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USE OF UI/X ON WEBSITE RECOMMENDATION OF LAPTOP SPECIFICATIONS WITH K-MEANS ALGORITHM

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ABSTRACT

The process of choosing a laptop that suits your needs is often a challenge for consumers because of the variety of specifications and features offered. Many consumers find it difficult to make the right choice, especially because the information available is often not well structured. In addition, the needs of each individual are different, ranging from use for daily productivity to special needs such as gaming or graphic design. Therefore, this study aims to develop a prototype design for a laptop recommendation system using the K-Means algorithm, where this algorithm can group laptop specification data into clusters that have been determined from similar features. A total of 25 laptop specification data were used in this analysis, with the main parameters being RAM capacity and SSD capacity. The data was processed using data mining methods and the K-Means algorithm was applied to perform clustering. The number of clusters was determined based on the closest distance to ensure accurate and relevant results. The clustering results show that laptops can be classified into certain groups that represent consumer needs, such as use for daily productivity or high-load work. The prototype design of this system was created using Figma to visualize an intuitive and easy-to-use user interface (UI). With this prototype design, it is hoped that it can be a reference in developing a system that makes it easier for consumers to choose a laptop that suits their preferences and needs.

Keywords: UI/X, Website, Laptop Specifications, K-Means Algorithm

1. INTRODUCTION

The development of information technology in this digital era has driven the need for computer devices, especially laptops, which is increasingly high. Laptops are one of the electronic goods that are currently most needed by the community, such as students, teachers, and IT departments in companies [1]. Laptops are now not only used for work purposes, but also for education, entertainment, and other daily activities. One important factor that influences the choice of laptop is the hardware specifications, such as the capacity of Random Access Memory or known as RAM and Solid State Drive or known as SSD, which can affect the performance and speed of the device. With the many choices of laptops available on the market, consumers often face difficulties in choosing a laptop that suits their needs and budget.

In addition, the development of e-commerce also influences laptop purchasing patterns. Consumers now have wide access to compare specifications from various brands through online platforms. However, the abundance of information available can actually cause confusion due to the lack of specific and relevant guidance. In this case, technology can play an important role in providing solutions in the form of recommendation systems that help consumers find the laptop that best suits their needs. On the other hand, the development of data mining technology provides opportunities to analyse data in a more efficient and accurate way. Data mining is used for large data management and helps the process of storing transaction data and processing data warehousing so that it can get the information needed for its users [2]. The method that is currently popular in data mining, namely the method that can group data, is the K-Means algorithm.

In grouping data, the K-Means algorithm is a method that can perform data analysis or data mining methods that perform unsupervised modelling processes and is one method that performs data grouping with a partition system [3]. This method allows data grouping based on certain similarities, so that it can be used to analyse various laptop specifications. By grouping laptops into certain categories, consumers can more easily understand product variations and make more informed decisions. This makes K-Means a potential tool for building effective recommendation systems. By utilizing the K-Means clustering

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algorithm, this study aims to overcome challenges in laptop selection, provide useful insights for consumers, and support better decision making.

2. MATERIALS AND METHODS

Research Methods

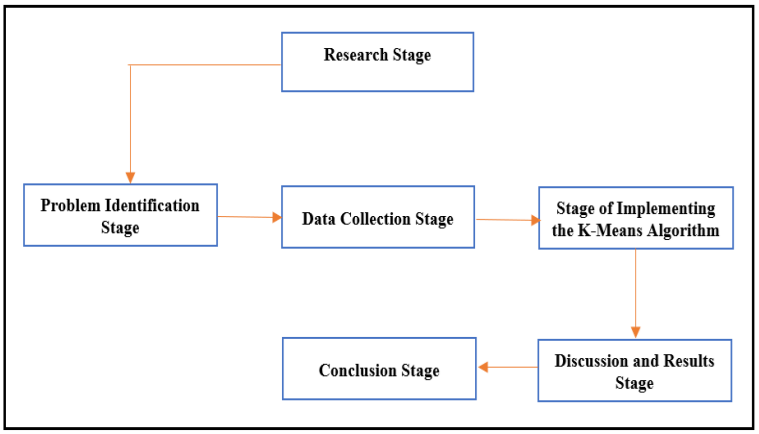

Figure 1. Research Stage

Based on Figure 1, it is explained as follows:

