Application of Data Mining to Predict Product Sales Using the K-Means Method

Titania Delfiano[1)*], Desiyanna Lasut[2)]

[1)2)]*Buddhi Dharma University*
Imam bonjol, Tangerang, Indonesia

[1)]titaniadelfiano@gmail.com

[2)]desiyanna.lasut@buddhidharma.ac.id

Abstract

Sales activities that run every day generate large amounts of transaction data which can become data stacks. This also happened in a bag-selling shop called Toko Blessing. Toko Blessing is a bag sales business that focuses on children's school supplies with various categories such as school bags, drink bottle bags, and lunch box bags which have several variants of models and motifs in each category. With so many product variations and manual reporting, Toko Blessing faces difficulties in determining which products are best-selling and need to be added in large quantities to meet buyer demands and avoid the accumulation of less desirable products. With the availability of large sales data, if processed properly this data can be used to design the right business strategy. The K-means method is used because it makes it easier for the store to analyze and classify data to find out the level of the product through large amounts of sales transaction data that can be done quickly. The K-means method aims to determine sales patterns by looking at Blessing Shop sales transactions to help find out which products are often sold/best-selling and to predict future sales. From the data mining application using the K-means method, sales reports were generated based on sales transaction data from January 2021 to December 2022 totaling 1,188 data, which can later be used to assist Blessing Stores in making decisions on which products are superior to predict sales in the coming year.

I. INTRODUCTION

In today's competitive business world, we are required to always develop our business in order to survive the competition, especially sales competition requires entrepreneurs to find a pattern that can increase sales and marketing in the company, one of which is by utilizing sales data [1].

Sales activities that run every day produce large amounts of transaction data which can become a pile of data. This also happened at a shop selling bags called Toko Blessing. Toko Blessing is a bag sales trading business located in Tangerang.

Bags are products that are in great demand by all groups, both upper and lower classes, men and women of all ages. Many people buy bags because they are a basic need or can also support a person's social standing. With a variety of brands and models, it is one of the attractions in selling bags, with a variety of brands and models of bags on offer, the sales business is able to generate quite large transaction opportunities, resulting in an accumulation of data that continues to increase, where Toko Blessing can sell 10 to 30 products per day. Blessing Store with a conventional store sales system and records data manually, namely by recording every product sales transaction in a book. Transaction data is only used as a document or as proof of payment. After that, the data is left without further processing, resulting in just a pile of transaction data that has no benefit.

There are several problems that can arise in the bag sales business, one of which is buyers who are disappointed because the bag product they are looking for is not available while the shop has a large stock of other products but they are not sold because they are less popular with buyers. This will certainly have a big influence on the development of the shop. In high business competition, the Blessing Shop must be able to predict product sales correctly. With the availability of large sales data, if processed properly this data can be used to design the right business strategy. But only with the availability of large amounts of data plus the absence of a system and method to process that data means the data will be useless [2]. Therefore, we need a method that can process data so that data processing is more efficient, namely by implementing the use of data mining and the K-means method.

---

[*] Corresponding author

The K-means method aims to determine sales patterns by looking at Blessing Store sales transactions to help find out which products are often sold/best sold and to predict future sales. Data mining using the K-means method is able to produce product predictions in the form of reports on product sales levels with information about very popular, best seller and less popular to help Blessing Stores in making decisions about which products are superior for predicting sales in the coming year.

II. METHODS

Data is information or facts that have been collected from observations or searches from certain sources. In general, data consists of basic information such as symbols, numbers, words, or images. However, data in "raw" form cannot provide much meaningful information. Therefore, further processing is needed through a model so that the data can produce useful information and conclusions, and be used as a basis for decision making [3].

Data is information that describes an event in the form of a description of reality. Data consists of facts and figures that do not necessarily have meaning for the recipient of the data [4].

Data mining is a process of extracting data from various important sources of information. The goal of data mining is to explore patterns from the data. These patterns are found from various types of databases such as relational databases, data warehouses, transaction data, and object-oriented data. The use of data mining has benefits for business people because it can help them make decisions quickly and accurately [1].

Clustering is a method for identifying groups in a case based on similarities in group attributes. Clustering works by separating a number of groups of data based on their respective characteristics, where the objects can be people, events and others that are interconnected between clusters [5].

