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Implementation of K-Medoids Clustering Method for Indihome Service Package Market Segmentation

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ABSTRACT

IndiHome (Indonesia Digital Home) is a leading digital fibre optic service product consisting of fibre optic internet services, landline telephones, and interactive TV services. Although the coverage of Indihome products is extensive in the city of Medan, in marketing, Indihome products have not reached the planned target. Based on data from Indihome service package users that have been received, Indihome product users only numbered 6419 customers in all STOs in Medan City. At the same time, the target was planned by PT. Telkom Access Medan, namely Marketing Indihome products, must reach 5,000 customers per month in all STOs in Medan City. Indihome product marketing is an obstacle for PT. Telkom Access Medan, because the Indihome product is a new product, the people of Medan City do not fully know what Indihome is and what facilities they get from using the Indihome service package. Therefore PT. Telkom Access Medan needs to make a plan to make a marketing strategy. The first step that needs to be done is to segment the market for the Indihome service package. This study aimed to determine the application of Data Mining using the K-Medoids Clustering method in the Indihome service package market segmentation at PT. Telkom Access Medan. With this research, it is hoped that it can provide a reference for the results of the decision so that it can help related parties to make it easier to classify the market segmentation of the Indihome service package at PT. Telkom Access Medan. Because the value of S > 0, then the calculation is stopped and ends in the 3rd iteration. Indihome service package data processing uses the k-medoids clustering method in the form of potential, potential, and not potential STO (Sentral Telephone Automated) cluster members.

Keywords: Clustering; IndiHome; K-Medoids; Market Segmentation; Service Package

INTRODUCTION

IndiHome (Indonesia Digital Home) is a leading digital fiber optic service product consisting of fiber optic internet services, landline telephones, and interactive TV services (Egi, et al., 2021). PT. Telkom is a company eng

Aged in telecommunications with IndiHome products, a combination of the types of products and services of telecommunications, information, media, and edutainment into one consisting of internet services, internet voice, and interactive internet or Triple Play (Salna et al., 2021).

Indihome products can now be enjoyed in the Medan City area, namely at STO (Automatic Telephone Center) Binjai, Belawan, Cinta Damai, Galang, Lubuk Pakam, Medan Centrum, Padang Bulan, Percut, Pulo Brayan, Sukaramai, Simpang Limun, Tanjung Mulia, Tanjung Morawa, Tembung and Tuntungan. Although the coverage of Indihome products is very wide in the city of Medan, in marketing Indihome products have not reached the planned target. Based on data from Indihome service package users that have been received, Indihome product users only numbered 6419 customers in all STOs in Medan City. While the target planned by PT. Telkom Access Medan, namely Marketing Indihome products must reach 5,000 customers per month in all STOs in Medan City.

Indihome product marketing is an obstacle for PT. Telkom Access Medan, because the Indihome product is new, the people of Medan City do not fully know what Indihome is and what facilities they get from using the Indihome service package. Therefore PT. Telkom Access Medan needs to make a plan to make a marketing strategy. The first step that needs to be done is to segment the market for the Indihome service package.

Market segmentation is a group of consumers with different needs, characteristics, and behaviors in a particular market so that it becomes a homogeneous and unified market target market with a marketing mix strategy (Prakasawati et al., 2019). Market segmentation aims to make marketing activities more directed, clear, and precise, and company resources in the marketing field will be more directed and used effectively and efficiently (Fitralisma & Mandasari, 2020).

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Therefore, to help PT. Telkom Access Medan, in knowing the market segmentation of the Indihome service package, we need an application that can process the Indihome service package data by applying the Data Mining field. Data mining is the process of extracting or mining. From the large amount of data obtained, this information is beneficial for development using techniques that are the proper data mining process will provide optimal results. (Hutagalung & Sonata, 2021). The primary purpose of data mining is to obtain knowledge that is still hidden in chunks of data and the ability to be explored in the form of patterns that still need to be extracted from existing chunks of data (Nasyuha et al., 2021). With data mining, it is possible to classify cases and deaths from COVID-19 in Southeast Asia based on the attributes of the assessment of total confirmed cases and total deaths (Hutagalung et al., 2021).

K-Medoids aim to reduce the sensitivity of the resulting partition concerning extreme values contained in the dataset; the use of medoids is not based on the observed mean owned by each cluster (Fira et al., 2021). The K-Medoids algorithm is an algorithm that overcomes the weakness of the K-Means algorithm, which is sensitive to outliers because objects with large values can deviate from the data distribution (Sindi et al., 2020).

