strategies while facilitating product purchases, complaint submission, and access to consultation services for customers.

METHOD

To address the research problem, this study was conducted through several systematically organized stages based on the research framework, as shown in Figure 1.

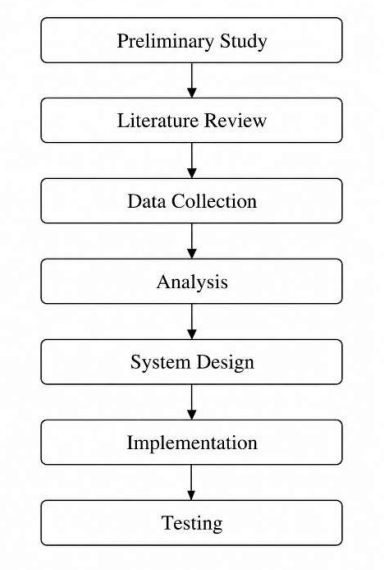

Figure 1. Research Framework

The research stages represent the sequence of processes carried out to accomplish this study. The stages are described as follows.

Preliminary Study

This study discusses the implementation of a Customer Relationship Management (CRM) system based on the K-Means algorithm and the Recency, Frequency, and Monetary (RFM) model to develop a web-based system aimed at improving customer loyalty at MM Beauty Clinic.

Literature Review

The literature review discusses the concepts of RFM, the K-Means algorithm, and CRM as the methods used for customer segmentation to support decision-making and improve customer loyalty.

Data Collection

At this stage, data were collected through observation, interviews, and a literature review at MM Beauty Clinic, located on Jend. Sudirman Street, Kota Pinang District, South Labuhanbatu Regency, North Sumatra Province. The data collection was conducted in May 2026.

Analysis

At this stage, 246 patient transaction records from MM Beauty Clinic during April 2026 were analyzed. The transaction data were processed using the RFM method to generate the Recency, Frequency, and Monetary attributes, followed by customer clustering using the K-Means algorithm.

System Design

During the system design stage, the Unified Modeling Language (UML) was used as a modeling tool to design the proposed system.

Implementation and Testing

At this stage, the system was implemented using the PHP programming language and a MySQL database. Subsequently, the system was tested to ensure that it met the specified requirements.

RESULTS AND ANALYSIS

RFM Analysis

The Recency (R) value was obtained by calculating the time interval between the date of the study (May 1, 2026) and the patient's most recent transaction. The Frequency (F) value was calculated based on the total number of transactions made by each patient, while the Monetary

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(M) value was determined from the total transaction amount spent by each patient during April 2026. The RFM analysis resulted in 163 patient records, as presented in Table 1.

Table 1. RFM Dataset

No.	Nama Pasien	R (Hari)	F (Kali)	M (Rupiah)
1.	Dani	3	2	630000
2.	Finta Sinaga	11	3	1240000
3.	Aspita	23	2	700000
4.	Juliani	4	2	1020000
5.	May Harahap	28	2	370000
6.	Nora	4	2	530000
7.	dr. Febri	1	4	860000
8.	Anggia	6	5	810000
9.	Santa	3	2	690000

Subsequently, the RFM dataset was transformed by assigning weights to each variable using a scale of 1 to 5. The weighting intervals are presented in Table 2.

Tabel 2. RFM Weighting Intervals

Recency	Minimum	Maximum
5	0	6
4	7	12
3	13	18
2	19	24
1	25	30
Frequency	Minimum	Maximum
1	0	1
2	2	2
3	3	3
4	4	4
5	5	5
Monetary	Minimum	Maximum
1	0	544000
2	544001	1088000
3	1088001	1632000
4	1632001	2176000
5	2176001	2720000

The weighted data were subsequently processed using the K-Means algorithm. The results are presented in Table 3.

Tabel 3. RFM Weighting Results

No.	Patient Name	R	F	M
1.	Dani	5	2	2
2.	Finta Sinaga	4	3	3
3.	Aspita	2	2	2
4.	Juliani	5	2	2
5.	May Harahap	1	2	1
6.	Nora	5	2	1
7.	dr. Febri	5	4	2
8.	Anggia	5	5	2
9.	Santa	5	2	2
...	...	...	...	...

K-Means Clustering Process

Determine the value of k. In this study, the data were divided into two clusters: Loyal (C1) and Less Loyal (C2).

Determine the initial cluster centroids randomly. The initial centroid values are presented in Table 4.