1. Problem Identification Stage
   At this stage, identification is carried out to understand the main problems faced in selecting a laptop according to consumer needs. This problem is related to the difficulty of grouping laptops based on relevant specifications, such as RAM and SSD capacity. Furthermore, the steps that need to be taken to solve the problem are determined, including the application of the K-Means clustering method.
2. Data Collection Stage
   At the data collection stage, this study uses secondary data which is one of the characteristics of quantitative research. The dataset used was obtained from publicly available sources and can be downloaded via Kaggle.com with the title "laptop data." The data was compiled by an unnamed third party, but is considered to have credible credibility.
3. Stages of Implementing the K-Means Algorithm
   At this stage, the K-Means algorithm is used to group data from laptop specifications. The process begins with data normalization so that each parameter has a balanced scale. Next, the optimal number of clusters is determined using the elbow method. After that, the K-Means algorithm iteration is carried out until each laptop data is combined into the appropriate cluster. The results of this grouping provide a classification of laptops based on similar specifications, such as categories for daily productivity or heavy use.
4. Discussion and Results Stage
   This phase includes the analysis of clustering results using the K-Means algorithm. The data that has been grouped is evaluated to ensure that the clusters formed are relevant to consumer needs. Each cluster is analysed to identify patterns or characteristics that can be the basis for recommending laptops to consumers.
5. Conclusion Stage
   This phase explains a result that has been done in grouping data using the K-Means algorithm. The conclusion is that by using this algorithm it can be used to solve the problem of grouping laptops based on specifications. In addition, recommendations based on the clusters formed can help consumers in choosing a laptop that suits their needs.

Data Mining

Data mining is a series of mechanisms applied to obtain patterns, relationships, and added value from large-scale data with the aim of extracting useful insights [4]. Data mining is a process that applies several techniques such as statistical techniques, mathematical techniques, artificial intelligence techniques, and machine learning techniques to help extract and identify useful information and related knowledge from various large databases [5]. Data mining has many techniques and methods or algorithms that are diverse so that the selection of the right method and algorithm is highly dependent on the results and stages of

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Knowledge Discovery in Database (KDD) as a whole [6].

Data mining can also be used to predict future trends that allow business people to make effective, proactive, and dynamic decisions. Data processed using data mining techniques is also able to produce knowledge that meets expectations. One of the uses of data mining in business is that data mining is currently often used by researchers to find patterns and relationships in data and help make better business decisions. In addition, data mining can also help in analyzing trends such as sales and can also accurately predict customer loyalty [7].

Clustering

Clustering related to data is a step used to group data sets where the class attributes cannot be described, seen from the concept of clustering can maximize and minimize a similarity between one class and another class [8]. There are two types of data in a clustering that are widely used when carrying out the grouping process phase of a data, namely the hierarchical type or hierarchical data clustering and the non-hierarchical type or non-hierarchical data clustering [9]. A cluster is a group of data or a collection of objects that are similar to each other in a cluster that has similarities and dissimilar to objects that have no similarities [10]. Basically, the purpose of a clustering is used to minimize the objective function that has been set when carrying out the clustering process, which is essentially in an effort to minimize variation in a cluster and maximize variation between clusters and other clusters [11].

The clustering method is expected to be able to measure its own ability in an effort to obtain a hidden pattern of data that is currently being studied. There are several methods that are currently used to measure a similarity value between one object and another object to be compared. One of them is by using Weighted Euclidean Distance. Euclidean Distance is a way to calculate the distance between two points by knowing the value of one attribute with another attribute at both points. Distance can be said to be an approach that is often used in determining the similarity or dissimilarity of two feature vectors known as ranking. If the ranking value obtained is smaller, the closer/further the similarity between the two vectors. The distance measurement technique using the Euclidean method is a method that is often used [12].
Distance measurements that will use the Euclidean method can be formulated using Equation 1.

$$j(v1, v2) = \sqrt{\sum_{K=1}^{N}(v1(k) - v2(k))^2} \quad (1)$$

K-Means

K-Means is a clustering method based on the distance that separates data into several clusters and the algorithm can only be processed on numeric or number attributes. K-Means is also one of the algorithms where the clustering data is non-hierarchical which will divide the data that has been determined into one type or more clusters so that data that has similar characteristics will be grouped into one similar cluster and data that has dissimilar characteristics will be grouped into another group.

