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Apriori Algorithm in Electrical Equipment Sales for Inventory Control Optimization

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ABSTRACT

XYZ Electrical Store is one of the small and medium enterprises that sells various types of electrical equipment for household needs. The management of sales data in the store is still done by recording sales transactions in a book, making the sales report generation process take a long time. With such a sales data management system, control and planning of stock items become less than optimal. Customers often find that the items they want to buy are out of stock. Moreover, the accumulation of less popular items also poses a challenge to the store's cash flow, resulting in suboptimal business processes. This research was conducted to address the issues of controlling and planning stock of goods using data mining techniques with the Apriori algorithm on sales transactions of electrical tools. Through a series of threshold tests, a minsup of 10% and minconf of 60% were obtained. This study results in information on the types of electrical tools that need to be monitored as they can lead to stock shortages when buyers need them, namely, the categories of LED lights, electrical cables, plugs, electrical insulation, and out bow. By knowing this information, it can provide solutions to Sinar Mulya Electric Store in stocking the most frequently sold items in the store.

I. Introduction

In the business world, the need for clear and accurate information has become a necessity for business actors, whether large, medium, or small scale. Along with the rapid development of information technology, data processing systems have also seen significant advancements. This allows data management to be faster, more precise, and efficient. One important piece of information in business activities is sales data, which includes transactions, inventory, and related information. Effective management of sales data plays a crucial role in supporting decision-making as well as the sustainability of the business itself. [1]

XYZ Electric Store is one of the micro, small, and medium enterprises (MSMEs) engaged in selling electrical supplies for household needs. Currently, the management of sales data at the store is still done manually with recordings in notebooks. This method is considered inefficient because it takes a long time to create reports and often results in inaccuracies in stock control. Consequently, the store faces several challenges, such as stock shortages on items that customers are interested in and the accumulation of less popular items, which impacts the cash flow and operational efficiency of the store.

To address these issues, it is necessary to utilize technology that can analyze customer purchasing patterns to assist in inventory management. One technique that can be used is data mining, particularly the association rule technique that can find relationships between items in sales transactions. One of the most commonly used algorithms in this technique is the Apriori algorithm, which is used to analyze the frequency of itemsets in large datasets. This algorithm allows the system to discover patterns of items that are frequently purchased together by customers. [2]

By understanding these patterns, store managers can more easily plan procurement and control inventory accurately. It is hoped that this can minimize excess stock, avoid shortages of needed items, and improve efficiency in the store's overall business processes.

II. The Proposed Method/Algorithm

The software development method used to build decision support systems employs the waterfall model. the waterfall model is often referred to as the linear sequential model or the classic life cycle. The waterfall model provides a sequential or orderly software life cycle approach beginning with analysis, design, coding, testing, and supporting stages. [3]