Table 4. Initial Centroids

Initial Centroids			
Centroid	R	F	M
Centroid 1	4	3	3
Centroid 2	2	1	1

Calculate the distance between each data point and the initial centroid using the Euclidean Distance formula:

$$De = \sqrt{(x_i - a)^2 + (y_i - b)^2 + (z_i - c)^2} \quad \text{.....(1)}$$

Compare the distance between each data point and the centroids. Each data point is assigned to the cluster with the nearest centroid.

Assign the data points to their respective clusters and calculate the new centroids. Then, return to Step 3.

Repeat the process until the nth iteration. The process stops when no data points change cluster membership.

The K-Means clustering process was performed iteratively until convergence was achieved.

In Iteration 1, two clusters were formed based on the initial centroids. The number of cluster members and the new centroids are presented in Table 5.

Table 5. Euclidean Distance Calculation and Cluster Assignment in Iteration 1

Data Point	Distance to Initial Centroid			Data Assignment					
	C1	C2	Cluster	Cluster 1			Cluster 2		
				R	F	M	R	F	M
1.	1.7	3.3	C1	5	2	2			
2.	0	3.5	C1	4	3	3			
3.	2.4	1.4	C2				2	2	2
4.	1.7	3.3	C1	5	2	2			
5.	3.7	1.4	C2				1	2	1
6.	2.4	3.1	C1	5	2	1			
7.	1.7	4.3	C1	5	4	2			
8.	2.4	5.1	C1	5	5	2			
9.	1.7	3.3	C1	5	2	2			
...	...	...	...	...	...	...	...	...	...
Total				363	152	141	194	94	92
Number of Data Point				78	78	78	85	85	85
Average				4.7	2	1.8	2.3	1.1	1.1

In Iteration 2, the use of the new centroids resulted in changes in cluster membership, resulting in 89 data points in Cluster 1 and 73 data points in Cluster 2. The centroids obtained in this iteration were (R = 4.6, F = 1.8, M = 1.6) for Cluster 1 and (R = 1.9, F = 1.1, M = 1.2) for Cluster 2.

In Iteration 3, no changes were observed in either the cluster membership or the centroid values compared with Iteration 2. This condition indicates that the algorithm had reached convergence; therefore, the clustering process was terminated. Consequently, the final clustering result consisted of 89 data points in Cluster 1 and 73 data points in Cluster 2, with final centroids of (R = 4.6, F = 1.8, M = 1.6) and (R = 1.9, F = 1.1, M = 1.2), respectively.

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The results of the clustering process are presented in Table 8.

Tabel 8. K-Means Clustering Results

Iteration	Centroids Used						Cluster Size	
	C1			C2			C1	C2
	R	F	M	R	F	M		
1	4.7	1.9	1.8	2.3	1.1	1.1	78	85
2	4.6	1.8	1.6	1.9	1.1	1.2	90	73
3	4.6	1.8	1.6	1.9	1.1	1.2	90	73

System Design

Use Case Diagram

The Use Case Diagram illustrates the interactions between the actors and the system and describes the expected functionalities of the system (Nirsal et al., 2025). The proposed system involves three actors: Admin, Member, and Non-Member. Figure 2 presents the Use Case Diagram of the proposed system.

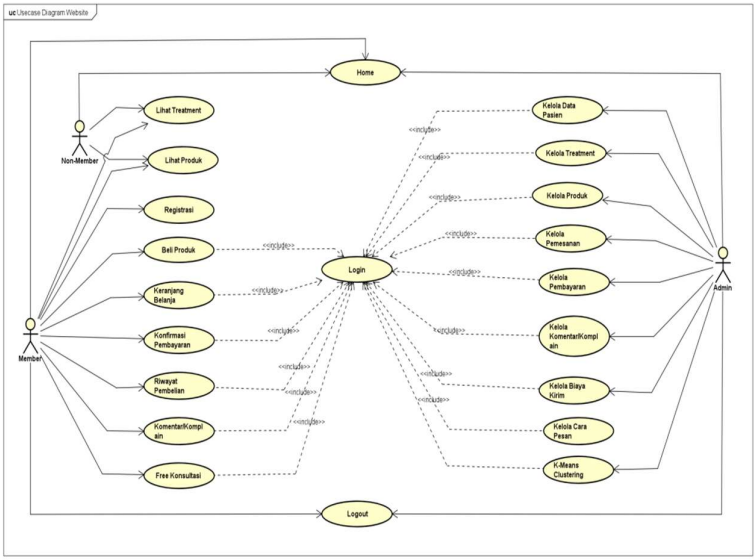

Figure 2. Use Case Diagram

Class Diagram

The Class Diagram illustrates the classes, database tables, attributes, and database operations used in the development of the MM Beauty Clinic web-based system.