The k-means clustering algorithm can be said to be an algorithm that has a partial, because k-means clustering as a benchmark for the initial number of groups in describing the initial centroid value. the desired number of initial clusters is needed as input and produces the final centroid point as output [13]. This algorithm is a popular algorithm, due to its ease and ability to group large data and outlier data very quickly [14]. According to [15] the initial process of the k-means algorithm is as follows:

1. Determine k as the number of clusters to be formed, set an arbitrary cluster center.
2. Calculate the distance from each data to the cluster center using the Euclidean equation
3. Group data into clusters that have the smallest distance values
4. Calculate the new cluster center by calculating the average for each cluster using Equation 2,

$$C_{kj} = \frac{\sum_{i=1}^{p} x_{ij}}{P} \quad (2)$$

Where:
C_{kj} = cluster to k
P = the number of cluster members to k

5. Repeat steps 2 to 4 until no more data is found moving to another cluster.

3. RESULTS AND DISCUSSION

Application of K-Means Algorithm Calculation

1. Grouping Laptop Recommendation Data

This study applies the clustering method by implementing the K-means algorithm. The purpose of this study is to produce groups or clusters of laptop brands. The laptop dataset processed in three groups, namely

laptops with basic specifications (low-end), mid-range laptops that have large storage capacity, laptops with high specifications (high-end) that have strong performance based on RAM and SSD capacity parameters. In this study, the sample used was 25 data in the laptop data file (Table 1).

Table 1. Laptop Dataset

No	Laptop Brands	Parameter	
		RAM	SSD
1	Dell Inspiron 3567 Intel Core i3 6006U 2GHz	4	256
2	HP ProBook 450 Intel Core i5 8250U 1.6GHz	8	256
3	Asus ZenBook Pro Intel Core i7 7700HQ 2.8GHz	16	512
4	HP 250 G6 Intel Core i5 7200U 2.5GHz	8	256
5	Lenovo IdeaPad 320-15IKBN Intel Core i5 7200U 2.5GHz	8	256
…	…	…	…
25	Lenovo ThinkPad Yoga Intel Core i5 7200U 2.5GHz	8	256

In the Table 1, there are 25 laptop data that will be processed using the K-Means Clustering algorithm from one of the methods in data mining by classifying laptop brands from a number of groups into clusters so that cluster formation pattern analysis can be carried out.

2. Determination of Initial Centroid

The initial centroid is an important step in the K-Means clustering algorithm. At this stage, the initial centroid value is selected manually or randomly from the available data. The determination of the initial centroid aims to be the basis for carrying out the initial calculation of the Euclidean distance between the laptop data and the cluster center in the first iteration. In determining the initial centroid value, it is taken from 2 RAM and SSD specifications on the laptop data consisting of three clusterings that will be used to carry out the calculation process in the 1st iteration. The table of results of determining the initial centroid can be seen on Table 2.

Table 2. Initial Centroid Values

Cluster	Laptop Brands	Description	
		Centroid 1	Centroid 2
C1	Dell Inspiron 3567 Intel Core i3 6006U 2GHz	4	256
C2	Lenovo Legion Y520-15IKBN Intel Core i5 7300HQ 2.5GHz	8	1000
C3	Asus ZenBook Pro Intel Core i7 7700HQ 2.8GHz	16	512

Based on Table 2, the data values in Cluster C1 = (4, 256), C2 = (8, 1000), C3 = (16, 512). This initial centroid will be the basis for calculating the 1st iteration in the K-Means algorithm to separate data into three clusters based on similarity of specifications.

3. Calculation of the Distance from Each Data on the Laptop to the Cluster Center in the 1st Iteration

In the calculation of the 1st iteration of the K-Means algorithm, each laptop data contained in the dataset is calculated for its distance to each initial centroid. For the calculation of distance, it is based on the Euclidean Distance formula, which is one method for measuring the distance between two points in multidimensional space. The calculation of the data distance is carried out with 25 laptop data used, in Table 3 are the results of calculating the distance between the 1st data to the 25th data.

Table 3. Results of the 1st Iteration Distance Calculation

No	Laptop Brands	Parameter		Cluster Distance			Cluster		
		RAM	SSD	JC1	JC2	JC3	C1	C2	C3
1	Dell Inspiron 3567 Intel Core i3 6006U 2GHz	4	256	0	744,01	256,28	*		
2	HP ProBook 450 Intel Core i5 8250U 1.6GHz	8	256	4	744	256,12	*		
3	Asus ZenBook Pro Intel Core i7 7700HQ 2.8GHz	16	512	256,28	488,07	0			*
4	HP 250 G6 Intel Core i5 7200U 2.5GHz	8	256	4	744	256,12	*		
5	Lenovo IdeaPad 320-15IKBN Intel Core i5 7200U 2.5GHz	8	256	4	744	256,12	*		
…	…	…	…	…	…	…	…	…	…
25	Lenovo ThinkPad Yoga Intel Core i5 7200U 2.5GHz	8	256	4	744	256,12	*		

Based on the results of the distance calculation in Table 3, each data will be grouped into each cluster

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that has the smallest distance from the center of the cluster, for example for the first data, the distance because the closest or smallest distance is to C1 (0), then the first data will be entered into cluster C1.