The definition of algorithm is very closely related to the word logic, namely the ability of a human being to think rationally about a problem to produce a truth, proven and acceptable to reason, logic is often associated with intelligence, someone who is able to reason well is often called an intelligent person. In solving a problem, logic is absolutely necessary. Logic is synonymous with reasonableness and reasoning [6].

The K-Means algorithm is a non-hierarchical method that can initially take many data components to become the initial center of the cluster. K-Means has the ability to group large amounts of data with relatively fast and efficient processing time. However, there are also weaknesses of K-Means which result in determining the initial cluster center [7].

The system according to [8] is a combination of several elements, components or variables that are integrated with each other to form a single unit so that a goal and target can be achieved.

Inventory is part of a company's capital that is less liquid than collections. Inventory needs to be managed well, because excessive investment in inventory is the same as incurring large costs [9].

A database is an integrated collection of logically related data elements. Databases consolidate many records that were previously stored in separate files. It is a set of logically related data and their descriptions, designed to fulfill the information needs of an organization. In other words, a database is a large data storage facility that can be used by many users. All database items are no longer owned by a single department but instead become a corporate resource that can be shared by multiple users [10].

A framework is a framework. Framework can also be interpreted as a collection of scripts (especially classes and functions) that can assist developers/programmers in handling various programming problems, such as database connections, variable calling, file handling, and so on, making the developer's work more focused and faster in building applications. A framework is a ready-to-use programming component that can be used anytime, so programmers don't have to create the same script for the same task [11].

C# or pronounced as C sharp is a versatile programming language used for general purposes, meaning it can be used for various functions such as server-side web programming, building desktop or mobile applications, game development, and so on. In practice, C# heavily relies on a framework called the .NET Framework, which is used to compile and execute C# code. C# was developed by Microsoft, with Anders Hejlsberg being recruited as part of the development team [12].

RapidMiner is an application or software that serves as a tool for learning in the field of data mining. The platform is developed by a company dedicated to all steps involving a large amount of data in commercial business, research, education, training, and learning. RapidMiner offers approximately 100 learning solutions for clustering, classification, and regression analysis. RapidMiner also supports around 22 file formats, such as .xls, .csv, and so on [13].

MySQL is one of the widely renowned types of database servers, extensively used for developing web applications that utilize a database as their source and for data management [14].

KDD is a method used to obtain knowledge originating from existing databases. The results of the knowledge obtained can be used for a knowledge base that is used to make decisions to produce information in a predetermined order [15]. The following are the KDD stages used:

a. **Data Selection**

At the data selection stage, data selection is carried out from the operational data collection. The selected data will be used for the data mining process, stored in a file, separate from operational data. The data

used in this research comes from the Blessing Shop, namely product sales transaction data with a time span of January 2021 to December 2022.

TABLE 1
SALES TRANSACTION DATA ATTRIBUTES

Attribute	DESCRIPTION
Date	The date the sales transaction occurred
Product name	The name of the selected product
Lots of it	Number of products selected
Price	The unit price of the selected product
Amount	The total price of the selected product
Payment Amount	The total price to be paid
Quant	Number of sales transactions for the selected product

From all existing data in Table 1, data selection will be carried out and only 3 attributes will be produced which will be used for the next Knowledge Discovery in Database (KDD) process, namely Date, Product Name and Quantity

b. Preprocessing

At this stage, a data integration process will be carried out to combine data from different databases, then data cleaning will be carried out to produce a clean dataset so that it can be used in the next stage. The preprocessing stage is carried out to group sales products based on the number of sales each month and year to simplify the process of calculating predictions and adding product codes as unique attributes. After the data is grouped, all the data will be added up.

The following are the results of the preprocessing process on sales data for the period January 2021 to December 2021:

TABLE 2
2021 PREPROCESSING STAGE RESULTS

No	Date	Code	Product Name	Lots of it
1	1/1/2021	LBM7	Lunch Bag Mini New Avanger	1
2	1/1/2021	CB1	Cover Bottle Basket Merah	2
3	1/1/2021	CB3	Cover Bottle Gadis Jepang	1
4	1/1/2021	LBGB1	Lunch Bag Bordir Astronot	1
5	1/1/2021	LBGB3	Lunch Bag Bordir Lemon Girl	1
6	1/1/2021	LBJB1	Lunch Bag Jumbo Bordir Captain America	1
…				
1.730	29/12/2021	LBJB4	Lunch Bag Jumbo Bordir Peri Dahan	2

The following are the results of the preprocessing process on sales data for the period January 2022 to December 2022:

TABLE 3
2022 PREPROCESSING STAGE RESULTS

No	Date	Code	Product Name	Lots of it
1	1/1/2022	CB2	Cover Bottle Cinderella	2
2	1/1/2022	CB11	Cover Bottle Skate Boy	2
3	1/1/2022	LBJP6	Lunch Bag Jumbo Print Lego	2
4	1/1/2022	LBJP3	Lunch Bag Print Balerina	1
5	1/1/2022	LBS2	Lunch Bag Serut Fire Truck	1
6	1/1/2022	LBS7	Lunch Bag Serut Racer	3
…				
1.515	12/29/2022	TP2	Tas Pianika Unicorn	1

c. Transformation

The transformation stage is the stage of changing the selected data, so that the data is suitable for the data mining process. The transformation process in Knowledge Discovery in Database (KDD) is a creative process and depends on the type or pattern of information to be searched in the database. At this stage, all transaction data grouped based on the date the transaction occurred is converted into months. Each month contains the total value of products sold in that months.

The following tables are the results of the transformation process:

TABLE 4
2021 TRANSFORMATION PROCESS RESULTS

No	Code	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
1	CB1	3	2	1	1	2	2	4	5	2	3	1	2
2	CB2	3	2	5	4	5	1	4	2	2	1	6	5

No	Code	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
3	CB3	2	2	5	1	3	5	6	2	3	3	1	1
4	CB4	3	1	5	2	3	1	1	3	1	4	1	6
5	CB5	1	1	2	3	4	4	1	7	7	5	5	4
6	CB6	2	1	1	3	2	1	2	6	1	2	1	1
…													
99	TD2	1	2	4	3	1	4	1	2	4	2	3	3

TABLE 5
2022 TRANSFORMATION PROCESS RESULTS

No	Code	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
1	CB1	11	8	2	3	6	5	6	4	8	7	7	9
2	CB2	4	6	6	4	6	8	5	7	5	8	6	5
3	CB3	5	9	4	8	7	8	4	6	5	8	5	7
4	CB4	7	7	6	9	7	9	5	3	2	1	3	4
5	CB5	1	1	2	3	4	4	1	11	7	5	5	12
6	CB6	2	1	1	1	1	1	2	1	1	2	2	1
…													
99	TD2	3	1	4	3	1	4	1	2	4	2	3	5

d. Data Mining

In the K-means method, a model is formed to process data using pseudo code and flowcharts. Pseudo code is a representation of the explanation of the steps in solving a problem, which uses a language similar to a programming language.

The application was designed on a web basis using Visual Studio Code using the PHP, C# and HTML programming languages

III. RESULTS

Before do clustering we need to know the number of clusters that will be formed. Using the Elbow method by looking for SSE (Sum of Square Error) we can determine the ideal number of clusters for a data set. The higher the SSE value means the data is spread wider, which causes the grouping to be inaccurate. The following is the formula for finding SSE that is used:

$$SSE = \sum_{k=1}^{K} \sum_{x_I = S_k} \|y_i - C_k\|^2 \qquad (1)$$

Where:

K = Number of clusters

Yi = i-th data

Ck = Average value of K clusters

After calculating, there are several K values that experience the largest decrease and then the K value will decrease slowly until the results of these values are stable
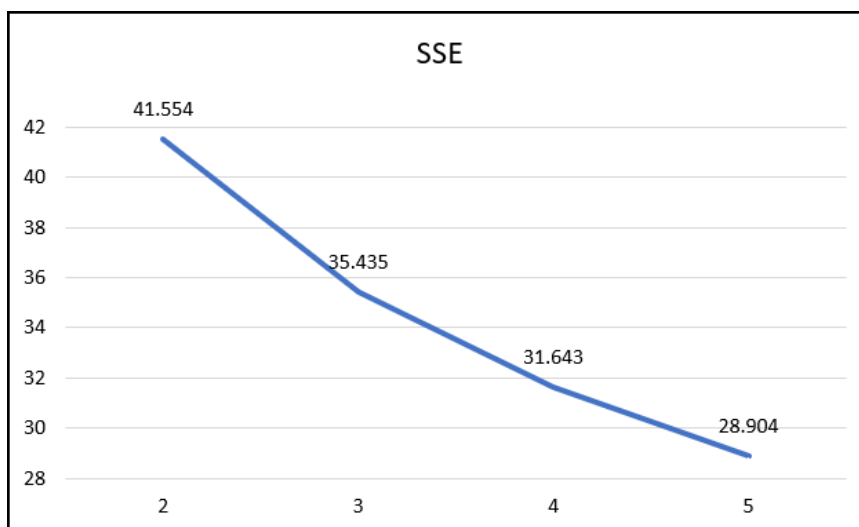