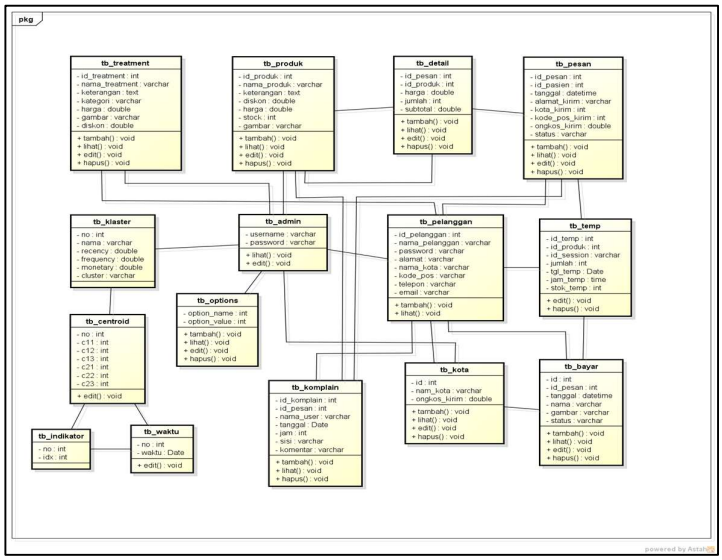

Figure 3. Class Diagram

System Interface Testing

Home Page

The Home Page serves as the main page accessed by users when opening the system. It provides various menus that allow users to access the available features, including product information, Face Treatment, Body Treatment, shopping cart, checkout, payment confirmation, complaints, and consultation services. Through this page, users can easily navigate all the services available in the system.

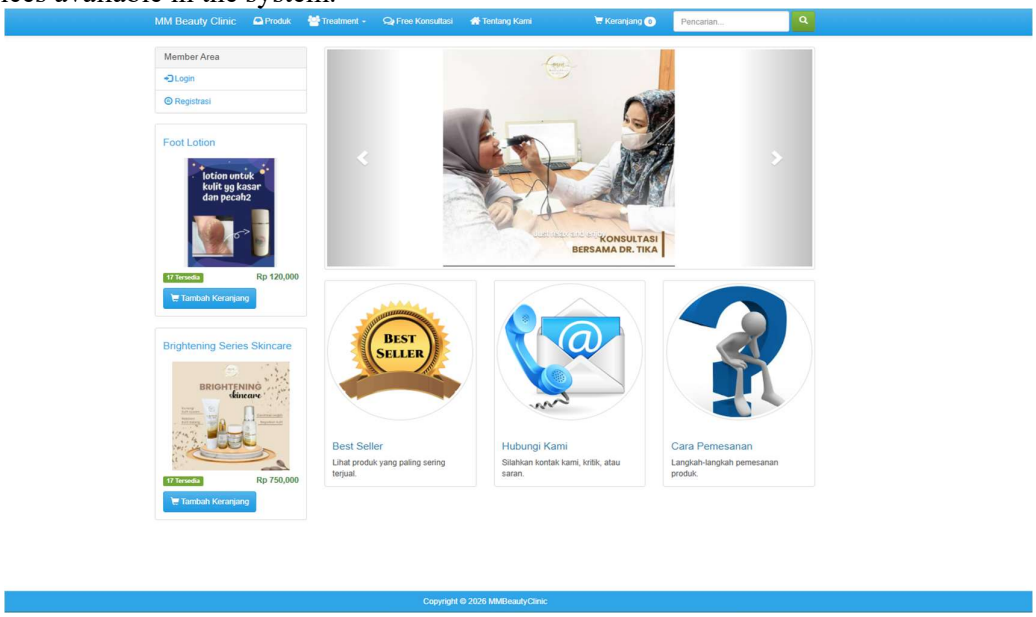

Figure 4. Home Page

K-Means Clustering Page

The K-Means Clustering Page is used by the administrator to perform customer segmentation based on the transaction data stored in the system. On this page, the administrator can define the clustering parameters, execute the clustering process using the K-Means algorithm, and view the resulting customer segments. These results can be used as the basis for developing Customer Relationship Management (CRM) strategies to improve customer loyalty.

