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Implementation of Apriori Algorithm in Determining the Layout of Items

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ABSTRACT

Shopping at mini markets is now becoming popular as people's shopping orientation changes. This results in consumers preferring to shop in modern markets rather than to stalls or traditional shops. Because consumers want to shop comfortably and practically or in terms of finding goods in an easy way and knowing the location of the desired item. Risaga Jaya is a retail business that sells various needs such as staples, cosmetics, stationery, various snacks, During its operation, many goods are not in demand and there is a buildup of goods in the warehouse because there is no strategy for placing the position of goods that are more attractive to consumers. The purpose of this research is to create a strategy for placing goods to maximize sales using data mining with the apriori algorithm. By using the apriori algorithm, it can organize and organize the layout of an item by bringing related items closer together so that it can increase sales at the store based on consumer purchasing patterns, namely if consumers buy chitato then buy snack candy with a support given of 10% and a confidence given of 75%.

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1. INTRODUCTION

The development of information technology has fundamentally changed the way humans interact, work and live their daily lives. Innovations in computing, networking, and software have enabled rapid and global access to information, optimized business processes, and created new platforms for communication. [1]. Capabilities in artificial intelligence, data analytics, and cloud computing have opened up opportunities for more advanced and efficient solutions in various sectors, including healthcare, education, and industry [2].

Developments in the retail or self-service business reflect changes in the way consumers fulfill their daily needs, from the traditional offering of basic goods, this retail business is growing rapidly by providing a variety of products, including fresh and innovative products [3]. In addition, awareness of sustainability has also influenced self-service businesses to adopt environmentally friendly practices, and emphasize local products, thus, the evolution of self-service retail businesses reflects a response to changing consumer preferences and increasingly complex environmental demands [4].

Shopping at mini markets has become popular as people's shopping orientation changes [5]. This has resulted in consumers preferring to shop at modern markets rather than at stalls or traditional shops [6]. Because consumers also want to shop comfortably and practically or in terms of finding goods in an easy way and knowing the location of the desired item [7]. Developing interest in shopping at minimarkets in consumers depends on what facilities are provided when consumers decide to buy the goods they want [8].

Risaga Jaya Market is a store engaged in retail. Risaga Jaya Market sells various needs such as staples, cosmetics, stationery, various snacks, and other needs. As information technology develops, it now

requires Risaga Jaya Market to use techniques or strategies to attract consumer attention and provide shopping convenience to consumers. Techniques that can be used are in predicting what patterns are purchased by consumers, products desired by consumers and providing convenience for consumers in finding the desired product [9].

In realizing consumer convenience in shopping, data mining techniques are used [10]. Data mining is a series of processes to explore added value in the form of information that has not been known manually from a database by extracting patterns from data with the aim of manipulating data into more valuable information obtained by extracting and recognizing important or interesting patterns from data contained in the database. There are several algorithms that can be used to help in this research, one of which is the a priori algorithm. The a priori algorithm is data collection with association rules determined by associative relationships from combinations of several items [11][12]. With this a priori algorithm, it can provide convenience for consumers by placing items that are often purchased together in a close or easily accessible position so that consumers do not have to bother buying the desired items [13].

By using data mining using the apriori algorithm, it can predict consumers in buying the desired item. Here are some previous studies that the authors made as references in this study, Research conducted by Muhammad Imron et al in 2023 [14] to determine the sales layout in a supermarket store using the apriori algorithm, they concluded that it can be used as a reference for supermarket managers in order to bring the resulting product layout closer to eggs, oil, and flour, then the products that must be kept away are soy sauce, snacks, candy, milk, and the last arrangement is detergent and soap, so that product sales in supermarkets that were previously less than optimal are better.Research conducted by Wulansari and Chulkamdi in 2022 [15] about the layout of placing merchandise at Toko Mekar Sari in Blitar using the apriori algorithm, the researcher concluded that the top product ranking is the product that has the most number of transactions, the lower the transaction that occurs on the product the less. By knowing the number of transactions for each product, the user can determine the layout and price appropriately.