Fig. 1 Elbow Method Calculation Result

Based on Fig 1 the results of SSE calculations on 99 data, there are SSE values that form an elbow on the graph at point K=3, so the ideal K cluster value is 3 clusters. SSE forms an elbow on the graph and the small decrease in value indicates that the closeness of the data is not too far and is the best number of clusters. Based on the results of the Elbow method carried out above on the data set, the clusters that will be created in this research are 3 clusters. The 3 clusters are labeled, namely C1 for the "Less Popular" category, C2 for the "Quite Popular" category and C3 for the "Best Seller" category.

In this process, manual calculations will be carried out on Blessing Shop sales data in 2021 and 2022. The following is a manual calculation with a number of clusters (k) of 3. Determine K the number of first centroid randomly. On this first experiment determined 3 data taken randomly from sales data for 2021 as the initial centroid point for calculating the distance of all cluster groups to be formed. Number of clusters = 3 (Less Popular, Quite Popular and Best Seller) Number of data = 99 Number of attributes = 12

The random data can be seen in Table 6:

TABLE 6
CENTROID FIRST ITERATION OF SALES DATA FOR 2021

Centroid	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des	Total Sales
C1	3	2	3	2	1	2	2	4	3	6	1	4	33
C2	1	10	2	11	2	1	1	4	2	1	3	2	40
C3	1	3	3	3	5	4	5	4	8	4	7	2	49

From centroid Table 6 to calculate the distance of the data to the centroid, the Euclidean Distance formula is used. The following is the Euclidean Distance equation:

$$D_{(x,y)} = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \cdots} \qquad (2)$$

TABLE 7
EXAMPLE OF MANUAL CALCULATION DATA

No	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
1	3	2	1	1	2	2	4	5	2	3	1	2

An example of calculating data in Table 7, in the first iteration is as follows:

$$C1: D_{(x_1,y_1)} = \sqrt{25} = 5 \qquad (3)$$
$$C2: D_{(x_1,y_3)} = \sqrt{188} = 13.7113092 \qquad (4)$$
$$C3: D_{(x_1,y_2)} = \sqrt{101} = 10.04987562 \qquad (4)$$

From the calculation example for data above, it can be concluded that data number 1 is included in cluster C1 because it has the smallest data distance to the centroid compared with C2 and C3.

After the first iteration, the centroid calculation continues until the centroid value does not change. In the second iteration, the SSE value was obtained at 3735.6, C1 was 72 products, C2 was 19 products and C3 was 8 products. The calculation continued in the third iteration with SSE results of 3550.5, C1 with 71 products, C2 with 19 products and C3 with 9 products. Then in the fourth iteration the SSE results were obtained at 3525.3, C1 at 69 products, C2 at 19 products and C3 at 11 products. In the fifth iteration, the centroid value did not change so that the calculation process was declared complete with SSE results of 3508.1, C1 with 69 products, C2 with 19 products and C3 with 11 products.

The final centroid values for sales data in 2021 are as follows in Table 8:

TABLE 8
FINAL CENTROID VALUE OF SALES DATA FOR 2021

Centroid	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
C1	2.26	1.72	2.06	1.898	2.78	2.14	2.38	2.638	1.83	2.33	2.29	1.93
C2	1.79	2.05	2.26	3.47	3.68	3.53	4.63	4.737	4.42	3.68	6.95	3.47
C3	2.64	8.91	4.09	3.18	2.89	2.45	4.45	2.455	2.55	2	2	3

In calculating the clustering of sales data for 2022, the results of the first iteration obtained a value of SSE = 7716, C1 with 14 products, C2 with 82 products and C3 with 3 products. In the second iteration, the SSE value was obtained at 5057.2, C1 had 16 products, C2 had 80 products and C3 had 3 products. The calculation continued in the third iteration with SSE results of 5041, C1 with 17 products, C2 with 79 products and C3 with 3 products. In the fourth iteration, the centroid value did not change so that the calculation process was declared complete with SSE results of 5036.7, C1 with 17 products, C2 with 79 products and C3 with 3 products.