This type of research related to applying the K-Medoids algorithm was also carried out by (Andini & Arifin, 2020). The dataset in this study is the patient disease dataset at the Bandung City Hospital in 2019. Meanwhile, in the research conducted by (Marlina et al., 2018), the dataset was used to distribute children with disabilities in Riau Province. The results of the second study show that the K-Medoids Algorithm works well; each object in each cluster has good quality, where each object has been grouped according to a high level, and K-Medoids are better at grouping data.

This study aimed to determine the application of Data Mining using the K-Medoids Clustering method in the Indihome service package market segmentation at PT. Telkom Access Medan. With this research, it is hoped that it can provide a reference for the results of the decision so that it can help related parties to make it easier to classify the market segmentation of the Indihome service package at PT. Telkom Access Medan.

LITERATURE REVIEW

This section presents several literature reviews whose contents are used as a reference in the study. There are several studies that have been conducted regarding the K-Medoid method, including The K-Medoids algorithm that can be implemented to determine hotel reservations as a marketing strategy with the K-Medoids Clustering calculation stage, where high orders are displayed in cluster 2 with 4530 items/order (Kurniawan et al., 2020).

The results of the research carried out and the discussion that the calculation of the K-Medoids algorithm has explained can perform an excellent grouping to determine the covid 19 data. By forming 3 clusters with the results of cluster 0 as many as 85 items, cluster 1 as many as 123 items, and cluster 2 as many as 59 goods. A total of 267 items according to the data used (Samudi et al., 2022). The active case grouping is carried out by cluster analysis using the K-Medoids Clustering method and calculating the distance between time series using Dynamic Time Warping (DTW) because the data is time series data from March 21, 2020, to July 4, 2021. The optimal number of groups taken in the clustering stage is based on the largest pseudo-F coefficient value (Irfan et al., 2021).

The method used is the k-medoids clustering method which is a clustering partition method to group objects into k clusters. The algorithm used is K-Medoids with Euclidean Distance and processing data by performing data selection, cleaning data, data transformation, data mining, and evaluation. The research found that the grouping of the characteristics of each set that was formed based on the poverty indicator values in East Java in 2020 was 2 clusters. There are 30 regencies/cities in cluster 1 and 8 regencies/cities in cluster 2 (Alfiah et al., 2022). Thus, the results obtained from the DHF disease dataset are: Karawang Regency in 2020 has 2 optimal clusters (Daffa Rafif Agustian, 2022).

In classifying the spread of the coronavirus in Indonesia. Able to open clusters using the K-Medoids algorithm method, the smallest Davies Boulden K-2 index value is 0.411 (Utomo, 2021). K-medoid grouping using the distance method to search and group data have similarities and differences. The distance measurement method is essential because it affects the performance of the medoid k cluster results. The euclidean measurement method is superior to Gower on a numeric type dataset using the k-medoids clustering algorithm (Aditya et al., 2021).

K-medoids algorithm is included in the partition-based clustering method. K-Medoids algorithm partitions data or divides data into groups based on symbolic objects (representatives). The K-medoids algorithm updates the centroid with the actual object as a cluster representation instead of using the average as in the K-Means algorithm. So the K-Medoids algorithm minimizes the differences between each p object and the nearest representation object, using the absolute number of errors (Orisa & Faisol, 2021).

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The stages of the k-medoids algorithm is as follows (Bimantoro & Wardhani, 2020):

1. Determine the desired k (number of clusters).
2. Randomly select k initial medoids from n data.
3. Calculate the distance of each object to the temporary medoid, then mark the closest distance of the object to the medoid and calculate the total.
4. Perform medoid iterations.
5. Calculate the total deviation (S) If a is the sum of the shortest distances between objects to the initial medoid, and b is the sum of the shortest distances between objects to the new medoid, then the total deviation is S = b- a , If S < 0, then swap objects with data to form a new k as a medoid.
6. Repeat steps 3 to 5 and stop if there is no change in the medoid member.

METHOD

In this research, the K-Medoids algorithm is used to group the Indihome package service market segmentation, so that information is found that can be used to determine the right product marketing strategy. The research used is experimental. The stages of the study can be seen in Figure 1.