Other research researched by Mardianti and Rahmat Fauzi in 2021 [16] about consumer patterns towards the layout of goods using the apriori algorithm. The researcher concluded that processing on sales transaction data as much as 1750 data and 23 attributes using the Apriori algorithm association method resulted in consumer patterns with 2-Itemset and the highest association rule of 4 rules with a minimum support of 5% and confidence of 50%. Based on the results of the implementation of the Apriori algorithm, recommendations are obtained for the placement of goods placed on adjacent shelves at Toko Agung Stationery. This aims to make it easier for consumers to shop for items that are often purchased together which is useful for developing strategies so that revenue will also increase.Further research by Iswandi et al in 2020 [17] about determining the layout of goods in hypermart using the apriori algorithm. Researchers concluded that the application of the Apriori Algorithm obtained nine associative rules. Of the nine rules, six categories of goods are recommended to be placed close together, namely: (1) H & B; (2) milk / coffee / tea; (3) detergent; (4) bulk product; (5) biscuits / snacks; and (6) sauces & spices. It is recommended to place the six categories of goods close together. The detergent category is recommended to be placed in the middle of the other five categories because it always appears in the associative rule. However, it is also necessary to consider the placement of items with the detergent category so as not to interfere with items with food or beverage type categories.

In other research researched by Yakub et al in 2019 [18] about the use of the apriori algorithm on the layout pattern of goods at Swalayan Berkah for sales strategy. From the research that has been done, it is concluded that this system was built by applying the apriori algorithm by following the steps of the algorithm to get the expected results, namely the identification of transaction data, high frequency pattern search analysis, the formation of a combination pattern of two item sets and the formation of association rules and this system is implemented to Toko Berkah Swalayan to be able to find out whether the system is in accordance with the needs or not.

2. RESEARCH METHOD

In this study, the object of research is Risaga Jaya Market which is a retail business located at Jl. Perintis Kemerdekaan Simpang Empat, Simpang Empat District, Regency. Asahan. In this study, several stages of research will be carried out, such as figure 1.

There are several stages to this research: (1) Problem identification: is the first step where at this stage looking for problems that occur in the field through direct observation to Risaga Jaya Market. (2) Data collection: carried out by conducting direct interviews with employees and owners of Risaga Jaya Market, the data collected is product data and transaction data. (3) Literature Study: this stage is looking for literature in the form of national and international journals or references regarding the same method that can provide the information needed for this research and can help strengthen existing theories. (4) Designing the System: is a pattern or description of the user interface of the application to be created using Microsoft Visio and

using the Unified Modeling Language as a system user design. (5) System implementation: is the stage of converting the results of the design that has been made before. For system implementation using the php programming language and mysql database. At this stage using the Sublime Text 3 application as an editor. (6) Testing the system: at this stage testing the finished system using the black box method the aim is to ascertain whether the system made is running properly and correctly.

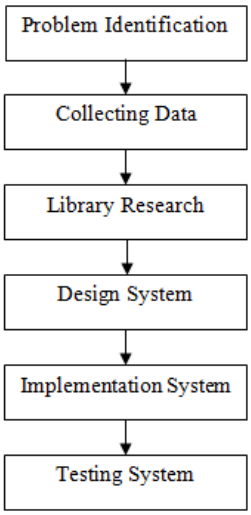

Figure 1. Stage of Research

2.1 Association Rule

Association rule is a data mining technique used to find interesting relationships between variables in large datasets. It is often used in shopping cart analysis to identify products that are often purchased together. An association rule consists of two parts: antecedent and consequent, with key metrics such as support, confidence, and lift that measure the strength of the rule. Support indicates how often the combination of items appear together, confidence measures how often the consequent appears when the antecedent is present, and lift indicates the increased likelihood of the consequent appearing when the antecedent is present compared to no antecedent [19].

2.2 Apriori Algoritm

The apriori algorithm is a data mining method used to discover patterns of frequent itemsets in large datasets and generate association rules. The algorithm works by identifying itemsets that co-occur frequently and then expanding them into larger rules if smaller itemsets also co-occur frequently. The process involves two main steps: finding all frequent itemsets with minimum support and generating strong association rules from those frequent itemsets with minimum confidence. Apriori uses the property of antimonotonicity, i.e. if an itemset is not frequent, then its supersets are also not frequent [20].

2.2.1 Data Set

A dataset in the Apriori algorithm is a set of transaction data used to find frequent itemsets patterns and generate association rules. Each transaction in the dataset is usually a list of items purchased or selected together by users or customers. The following is a dataset of transactions at Risaga Jaya Market.