4. Determining New Centroids Based on Cluster Averages

After the data in the 1st iteration is grouped into clusters based on the closest distance from the initial centroid, the next step is to perform calculations with this new centroid for each cluster data. In this new Centroid to obtain the average value of the parameters (RAM and SSD) of all data included in each cluster. Calculating the average to determine the new centroid,

$$= \frac{1000 + 1000 + 1000 + 1000 + 1000 + 1000}{6}$$

$$= \frac{6000}{6} = 1000$$

Table 4. New Centroid Values

Cluster	Laptop Brands	Description	
		Centroid 1	Centroid 2
C1	Dell Inspiron 3567 Intel Core i3 6006U 2GHz	8,266666667	256
C2	Lenovo Legion Y520-15IKBN Intel Core i5 7300HQ 2.5GHz	13,33333333	1000
C3	Asus ZenBook Pro Intel Core i7 7700HQ 2.8GHz	12	512

Based on the results of Table 4, the calculation of the new centroid, the data value in Cluster C1 = (8.266666667, 256), C2 = (13.33333333, 1000), and C3 = (12, 512). This new centroid will be used as the basis for calculating the 2nd iteration in the K-Means algorithm, in order to update the data grouping into three clusters based on more accurate specification similarities.

5. Calculation of the Distance of Each Laptop Data to the Cluster Center in the 2nd Iteration

After getting the new centroid value, it can be recalculated for the 2nd iteration using a similar method to the 1st iteration, namely calculating the distance of each data with the centroid using the Euclidean Distance formula in the 1st iteration. If the cluster position result in the 2nd iteration is the same as the position in the 1st iteration, then the process is stopped, but if not, the process is continued to the 3rd iteration.

Table 5. Results of Calculating the Distance of Each Laptop Data to the Cluster Center in the 2nd Iteration

No	Laptop Brands	Parameter		Cluster Distance			Cluster		
		RAM	SSD	JC1	JC2	JC3	C1	C2	C3
1	Dell Inspiron 3567 Intel Core i3 6006U 2GHz	4	256	4,26666 6667	744,058 5401	256,124 9695	*		
2	HP ProBook 450 Intel Core i5 8250U 1.6GHz	8	256	0,26666 6667	744,019 1156	256,031 2481	*		
3	Asus ZenBook Pro Intel Core i7 7700HQ 2.8GHz	16	512	256,116 7789	488,007 2859	4			*
4	HP 250 G6 Intel Core i5 7200U 2.5GHz	8	256	0,26666 6667	744,019 1156	256,031 2481	*		
5	Lenovo IdeaPad 320-15IKBN Intel Core i5 7200U 2.5GHz	8	256	0,26666 6667	744,019 1156	256,031 2481	*		
…	…	…	…	…	…	…	…	…	…
25	Lenovo ThinkPad Yoga Intel Core i5 7200U 2.5GHz	8	256	0,26666 6667	744,019 1156	256,031 2481	*		

Based on Table 5, the clustering results in the 2nd iteration show that the data position in each cluster has not changed compared to the cluster position in the 1st iteration shown in Table 3. This indicates that the algorithm has reached convergence, which is a condition where the centroid is stable and no longer shifts. Therefore, the iteration calculation process is stopped, and the final clustering result is considered complete with 2 iterations.

UI/X Application of K-means Algorithm

The main view of the implementation of the laptop data k-means clustering system interface page is designed to provide an intuitive, informative, and easily accessible user experience, as follows:

1. Login Page

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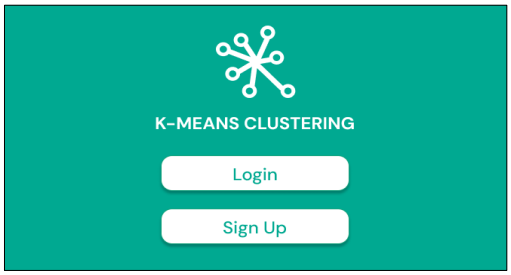

Figure 2. Login page

Figure 2 shows a page that functions to select the login or sign-up option to create a k-means clustering data laptop account.