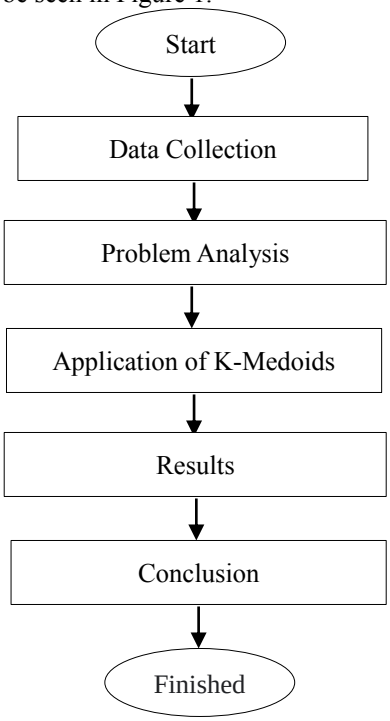

Fig. 1 Research Stages

Data samples were collected from PT Telkom Access Medan in the form of Indihome service package data for the period November-December 2021. Perform problem analysis by segmenting the market for the Indihome service package. By segmenting the Indihome service package market, PT. Telkom Access Medan can choose a market that will be prioritized as a marketing target for Indihome products and make it easier to determine marketing strategies in each segment or group so that marketing is more focused and marketing channels will be well organized. Therefore, to help PT. Telkom Access Medan in knowing the market segmentation of the Indihome service package, we need an application that can process the Indihome service package data using the k-medoids clustering method in the field of Data Mining. To determine the market segmentation of the Indihome service package, the attributes used are Automated Telephone Central (STO), one play package (1p), double play package (2p).) and triple play (3p) packages.

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These results are obtained from the data taken by data mining calculations, then processed using the k-medoids clustering algorithm so as to produce accurate information and values for the segmentation of the Indihome service package market at PT. Telkom Access Medan. Performance and time in the data processing process become more effective and efficient.

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Performance and time in the data processing process become more effective and efficient. These results are obtained from the data taken by data mining calculations, then processed using the k-medoids clustering algorithm to produce accurate information and values for segmenting the Indihome service package market at PT. Telkom Access Medan.

RESULT

Data Selection

Before researching the information in the KDD, the data selection is first carried out, namely the piece of data from operational data whose selection is stored in a file. Data selection based on the type of Indihome service package consists of the Internet, Internet + Voice / Internet + IPTV, Internet + Voice + IPTV, as shown in table 1 below.

Table 1. Data Selection Based on Indihome Service Package Type

No.	Initialization	Service Type
1	1p	Internet
2	2p	Internet + Voice / Internet + IPTV
3	3p	Internet + Voice + IPTV

After completing the initialization table for the Indihome service pack type, the initialization table is re-created for the initial center point of the cluster to start the calculation. After initializing the initial center point of the group, the next step is to create a frequency table for the Indihome service pack, as shown in Table 2 below.

Table 2. Frequency of Indihome Service Packages

No.	Initialization	STO Name	1p	2p	3p
1	BJI	Binjai	182	136	301
2	TMU	Tembung	211	85	92
3	SKI	Sukaramai	97	104	316
4	MDC	Medan Centrum	145	185	335
5	PDB	Padang Bulan	126	140	102
6	CTD	Cinta Damai	136	172	323
7	SPM	Simpang Limun	94	153	79
8	GLG	Galang	124	98	111
9	TJR	Tanjung Morawa	149	112	308

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10	TJM	Tanjung Mulia	161	82	98
11	LBP	Lubuk Pakam	112	126	81
12	TTG	Tuntungan	120	95	77
13	PUB	Pulo Brayan	102	124	135
14	PRT	Percut	129	113	94
5	BLW	Belawan	145	97	112

Application of The K-Medoids Algorithm

At this stage, the application of the k-medoids algorithm is carried out using the Euclidian Distance measure formula with the formula:

$$d(x,y) = \|x - y\| = \sqrt{\sum_{i=1}^{n}(xi - yi); k = 1,2, \dots n}$$

Information :
d(x,y) = Distance of data to x to center of cluster y
xi = Data to x on data attribute to i
yi = Data to y on attribute data to i
n = number of attributes used
The steps in the K-Medoids Clustering algorithm are as follows:

1. Determination of the Initial Center (Medoids) of the Cluster
   The determination of the number of clusters (K) is 3 clusters. After setting the number of clusters, determine the initial center point of the cluster (medoid). The following is a table of the initial center points of the selected medoid, as shown in table 3 below.