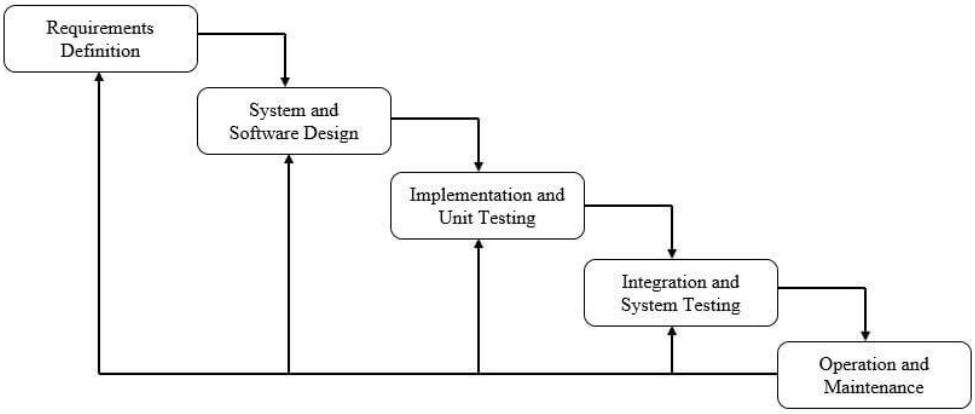

Fig1. The waterfall models

Requirements Definition: In this phase, the process of gathering and analyzing system requirements from users is conducted. All functional and non-functional requirements are detailed thoroughly as the basis for system design. Output: System Requirements Specification (SRS) document [4]. System and Software Design: In this phase, based on the specified requirements, the system architecture, database structure, and user interface (UI) designs are created. This phase divides the system into modules to facilitate implementation. Output: System Design Document (HLD & LLD – High/Low Level Design).Implementation and Unit Testing: In this phase, each designed module is then coded (programming). After that, unit testing is performed to ensure that each module works according to its function. Output: Program code and unit test results. Integration and System Testing at this stage After all units are completed and tested, integration between modules is carried out [5]. Then the system is tested as a whole to ensure that the system works in an integrated manner and meets the initial requirements. Output: A tested integrated system. Operation and Maintenance at this stage the system that has been tested and declared ready for use will. [6]

III. Method

The method used in this research follows the stages of Knowledge Discovery in Database (KDD), which consists of processes of data selection, preprocessing, transformation, data mining, and interpretation or evaluation of results. The data used comes from sales transactions of electrical tools at Toko Listrik Sinar Mulya during September and October 2024. From all the

available attributes, only two main attributes are used in the data mining process, namely the classification of goods and the sales transaction number. This data selection is carried out to ensure that only relevant data is used in the pattern searching process. [7]

The next stage is preprocessing, which includes two main processes: data integration and data cleaning. Although the data comes from a single source, validation of the data structure is still performed to ensure its integrity. In the cleaning stage, data that contains missing values, duplicates, or irrelevant information is cleaned to meet the initial requirements in the data mining process. After the data is cleaned, a transformation process is carried out, which involves converting the data into a transaction format suitable for the input of the Apriori algorithm. Each transaction contains a list of items or goods purchased by customers in a single transaction, arranged in a tabular format. [8]

The core stage of this method is the data mining process using the Apriori algorithm. This algorithm is used to find purchase patterns of goods and association rules between items that are frequently bought together. The algorithm works based on minimum support and minimum confidence parameters to determine valid rules. The result of this process is a combination of itemsets and rules such as 'if buying A01 and B01, then also tends to buy C01', which will later be used to support inventory management decisions.

The final stage of this method is interpretation and evaluation. At this stage, the generated rules are analyzed and compared with real conditions in the field. The goal is to ensure that the information obtained from the data mining process is truly beneficial in decision-making, especially in stock planning and control. With known purchasing patterns, store managers can be more precise in determining stock levels, avoid shortages of highly sought-after items, and reduce the accumulation of slow-moving goods in the market. [9]

IV. Results and Discussion

A. Implementasi User Interface

1. Application Login

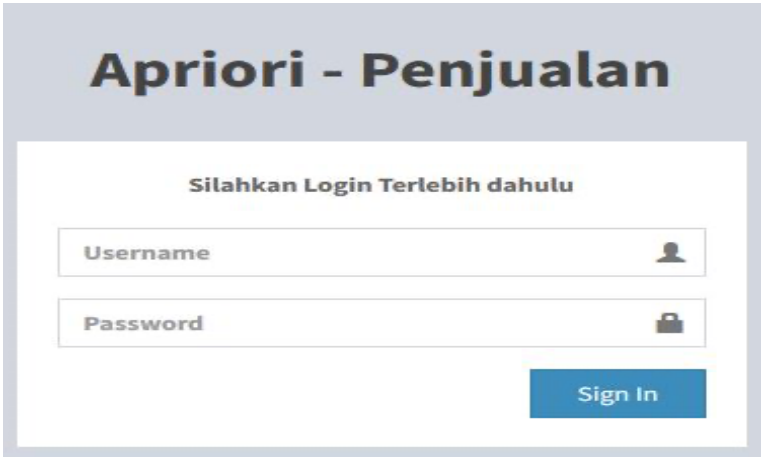

Fig. 2. Application Login

Figure 2 illustrates the login interface of the system, which serves as an authentication gateway for users before accessing the main features. The login form consists of two input fields: ***username*** and ***password***, which must be entered correctly to proceed. This process ensures that only authorized users with registered credentials can access the system, thereby enhancing security and protecting sensitive data. The interface is designed to be simple and user-friendly, allowing both administrators and regular users to log in based on their respective access rights.