Table 1. Data Set

No	Code of Transaction	Item
1	22012400177	Abc Chocomalt, Dilan Choco, Inaco Jelly Mini, Oreo Double Choco
2	23012400042	Aice, Led Ace, Nice Facial Soft
3	24012400113	Aice, Better, Gula Putih Lampung, Telur Ayam, Tiga Sapi Putih, Yupi Strawberry, Zwitsal Hair&Body Wash
4	24012400060	Aice, Kanzler, Kecap Sedap, Mr Potato, Pejoy
5	23012400146	Amazing Creme, Beras Payung, Daia, Royale
6	22012400208	Anti Nyamuk, Chitato, Coln Spray, Japota, Kapas Kecantikan, Pejoy, Permen Jajan, Roma Superstarwafer
7	24012400031	Atb, Hatari, Kemiri Artis, Mb Powder, Permen Jajan, Vegetable Stick, Zyluck Stick
8	23012400123	Baterai Um, Buku Tulis, Gula Putih Lampung, Jam Dinding, Mb Powder, Pisau Ideal, Top White Coffe, Vape, Wdh Spf 30
9	23012400135	Bebelove, Cimory Yogurt, Minyak Makan, Mt Gt White, Poster Cpr, Tiga Sapi

No	Code of Transaction	Item
10	22012400160	Putih Beras Payung, Bodrex Box
..	…….	……
24	22012400073	Sosis Asimo, Tiga Sapi Putih, Vegetable Stick

2.2.2 Value Support Itemset 1

To calculate the support value of itemset 1 using the formula 1.

$$Support\ (A) = \frac{number\ of\ transactions\ containing\ A\ x\ 100\%}{total\ transaction} \quad (1)$$

After doing the calculations using the formula above, the results are shown in Table 2 below.

Table 2. Value Support Itemset 1

No	Item1	Qty	Support
1	Abc Chocomalt	Number of transactions that contain abc chocomalt = 1	Number of transactions that contain abc chocomalt / sum of all transactions = 1 / 24 = 4.17%
2	Dilan Choco	Number of transactions that contain dilan choco = 1	Number of transactions that contain dilan choco / sum of all transactions = 1 / 24 = 4.17%
3	Inaco Jelly Mini	Number of transactions that contain inaco jelly mini = 2	Number of transactions that contain inaco jelly mini / sum of all transactions = 2 / 24 = 8.33%
4	Oreo Double Choco	Number of transactions that contain oreo double choco = 1	Number of transactions that contain oreo double choco / sum of all transactions = 1 / 24 = 4.17%
5	Aice	Number of transactions that contain aice = 3	Number of transactions that contain aice / sum of all transactions = 3 / 24 = 12.5%
6	Led Ace	Number of transactions that contain led ace = 1	Number of transactions that contain led ace / sum of all transactions = 1 / 24 = 4.17%
7	Nice Facial Soft	Number of transactions that contain nice facial soft = 3	Number of transactions that contain nice facial soft / sum of all transactions = 3 / 24 = 12.5%
8	Better	Number of transactions that contain better = 1	Number of transactions that contain better / sum of all transactions = 1 / 24 = 4.17%
9	Gula Putih Lampung	Number of transactions that contain gula putih lampung = 6	Number of transactions that contain gula putih lampung / sum of all transactions = 6 / 24 = 25%
10	Telur Ayam	Number of transactions that contain telur ayam = 1	Number of transactions that contain telur ayam / sum of all transactions = 1 / 24 = 4.17%
…	…….	……	……
89	Sosis Asimo	Number of transactions that contain sosis asimo = 1	Number of transactions that contain sosis asimo / sum of all transactions = 1 / 24 = 4.17%

Based on the itemset value obtained, an elimination process is carried out from 1 itemset which has a minimum support value of 10%, then items that have a support value of less than 10% are eliminated The results of the minimum support of 1 itemset obtained can be seen in table 3.

Table 3. Minimum Support Itemset 1

No	Item1	Qty	Support
1	Permen Jajan	8	33.33%
2	Gula Putih Lampung	6	25.00%
3	Beras Payung	6	25.00%
4	Tiga Sapi Putih	5	20.83%
5	Chitato	4	16.67%
6	Mb Powder	4	16.67%
7	Nice Facial Soft	3	12.50%
8	Mr Potato	3	12.50%
9	Aice	3	12.50%

2.2.3 Value Support Itemset 2

To calculate the support value of itemset 2 using the formula 2.

$$Support\ (A\ \cup B) = \frac{number\ of\ transactions\ containing\ \ A\ and\ B\ x\ 100\%}{total\ transaction} \quad (2)$$

After doing the calculations using the formula above, the results are shown in Table 4.