Table 3. Initial Center Point Cluster Iteration 1

Iteration 1				
Initialization	Medoids	1p	2p	3p
BJI	m1	182	136	301
TJM	m2	161	82	98
PRT	m3	129	113	94

2. Distance Calculation With Cluster Center
   Allocate each data (object) to the nearest cluster using the Euclidian Distance measure equation.
   a. Distance between BJI and point m1
      $= \sqrt{(182-182)^2 + (136-136)^2 + (301-301)^2}$
      $= 0$
   b. Distance between TMU and point m1
      $= \sqrt{(211-182)^2 + (85-136)^2 + (92-301)^2}$
      = 217.078
   c. Distance between SKI and point m1
      $= \sqrt{(97-182)^2 + (104-136)^2 + (316-301)^2}$
      = 92.054

   And so on, the distance calculation is carried out until the 15th data with the formula as above. For more the complete distance in each data row, the results are as in table 4 below:

Table 4. Results of 1 Iteration Calculations

Initialization	C1	C2	C3	Nearest Distance	*Cluster*
BJI	0	211.107	214.912	0	C1
TMU	217.078	50.448	86.672	50.448	C2
SKI	92.054	228.263	224.475	92.054	C1

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MDC	70.185	258.909	252.034	70.185	C1
PDB	206.768	67.86	28.32	28.32	C3
CTD	62.418	243.619	236.582	62.418	C1
SPM	239.41	99.454	55.227	55.227	C3
GLG	202.257	42.356	23.216	23.216	C3
TJR	41.4	212.471	214.935	41.4	C1
TJM	211.107	0	44.733	0	C2
LBP	231.084	68.015	25.04	25.04	C3
TTG	236.011	47.864	26.344	26.344	C3
PUB	184.662	81.327	50.309	50.309	C3
PRT	214.912	44.733	0	0	C3
BLW	196.497	26.019	28.914	26.019	C2
Total Cost				550.98	

3. Determination of New Centers (Medoids) Randomly In Each Cluster
Randomly select an object in each cluster as a candidate for new medoids, as shown in table 5 below.

Table 5. New Center Points (Medoids) 2 Iteration

Iteration 1				
Initialization	Medoids	1p	2p	3p
TMU	*m1*	211	85	92
CTD	*m2*	136	172	323
GLG	*m3*	124	98	111

4. Calculate Center Point Distance (Medoids) New
Calculate each object distance that is in each cluster with the new candidate medoids, as shown in table 6 below.
   a. Distance between BJI and point m1
   $= \sqrt{(182-211)^2 + (136-85)^2 + (301-92)^2}$
   $= 217{,}078$
   b. Distance between TMU and point m1
   $= \sqrt{(211-211)^2 + (85-85)^2 + (92-92)^2}$
   $= 0$
   c. Distance between SKI and point m1
   $= \sqrt{(97-211)^2 + (104-185)^2 + (316-92)^2}$
   $= 252.058$

Table 6. Results of 2 Iteration Calculations

Initialization	C1	C2	C3	Nearest Distance	*Cluster*
BJI	217.078	62.418	202.257	62.418	C2
TMU	0	257.983	89.994	0	C1
SKI	252.058	78.702	206.857	78.702	C2
MDC	270.934	19.849	241.218	19.849	C2
SPM	135.949	248.316	70.349	70.349	C3
GLG	89.994	224.864	0	0	C3
TJR	226.338	63.198	199.073	63.198	C2
TJM	50.448	243.619	42.356	42.356	C3
LBP	107.717	247.499	42.755	42.755	C3
TTG	92.769	258.265	34.366	34.366	C3
PUB	123.495	196.987	41.665	41.665	C3
PRT	86.672	236.582	23.216	23.216	C3
BLW	70	224.114	21.048	21.048	C3
TOTAL *COST*				542.922	

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5. Calculating Total Cost/Distance
   Calculate the total deviation (S) by calculating the value between the new total distance - the old total distance. If S < 0 ,then swap objects with cluster data to form a new set of objects as medoids. Calculate the value of S with the formula:
   S = new total cost – old total cost
   S = 542,922 – 550.98= - 8.058
   Because S < 0 , then the calculation is continued in the 3rd iteration, swapping objects with cluster data to form a new set of objects as medoids.

Repeat Steps 3 to 5 Until No Change in Medoids.