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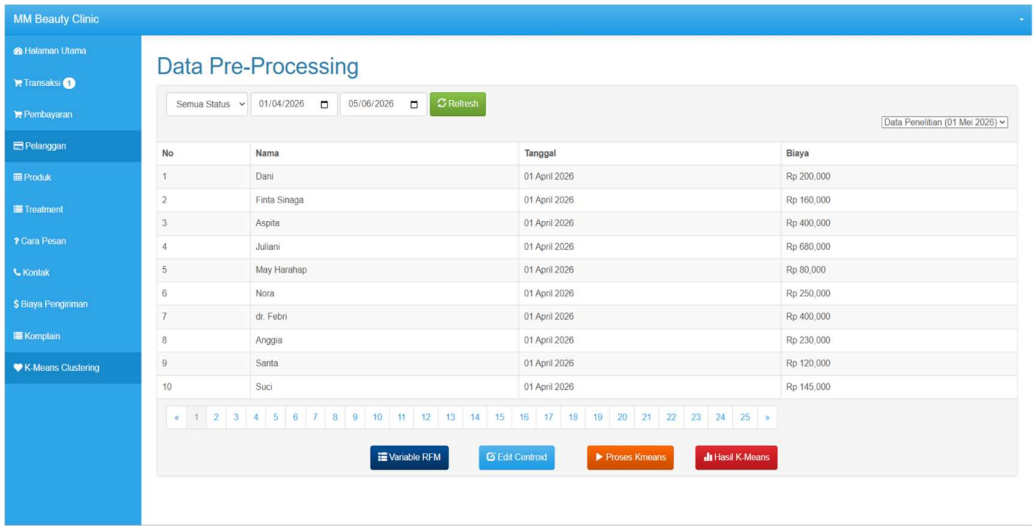

Figure 5. K-Means Clustering Page

CONCLUSIONS

Based on the clustering results of patient transaction data from April 2026, two customer groups were identified, consisting of 90 loyal patients and 73 less loyal patients. This segmentation provides an overview of patient loyalty toward MM Beauty Clinic based on transaction patterns analyzed using the clustering method. The resulting customer segments can serve as the basis for implementing more effective Customer Relationship Management (CRM) strategies. Loyal patients can be retained through improved service quality, loyalty programs, membership cards, and exclusive discounts. Meanwhile, the loyalty of less loyal patients can be enhanced through promotional programs, free consultation services, and improvements in service quality. The development of the web-based system is expected to support the effective implementation of CRM by facilitating customer services, patient data management, and the online purchase of products and services. Consequently, the system is expected to improve operational efficiency, customer satisfaction, and customer loyalty.

For future research, it is recommended to compare the proposed approach with other customer segmentation methods, such as Fuzzy C-Means, Hierarchical Clustering, and DBSCAN. In addition, clustering performance should be evaluated using metrics such as the Silhouette Coefficient, Davies–Bouldin Index, and Calinski–Harabasz Index to achieve better clustering quality. Furthermore, the use of more diverse customer data and the enhancement of the web-based system through personalized service features, automatic promotional notifications, an online reservation system, and social media integration are expected to improve segmentation accuracy, service quality, and the effectiveness of CRM strategies.

REFERENCES

Abdillah, M. Z. (2024). *Dasar Pemrograman Web Menggunakan Php Dan Mysql*. Uwais Inspirasi Indonesia.

Afdal, M., & Marsal, A. (2024). *Business to Business Customer Loyalty Analysis Based on RFM Model Using Fuzzy C-Means Algorithm Analisis Loyalitas Pelanggan Business To Business Berdasarkan Model RFM Menggunakan Algoritma Fuzzy C-Means*. *4*(April), 359–365. https://doi.org/10.57152/malcom.v4i1.1163

Azhari, R., Hartama, D., Lubis, M. R., Nasution, D. F., & Windarto, A. P. (2023). *Analisis Penerapan Data Mining Terhadap Kasus Positif Covid-19 Menggunakan Metode K-Means Clustering*. *3*(2), 221–235. https://doi.org/10.47065/jieee.v3i2.1760

Bahtiar, D., Studi, P., Informatika, T., Komputer, F. I., Pamulang, U., Penerima, P., Sosial, B. D., & Jaya, D. W. (2023). *Scientia Sacra : Jurnal Sains , Teknologi dan Masyarakat*

PEMETAAN PENDUDUK PENERIMA BANTUAN SOSIAL DESA WARU JAYA MENGGUNAKAN ALGORITMA K-MEANS. *3*(2), 29–39.