The final centroid values for sales data in 2022 are as follows in Table 9:

TABLE 9
FINAL CENTROID VALUE OF SALES DATA FOR 2022

Centroid	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nov	Des
C1	4.35	3.59	3.12	3.29	4.76	4.71	4.59	6.941	5.77	5.06	4.47	8.47
C2	2.43	2.37	2.61	2.18	2.49	2.71	3.39	2.633	2.18	2.16	3.28	2.53
C3	5.33	3.67	4.67	1.33	18	2	1.33	2	3.67	2.67	5.67	2.67

IV. DISCUSSION

TABLE 10
BLACKBOX TESTING

No	Test Scene	Scenario	Expected Result	Test Result
1	Login Page	User input Username and Password and press the login button to login	If the Username and Password are correct, it will enter the dashboard page.	Valid
2	Login Page	User input Username and Password and press the login button to login	If the Username or Password are incorrect, a failed login error massage will appear	Valid
3	Dashboard Page	User enter the dashboard page and press the sub menu on left side (Input Data, Clustering Data, Chart, Result and Report) or press logout	The user will move to the selected menu page, and can also log out of the application	Valid
4	Input Data Page	User enter Input Data Page, user can press input new data button, edit data or delete button to change the transaction data from the dataset table	Changes will be made to the dataset table depending the button user choose. If user choose input new data button, then user will be given input data form, and if user choose edit data, then user will be given the edit data form, else user chooses the delete button then the chosen data will be deleted from database	Valid
5	Clustering Data Page	User enter Clustering Data Page, user will be asked to choose between Clustering year 2021 or Clustering year 2022	User will be move depending the menu it chooses, if user press the clustering year 2021 then user will be redirected to Clustering year 2021 page or if user press the clustering year 2022 then user will be redirected to Clustering year 2022 page.	Valid
6	Clustering year 2021 and 2022 Pages.	User press one of the menus and enter the chosen menu page. User press process button.	There will be information massage and user will be re-directed to Result Page	Valid
7	Chart Page	User enter Chart Page	User will be given clustering dataset year 2021 and year 2022 in chart form	Valid
8	Result Page	User will be given option to choose the result year between 2021 and 2022	The chosen year result page will be opened and user will be given the clustering result	Valid
9	Report Page	User will be given option to choose the report year between 2021 and 2022	The chosen year report page will be opened.	Valid
10	Report year 2021 and 2022 pages	User press the print button	User will be redirected to print form and user can choose the format of the report to be printed (PDF or to the selected printer)	Valid

V. CONCLUSIONS

From clustering calculations performed on sales data for both 2021 and 2022, it was observed that the Sum of Squared Errors (SSE) for 2021 was 3508.1, with three distinct clusters identified: C1 comprising 69 products, C2 consisting of 19 products, and C3 containing 11 products. In contrast, for the 2022 sales data, the SSE increased to 5036.7, and the clustering revealed a different pattern with C1 now having 17 products, C2 having 79 products, and C3 comprising just 3 products. The utilization of data mining techniques, specifically the K-means algorithm, has provided valuable clustering reports that can aid the Blessing Shop in optimizing inventory management and decision-making. This application's potential to enhance Blessing Shop's operations can be fully realized, ensuring efficient inventory control and improved performance.

REFERENCES

[1] Normah, S. Nurajizah, and A. Salbinda, "Penerapan Data Mining Metode K-Means Clustering Untuk Analisa Penjualan Pada Toko Fashion Hijab Banten," *J. Tek. Komput. AMIK BSI*, vol. 7, no. 2, pp. 158–163, 2021, doi: 10.31294/jtk.v4i2.

[2] A. F. Budiantara and C. Budihartanti, "Implementasi Data Mining Dalam Manajemen Inventory Pada Pt. Mastersystem Infotama Menggunakan Metode Algoritma Apriori," *PROSISKO J. Pengemb. Ris. dan Obs. Sist. Komput.*, vol. 7, no. 1, Mar. 2020, doi: 10.30656/prosisko.v7i1.2130.

[3] Nawassyarif, M. Julkarnain, and K. Rizki Ananda, "Sistem Informasi Pengolahan Data Ternak Unit Pelaksana Teknis Produksi Dan Kesehatan Hewan Berbasis Web," *J. Inform. Teknol. dan Sains*, vol. 2, no. 1, pp. 32–39, 2020, doi: 10.51401/jinteks.v2i1.556.