1. Random determination of new centers (medoids) in each cluster, as shown in table 7 below.

Table 7. New Center Point (Medoids) Iteration 3

	Iteration 1			
Initialization	Medoids	1p	2p	3p
MDC	m1	145	185	335
LBP	m2	112	126	81
BLW	m3	145	97	112

Calculate new center point distance (medoids). Calculate each object distance that is in each cluster with the new candidate medoids, as shown in table 8 below.

a. Distance between BJI and point m1
$= \sqrt{(182-145)^2 + (136-185)^2 + (301-335)^2}$
$= 70{,}185$

b. Distance between TMU and point m1
$= \sqrt{(211-145)^2 + (85-185)^2 + (92-335)^2}$
$= 270.934$

c. Distance between SKI and point m1
$= \sqrt{(97-145)^2 + (104-185)^2 + (316-335)^2}$
$= 96.052$

Table 8. Results of 3 Iteration Calculations

Initialization	C1	C2	C3	Nearest Distance	*Cluster*
BJI	70.185	231.084	196.497	70.185	C1
TMU	270.934	107.717	70	70	C3
SKI	96.052	236.504	209.688	96.052	C1
MDC	0	262.842	239.735	0	C1
CTD	19.849	247.499	224.114	19.849	C1
SPM	262.985	32.512	82.62	32.512	C2
GLG	241.218	42.755	21.048	21.048	C3
TJR	77.936	230.421	196.614	77.936	C1
TJM	258.909	68.015	26.019	26.019	C3
LBP	262.842	0	53.768	0	C2
TTG	274.388	32.265	43.058	32.265	C2
PUB	213.471	54.955	55.74	54.955	C2
PRT	252.034	25.04	28.914	25.04	C2
BLW	239.735	53.768	0	0	C3
TOTAL *COST*				**554.723**	

2. Calculating total cost/distance
   Calculate the total deviation (S) by calculating the value between the new total distance - the old total distance. If S < 0, then swap objects with cluster data to form a new set of objects as medoids. Calculate the value of S with the formula:

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S = new total cost – old total cost
S = 554.723 –542.922 = 11.081
S = 11.081 > 0
Because the value of S > 0 then the calculation is stopped and ends in the 3rd iteration.

3. *Interpretation* atau *Evaluation*
At this stage, it produces information from the process of implementing data mining for market segmentation of the indihome service package using the k-medoids clustering method at PT. Telkom Access Medan. as shown in table 9 below.

Table 9. The Results of STO Cluster Members

No.	Initialization	STO Name	*Cluster*	Information
1	BJI	Binjai	*Cluster* 1	Very Potential
2	SKI	Sukaramai	*Cluster* 1	Very Potential
3	MDC	Medan Centrum	*Cluster* 1	Very Potential
4	CTD	Cinta Damai	*Cluster* 1	Very Potential
5	TJR	Tanjung Morawa	*Cluster* 1	Very Potential
6	PDB	Padang Bulan	*Cluster* 2	Potential
7	SPM	Simpang Limun	*Cluster* 2	Potential
8	LBP	Lubuk Pakam	*Cluster* 2	Potential
9	TTG	Tuntungan	*Cluster* 2	Potential
10	PUB	Pulo Brayan	*Cluster* 2	Potential
11	PRT	Percut	*Cluster* 2	Potential
12	TBU	Tembung	*Cluster* 3	Not Potential
13	GLG	Galang	*Cluster* 3	Not Potential
14	TJM	Tanjung Mulia	*Cluster* 3	Not Potential
15	BLW	Belawan	*Cluster* 3	Not Potential

DISCUSSIONS

System implementation is when an application is ready to be operated or implemented. Performance of the system begins by displaying the login form, then the main menu, and other forms. The following displays the system implementation in the Application of Data Mining for Market Segmentation of Indihome Service Packages Using the K-Medoids Clustering Method at PT. Telkom Access Medan.

Data Package Form Display

Package data form is a form used to import data in the form of excel documents. The package data form consists of 4 button objects, namely choose file, import, add data and delete all data. The following figure 2 is a display of the package data form when the excel document has been imported:

A package data form is used to import data in the format of excel documents. The package data form consists of 4 button objects: choose file, import, add data and delete all data. The following table 10 is a display of the package data form when the excel document has been imported:

Table 10. Display of Package Data Form

No.	Initialization	STO Name	*1p*	2p	3p
1	BJI	Binjai	182	156	301
2	SKI	Sukaramai	145	97	112
3	MDC	Medan Centrum	136	172	323
4	CTD	Cinta Damai	124	95	111
5	TJR	Tanjung Morawa	112	126	81
6	PDB	Padang Bulan	145	185	335

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7	SPM	Simpang Limun	126	140	102
8	LBP	Lubuk Pakam	129	113	94
9	TTG	Tuntungan	102	124	135
10	PUB	Pulo Brayan	97	104	316
11	PRT	Percut	94	153	79
12	TBU	Tembung	161	82	98
13	GLG	Galang	149	112	308
14	TJM	Tanjung Mulia	211	85	92
15	BLW	Belawan	120	95	77

Process Form Display

The process form is used to process the calculation of the k-medoids clustering algorithm for processing the Indihome service package data that was imported in the previous form.