2. Home Page

Fig. 3. Home Page

Figure 3 shows the home page of the application after the user successfully logs in. This page serves as the main navigation center, providing quick access to various features and system modules, such as sales data management, reports, and user settings. The home page is designed to be simple and intuitive, making it easy for users to operate the application while displaying important information concisely to support effective decision-making.

3. Electrical Equipment Data Menu

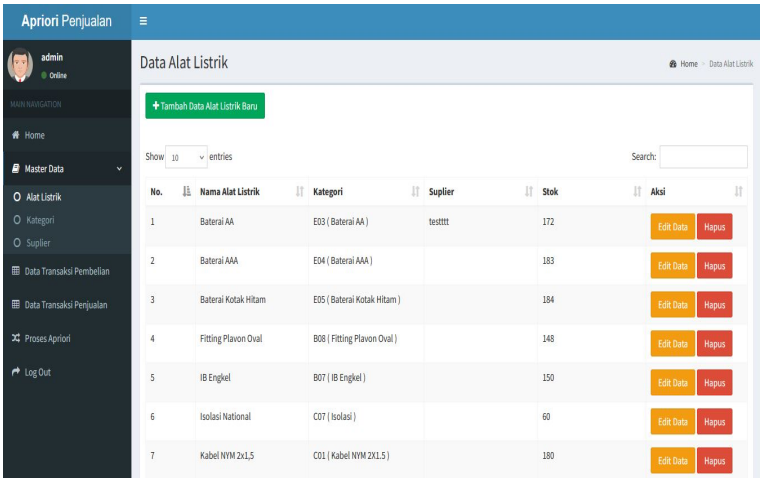

Fig. 4. Electrical Equipment Data Menu

Figure 4 displays the electrical equipment data menu, which serves as the main module for managing product information sold in the store. In this menu, users can perform various activities such as viewing the list of electrical items, adding new data, editing product details, and deleting unnecessary records. The menu interface is designed to be user-friendly, facilitating fast and accurate data management, thereby supporting smooth business operations and effective stock control.

4. Purchase Transaction Data Menu

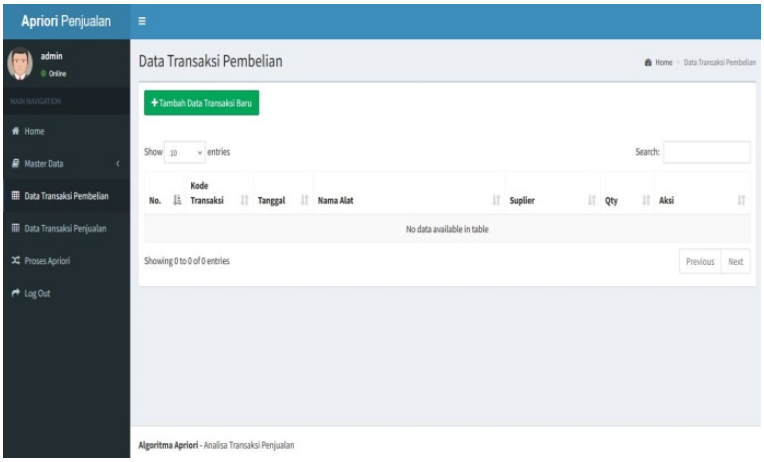

Fig. 5. Purchase Transaction Data Menu

Figure 5 displays the purchase transaction data menu, which is used to record and manage all purchase transactions in the store. Through this menu, users can input new transaction data, view purchase history, and update or delete transaction records as needed. The menu is designed to make the transaction recording process more efficient and organized, facilitating better monitoring of stock movement and supporting more accurate decision-making in inventory management.