Table 4. Value Support 2 Itemset

No	Item1	Item2	Qty	Support
1	Permen Jajan	Chitato	Number of transactions that contain permen jajan, chitato = 3	Number of transactions that contain permen jajan, chitato / sum of all transactions = 3 / 24 = 12.5%
2	Permen Jajan	Nice Facial Soft	Number of transactions that contain permen jajan, nice facial soft = 2	Number of transactions that contain permen jajan, nice facial soft / sum of all transactions = 2 / 24 = 8.33%
3	Beras Payung	Gula Putih Lampung	Number of transactions that contain beras payung, gula putih lampung = 2	Number of transactions that contain beras payung, gula putih lampung / sum of all transactions = 2 / 24 = 8.33%
4	Permen Jajan	Mb Powder	Number of transactions that contain permen jajan, mb powder = 2	Number of transactions that contain permen jajan, mb powder / sum of all transactions = 2 / 24 = 8.33%
5	Tiga Sapi Putih	Permen Jajan	Number of transactions that contain tiga sapi putih, permen jajan = 2	Number of transactions that contain tiga sapi putih, permen jajan / sum of all transactions = 2 / 24 = 8.33%
6	Chitato	Mr Potato	Number of transactions that contain chitato, mr potato = 2	Number of transactions that contain chitato, mr potato / sum of all transactions = 2 / 24 = 8.33%
7	Tiga Sapi Putih	Aice	Number of transactions that contain tiga sapi putih, aice = 1	Number of transactions that contain tiga sapi putih, aice / sum of all transactions = 1 / 24 = 4.17%
8	Permen Jajan	Mr Potato	Number of transactions that contain permen jajan, mr potato = 1	Number of transactions that contain permen jajan, mr potato / sum of all transactions = 1 / 24 = 4.17%
9	Gula Putih Lampung	Mb Powder	Number of transactions that contain gula putih lampung, mb powder = 1	Number of transactions that contain gula putih lampung, mb powder / sum of all transactions = 1 / 24 = 4.17%
10	Gula Putih Lampung	Aice	Number of transactions that contain gula putih lampung, aice = 1	Number of transactions that contain gula putih lampung, aice / sum of all transactions = 1 / 24 = 4.17%
…	……..	……	…….....	…….
36	Aice	Mb Powder	Number of transactions that contain aice, mb powder = 0	Number of transactions that contain aice, mb powder / sum of all transactions = 0 / 24 = 0%

Items with the name Candy snacks that meet 10% support have a support value of 12%.

2.2.4 Count Confidence 2 Itemset

To calculate confidence, you can use the formula :

$$Confidence\left(\frac{B}{A}\right) = \frac{jThe\ transaction\ amount\ contains\ A\ and\ B\ x\ 100\%}{number\ of\ transactions\ containing\ A} \quad (3)$$

After doing the calculations using the formula above, the results are obtained in table 5 below.

Table 5. Value Confidence 2 Itemset

No	Rule	Support	Confidence	Sup. * Conf.	Lift Ratio
1	f a consumer buys Chitato then buys Permen Jajan	12.5%	Number of items that contain Permen Jajan, Chitato Number of items containing Chitato = 3/4=75%	12.5% * 75% = 9.38%	Support item (Permen Jajan, Chitato) / (Support item (Chitato) * Support item (Permen Jajan)) = 0.13 / (0.17 * 0.33 = 2.25

3. RESULTS AND ANALYSIS

From the system design that has been converted into an application, the last step is to test the system that has been created using black box testing.

3.1 Design System

The results of the use case diagram design aim to help identify and document the main functionality of the system. In addition, it provides an overview of how users or actors will interact with the system. Use case diagram of data mining analysis using apriori algorithm to determine the layout of goods at Risaga Jaya Market has 2 (two) actors, namely admin and owner. This use case has 2 (two) actors, namely admin and owner. The system design can be seen in Figure 2.