When the user clicks the k-medoids process button on the main menu, the system will display the process form by inputting medoids 1, 2, and 3 in iteration 1. After that, the user clicks the process button, and the system displays the iteration results. Once the next process is up to the 3rd iteration. The following table 11 is a display of the process form:

Table 11. Display of Iteration Results On The Process Form

Initialization	C1	C2	C3	Nearest Distance	*Cluster*
BJI	0	211.107	214.912	0	C1
TMU	217.078	50.448	86.672	50.448	C2
SKI	92.054	228.263	224.475	92.054	C1
MDC	70.185	258.909	252.034	70.185	C1
PDB	206.768	67.86	28.32	28.32	C3
CTD	62.418	243.619	236.582	62.418	C1
SPM	239.41	99.454	55.227	55.227	C3
GLG	202.257	42.356	23.216	23.216	C3
TJR	41.4	212.471	214.935	41.4	C1
TJM	211.107	0	44.733	0	C2
LBP	231.084	68.015	25.04	25.04	C3
TTG	236.011	47.864	26.344	26.344	C3
PUB	184.662	81.327	50.309	50.309	C3
PRT	214.912	44.733	0	0	C3
BLW	196.497	26.019	28.914	26.019	C2

The table 12 is the display of iteration 1 cluster members on the process form as follows:

Table 12. Display of Cluster Members on the Process Form

Cluster 1			
BJI	182	136	301
CTD	136	172	323
MDC	145	185	335
SKI	97	104	316
TJR	149	112	308
Cluster 2			
BLW	145	97	112
TJM	161	82	96

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TMU	211	85	92
		Cluster 3	
GLG	124	98	111
LBP	112	126	81
PDB	126	140	102
PRT	129	113	94
PUB	102	124	135
SPM	94	153	79
TTG	120	95	77

Report Form Display

The report form serves to display report results based on data processing of the Indihome service package using the k-medoids clustering method, in the form of very potential, potential, and not potential STO (Automatic Telephone Central) cluster members. Table 13 is a display of the report form from the calculation process of the k-medoids clustering algorithm as follows:

Table 13. Report Printout Display

No.	Initialization	STO Name	*Cluster*	Information
1	BJI	Binjai	*Cluster* 1	Very Potential
2	BLW	Belawan	*Cluster* 3	Not Potential
3	CTD	Cinta Damai	*Cluster* 1	Very Potential
4	GLG	Galang	*Cluster* 3	Not Potential
5	LBP	Lubuk Pakam	*Cluster* 3	Not Potential
6	MDC	Medan Centrum	*Cluster* 1	Very Potential
7	PDB	Padang Bulan	*Cluster* 3	Not Potential
8	PRT	Percut	*Cluster 3*	Not Potential
9	PUB	Pulo Brayan	*Cluster 3*	Not Potential
10	SKI	Sukaramai	*Cluster* 1	Very Potential
11	SPM	Simpang Limun	*Cluster* 2	Potential
12	TJM	Tanjung Mulia	*Cluster* 3	Not Potential
13	TJR	Tanjung Morawa	*Cluster 1*	Very Potential
14	TMU	Tembung	*Cluster* 3	Not Potential
15	TTG	Tuntungan	*Cluster* 3	Not Potential

CONCLUSION

After implementing the system and testing, the following conclusions can be drawn: The system is used to determine the market segmentation of the Indihome service package using the k-medoids clustering method, then a system is designed that is able to apply the field of data mining science. The web-based application has been able to apply the field of data mining science in processing Indihome service package data so that data processing results can be used as material to determine which markets will be prioritized as marketing targets for Indihome products. The system that has been designed can be used as a problem solution precisely and accurately. Indihome service package data processing uses the k-medoids clustering method in the form of very potential, potential, and not potential STO (Sentral Telephone Automated) cluster members.

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