[4] H. Situmorang, "Sistem Informasi Pengelolahan Data Alumni Berbasis Web (Studi Pada Fakultas Sain, Teknologi Dan Informasi) Universitas Sari Mutiara Indonesia," *J. Mahajana Inf.*, vol. 4, no. 1, pp. 34–48, 2019.

[5] J. Nasir, "Penerapan Data Mining Clustering Dalam Mengelompokan Buku Dengan Metode K-Means," *Simetris J. Tek. Mesin, Elektro dan Ilmu Komput.*, vol. 11, no. 2, pp. 690–703, Oct. 2020, doi: 10.24176/simet.v11i2.5482.

[6] A. M. Retta, A. Isroqmi, and T. D. Nopriyanti, "Pengaruh Penerapan Algoritma Terhadap Pembelajaran Pemrograman Komputer," *Indiktika J. Inov. Pendidik. Mat.*, vol. 2, no. 2, pp. 126–135, May 2020, doi: 10.31851/indiktika.v2i2.4125.

[7] Y. Dharma Putra, M. Sudarma, and I. B. A. Swamardika, "Clustering History Data Penjualan Menggunakan Algoritma K-Means," *Maj. Ilm. Teknol. Elektro*, vol. 20, no. 2, p. 195, 2021, doi: 10.24843/mite.2021.v20i02.p03.

[8] Maydianto and Muhammat Rasid Ridho, "Rancang Bangun Sistem Informasi Point of Sale Dengan Framework Codeigniter Pada Cv Powershop," *J. Comasie*, vol. 4, no. 2, pp. 50–59, 2021, [Online]. Available: http://ejournal.upbatam.ac.id/index.php/comasiejournal/article/view/3173

[9] R. H. Taufik and A. Leo, "Analisis Dan Perancangan E-Commerce Berbasis Web Penjualan Dan Stok Barang Market Digital Pada Pt. Mahajaya Plastindo …," *Akselerator J. Sains Terap.*, vol. 3, no. 2, pp. 83–94, 2022, [Online]. Available: https://jurnal.buddhidharma.ac.id/index.php/aksel/article/view/1858%0Ahttps://jurnal.buddhidharma.ac.id/index.php/aksel/article/download/1858/1164

[10] A. Sudarso, "Pemanfaatan Basis Data, Perangkat Lunak Dan Mesin Industri Dalam Meningkatkan Produksi Perusahaan (Literature Review Executive Support System (Ess) for Business)," *J. Manaj. Pendidik. Dan Ilmu Sos.*, vol. 3, no. 1, pp. 1–14, 2022, doi: 10.38035/jmpis.v3i1.838.

[11] Dermawan, D. S. D. Putra, and L. W. Kusuma, "Aplikasi Pendaftaran Seminar Menggunakan Metode Mvc Berbasis Website Menggunakan Framework Codeigniter 3.1.10," *J. Algor*, vol. 1, no. 2, 2020.

[12] R. D. Safitri, A. Susanto, R. Rino, and L. W. Kusuma, "Rancang Bangun Aplikasi Absensi Sekolah Minggu Dengan Pengenalan Wajah Menggunakan Principal Component Analysis (Pca) Pada Gereja Gbi Modernland," *Algor*, vol. 2, no. 2, pp. 31–40, 2021, doi: 10.31253/algor.v2i2.567.

[13] V. R. Prasetyo, H. Lazuardi, A. A. Mulyono, and C. Lauw, "Penerapan Aplikasi RapidMiner Untuk Prediksi Nilai Tukar Rupiah Terhadap US Dollar Dengan Metode Linear Regression," *J. Nas. Teknol. dan Sist. Inf.*, vol. 7, no. 1, pp. 8–17, 2021, doi: 10.25077/teknosi.v7i1.2021.8-17.

[14] A. Hendri and A. S. Mochammad, "Sistem informasi pelaksanaan kegiatan komisi kepolisian nasional berbasis desktop," *J. CoSciTech (Computer Sci. Inf. Technol.*, vol. 2, no. 1, pp. 14–23, 2021, doi: 10.37859/coscitech.v2i1.2393.

[15] Gustientiedina, M. H. Adiya, and Y. Desnelita, "Penerapan Algoritma K-Means Untuk Clustering Data Obat-Obatan," *J. Nas. Teknol. dan Sist. Inf.*, vol. 5, no. 1, pp. 17–24, 2019, doi: 10.25077/teknosi.v5i1.2019.17-24.