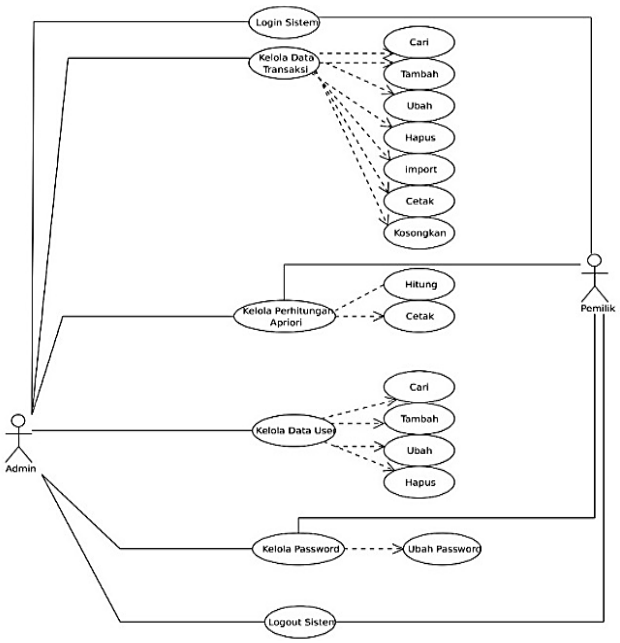

Figure 2. Use Case Diagram

3.2 Implementation System

The implementation stage is the stage of the system based on the results of the previously designed design so that the system can function in actual circumstances and it can be seen whether the system created has succeeded in achieving its actual goals. In the system that has been designed using the use case diagram, there are 2 actors as system users, namely the admin and the owner.

3.2.1 Transaction Data Page

On this transaction data page can be used by admins and owners to view all transactions made which displays transaction data data that has been inputted into the system. The transaction data are transactions, data, and dates. The transaction data form has several action buttons, namely search, add, change, delete, import, and empty.

3.2.2 Apriori Calculation With System

The calculation of data mining using the apriori algorithm can be printed by the admin and owner for archiving as shown in Table 6.

Table 6. Apriori Calculation With System

No	Item1	Qty	Support
1	Abc Chocomalt	1	4.17%
2	Dilan Choco	1	4.17%
3	Inaco Jelly Mini	2	8.33%
4	Oreo Double Choco	1	4.17%
5	Aice	3	12.50%
6	Led Ace	1	4.17%
7	Nice Facial Soft	3	12.50%
8	Better	1	4.17%
9	Gula Putih Lampung	6	25.00%
10	Telur Ayam	1	4.17%
..	……..	……	……..
89	Sosis Asimo	1	4.17%

3.2.3 Testing System

In order for the system to function optimally, the system must first be tested to identify weaknesses and errors, which will then be evaluated. The test results using black box testing, as shown in table 6.

Table 7. Black Box Testing

Input Data	What to Expect	Observation	Conclusion
Click button login	Can do the filling username and password	Username and password in accordance with access rights	[√] Accepted [ ] Rejected

Input Data	What to Expect	Observation	Conclusion
Click button searc	Can view data what to look for.	Search button as expected.	[√] Accepted [ ] Rejected
Click button add	Can add data transaction.	Add button as expected	[√] Accepted [ ] Rejected
Click button edit	Can change data transaction.	Edit button as expected	[√] Accepted [ ] Rejected
Click button delete	Can delete data transaction	Delete button as expected	[√] Accepted [ ] Rejected
Click button import	Can import data transaction.	Import button as expected	[√] Accepted [ ] Rejected
Click button empty	Can empty data transaction.	Empty button as expected	[√] Accepted [ ] Rejected
Click button calculation	Can calculate data.	Calculate button as expected	[√] Accepted [ ] Rejected
Click button print	Can print data.	Print button as expected	[√] Accepted [ ] Rejected
Click button view	Can view graphich.	View button as expected	[√] Accepted [ ] Rejected
Click button change password	Can save data.	Change Password button as expected	[√] Accepted [ ] Rejected
Click button logout	Logout from system.	Logout button as expected	[√] Accepted [ ] Rejected

4. CONCLUSION

Based on research conducted at Risaga Jaya Market, it can be concluded that manual calculations with calculations using data mining applications using the apriori algorithm at Risaga Jaya Market are the same based on the support and confidence values given. By using the apriori algorithm, it can organize and organize the layout of an item by bringing related items closer together so that it can increase sales at the store based on consumer purchasing patterns, namely if consumers buy chitato then buy snack candy with the support given of 10% and the confidence given of 75%.

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