2. Home Page

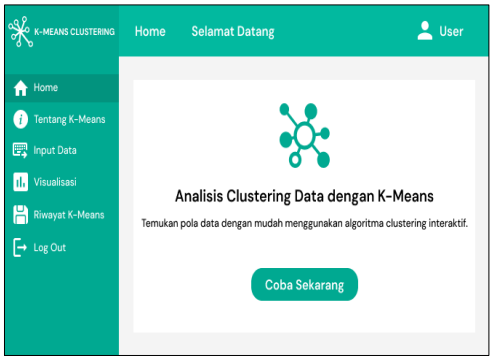

Figure 3. Home Page

Figure 3 shows the main page display which functions as a home k-means clustering laptop data.

3. About K-means Page

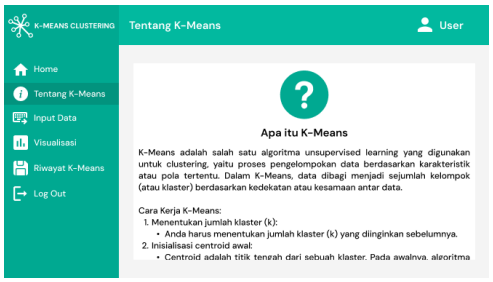

Figure 4. About K-means page

Figure 4 shows a page display about k-means clustering of laptop data which functions to explain what k-means is and how k-means works.

4. Upload File Page

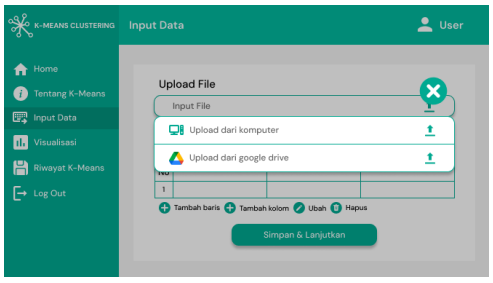

Figure 5. File Upload Page

Figure 5 shows the appearance of the k-means clustering laptop data file upload page which contains a choice between two events, namely uploading files from a laptop or uploading files from Google Drive.

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5. Manual Data Input Page

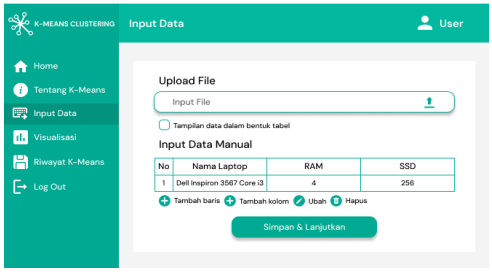

Figure 6. Manual Data Input Page

Figure 6 contains a display of the manual data input page for k-means clustering laptop data where users can input data manually according to user needs.

6. Initial Centroid Input Page

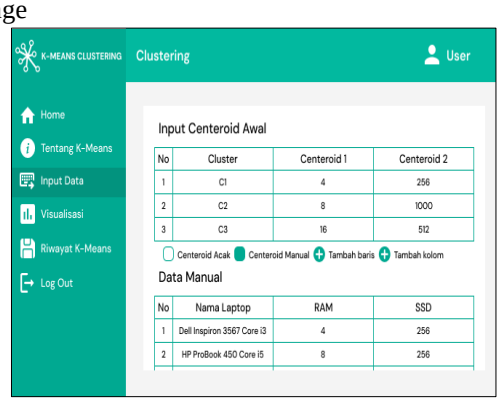

Figure 7. Initial Centroid Input Page

Figure 7 contains the initial centroid input page display of k-means clustering laptop data. The page shows that the user must input the initial centroid to calculate the distance of laptop data based on RAM and SSD parameters, the initial centroid can be determined according to the user's wishes.

7. Literacy 1 Clustering Results Page

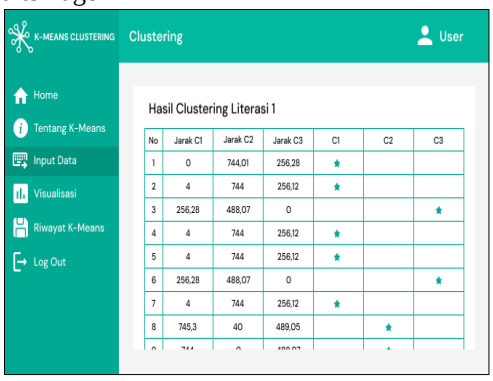

Figure 8. Literacy 1 Clustering Results Page

Figure 8 shows the page display that functions to display the results of the 1st literacy clustering k-means clustering of laptop data. The page shows the results of the 1st literacy clustering which shows the results of 25 laptop data that have been calculated between the distances C1, C2, C3 and then grouped into clusters C1, C2, C3 based on the smallest sparse results.