5. Sales Transaction Data Menu

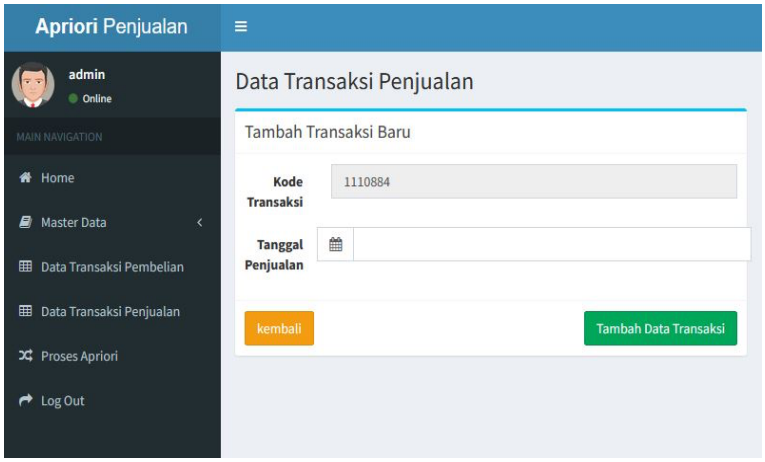

Fig. 6. Sales Transaction Data Menu

Figure 6 shows the sales transaction data menu, which functions to record and manage all sales activities in the store. Through this menu, users can input new sales transaction data, view sales history, and make changes or delete transaction records as needed. The menu is designed to make the sales recording process faster and more accurate, facilitating better stock management and supporting effective business decision-making.

5. Apriori Process Menu

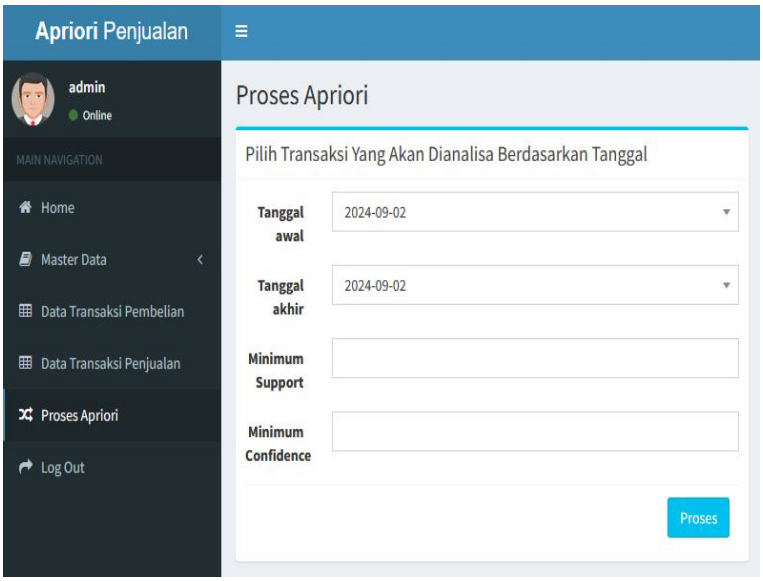

Fig.7 Apriori Process Menu

Figure 7 displays the Apriori process menu used to run the Apriori algorithm in analyzing sales transaction data. Through this menu, users can set parameters such as minimum support and confidence values to obtain relevant association rules. The results of this process are patterns of associations between products frequently bought together, which can then be used to assist in stock management and marketing strategies. This menu is designed to make the data mining process easy to operate and to produce valuable information for decision-making.

V. Conclusion

The association rules generated from the calculations are influenced by the threshold values used [10-12]. The higher the threshold values applied; the more accurate the resulting association rules will be. This is because fewer association rules are produced, which also reduces execution time. Based on the results obtained from manual calculations, calculations using the RapidMiner application, and the developed system, all have the same outcomes. Based on the problem identification and formulation stated at the beginning of the study, and supported by the research results, the following conclusions can be drawn:

a. Planning and controlling inventory can be optimized by using data mining techniques, such as the Apriori algorithm applied in this study. By using a minimum support value of 4% and a minimum confidence value of 30%, the store owner gains insight into which types of items require special attention regarding their stock.
b. With optimal inventory planning and control, the store owner is helped in improving cash flow.

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