Fauzan, R. M., & Alfian, G. (2024). *Segmentasi Pelanggan E-Commerce Menggunakan Fitur Recency , Frequency , Monetary (RFM) dan Algoritma Klasterisasi K-Means*. *9*(3), 170–177. https://doi.org/10.14421/jiska.2024.9.3.170-177

Hendrastuty, N. (2024). *Penerapan Data Mining Menggunakan Algoritma K-Means Clustering Dalam Evaluasi Hasil Pembelajaran Siswa*. *3*, 46–56. https://doi.org/10.58602/jima-ilkom.v3i1.26

Homepage, J., Fadhillah, M. F., Lovely, A., Suyoso, A., & Puspitasari, I. (2025). *MALCOM: Indonesian Journal of Machine Learning and Computer Science Customer Segmentation with Clustering Algorithm Based on Recency, Frequency, and Monetary (RFM) Attributes Segmentasi Pelanggan dengan Algoritma Clustering Berdasarkan Atribut Recency, Fr*. *5*(1), 48–56. https://doi.org/10.57152/malcom.v5i1.1491

Jihan, A., Prihartono, W., & Cirebon, K. (2025). Konsumen K-Means Berdasarkan Model Rfm. *JITET (Jurnal Informatika Dan Teknik Elektro Terapan)*, *13*(2), 780–788. https://doi.org/10.23960/jitet.v13i2.6327

Keuangan, D. A. N., Akbar, A. S., & Iriani, S. S. (2025). *A Systematic Literature Review on the Effectiveness of Customer Relationship Management in Building Customer Loyalty in the Digital Era*. *9*(2), 107–128. https://doi.org/10.26740/jpeka.v9n2.p107-128

Management, C. R. (n.d.). *Teori & Praktek*.

Nirsal, N., Roji, M. F., Syam, S., Selviana, R., Widianto, A., Gunawan, I. M. A. O., Arsana, I. N. A., Sutoyo, M. N., Kurniadi, W., Sari, I. K., & others. (2025). *Buku ajar Analisis dan Perancangan Sistem*. PT. Sonpedia Publishing Indonesia.

Nugraha, R. D., Adelia, D. D., & Rivaldi, D. (2025). *Segmentasi Pelanggan Retail Berbasis Perilaku menggunakan Algoritma K- Means Clustering*. *5*(2), 141–148. https://doi.org/10.47709/digitech.v5i2.6340

Polgan, J. M., Aziz, R. A., Sansprayada, A., Mariskhana, K., Mandiri, U. N., Bina, U., & Informatika, S. (2025). *Perancangan Sistem Informasi Managemen Cuti Karyawan Pada PT SuMoIn dengan Menggunakan PHP dan MYSQL*. *14*(13), 442–451. https://doi.org/10.33395/jmp.v14i1.14747

Ramadian, A., Judijanto, L., & Erwin, E. (2025). *Customer Relationship Management (CRM): Strategi Membangun Hubungan Pelanggan yang Kuat*. PT. Green Pustaka Indonesia.

Shodikin, M., & Taniasari, N. (2025). *Comparative Analysis of DBSCAN and K-Means Algorithms in Inpatient Patient Segmentation Using the RFMT Model Approach Analisis Komparasi Algoritma DBSCAN dan K-Means dalam Pemetaan Segmentasi Pasien Rawat Inap Menggunakan Model RFMT*. *5*(October), 1231–1241.

Wibawa, M. B., Purnandi, M., Informatika, P., Sains, F., & Indonesia, U. U. (2025). *PERANCANGAN SISTEM MONITORING DAN EVALUASI KEUANGAN BERBASIS WEB PADA BAGIAN PERENCANAAN DAN KEUANGAN PADA KABUPATEN PIDIE Design Of A Web-Based Financial Monitoring And Evaluation System In The Planning And Finance Division Of Pidie Regency*. *11*(1), 24–30.

Yahya, A., & Kurniawan, R. (2025). *Implementation of K-Means Algorithm for Clustering Sales Data Based on Sales Patterns Implementasi Algoritma K-Means untuk Pengelompokan Data Penjualan Berdasarkan Pola Penjualan*. *5*(January), 350–358. https://doi.org/10.57152/malcom.v5i1.1773

Yusak, A., Rumapea, N., Pratiwi, D., & Sari, S. (2024). *Analisis Segmentasi Pelanggan Ritel Online Menggunakan K-Means Clustering Berdasarkan Model Recency , Frequency , Monetary (RFM)*. *6*(3), 292–299.

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