8. Literacy Clustering Results Page 2

Figure 9 contains a page display that functions to display the results of the 2nd literacy clustering of k-means clustering of laptop data, after calculating the average value based on cluster grouping, the distance calculation is carried out in the same way as in the 1st literacy, if the grouping results do not change between the 1st and 2nd literacy then the calculation has reached the final.

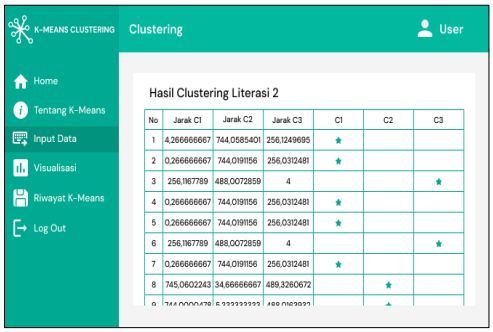

Figure 9. Literacy 2 Clustering Results Page

9. Visualization Page

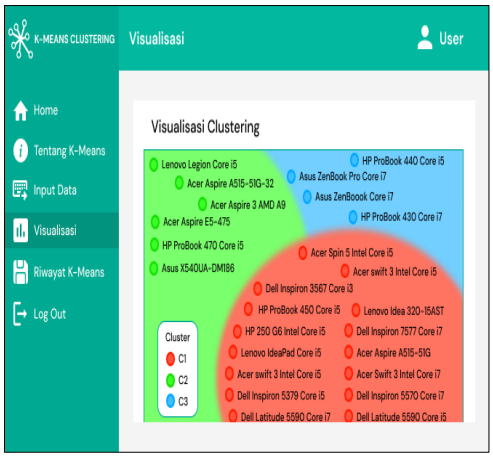

Figure 10. Visualization Page

Figure 10 contains a display of the k-means clustering visualization page for laptop data clustering. After clustering the 1st and 2nd literacy of laptop data, the clustering results can be described or visualized, which shows that C1 has a total of 15 laptop data, C2 has 6 laptop data, and C3 has 4 laptop data.

10. K-means History Page

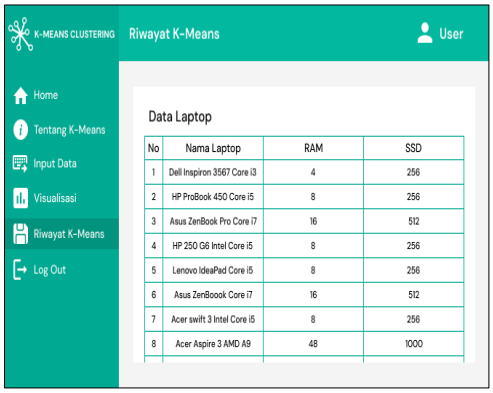

Figure 11. K-means History Page

Figure 11 contains a display of the k-means clustering history page for laptop data, where users can see the clustering results of laptop data that has been saved by opening the k-means history page display.

4. CONCLUSION AND SUGGESTIONS

In this study, it was concluded that the application of the K-Means algorithm in laptop recommendations based on laptop specifications, using RAM and SSD parameters from the number of samples used as many as 25 laptop data, successfully grouped laptop data into three clusters through the grouping process using the K-Means clustering algorithm. From the results of the 1st and 2nd iterations, laptops with basic specifications (low-end) can be grouped in Cluster 1 (C1) consisting of 15 laptops, for mid-range devices that have large storage capacity are in Cluster 2 (C2) consisting of 6 laptops and for

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devices with high specifications (high-end) that have strong performance are in Cluster 3 (C3) consisting of 4 laptops.

For further development, it is recommended that this study use a larger and more varied dataset. This will improve the accuracy of the clustering and the relevance of the results, especially for broader applications. In addition, parameters such as processor, battery capacity, or price can be included in the analysis to create richer clusters that are more in line with consumer needs. The study can also be evaluated by comparing the K-Means algorithm with other clustering methods, such as Apriori or hierarchical clustering and so on, to ensure that the algorithm used is the most optimal in the context of laptop specifications. These steps are expected to provide more complete and useful results for the development of laptop recommendation systems in the future.

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