

## Web-Based Sales Forecasting Point-of-Sales System Using Simple Moving Average Method at Haka Farma Pharmacy

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### Abstract

POS-POS system is a POS which manages sales transactions, inventory, and daily sales reports at Haka Farma Pharmacy, but it has no sales forecasting capacity. Therefore, many judgment and judgment making processes often need to go through previous procurement to determine the inventory stocks. In order to resolve this issue, this study was aimed at creating a web-based POS system in combination with a sales forecasting component in conjunction with a simple moving average module. Development of the system is conducted using waterfall, which involves requirement analysis, system design, implementation, testing, and deployment of the system. The techniques employed were observational, staff interviews through pharmacy members, and through in-depth literature review. The system developed in PHP using the Laravel framework, was implemented through the MySQL database managers for system. The software's forecast module also uses SMA method to calculate the average sales volume over the last three months in order to estimate demand in the future. Functions testing and testing of system: user authentication, product management, sales transaction processing, reporting, forecasting, and error analysis were done. Testing results were not inconsistent with the specification; all the system related features were functioning as expected. From paracetamol sales data, we found a 253-unit rate expected for December 2025. The MAPE data shows strong forecasting in the form of 3.16% MAPE (Mean Absolute Percentage Error) indicating its predictive power in this study. This confirms that the developed forecasting module can assist in inventory planning, reducing uncertainty for all decision makers, and optimize operational efficiency with evidence-based control of stock in Haka Farma Pharmacy.

Keywords: Point of Sales, Sales Forecasting, Simple Moving Average, Laravel, Information System.

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### 1. Introduction

Information technology has transformed business processes in retail and pharmacy services. No longer are electronic systems employed in simple record keeping (e.g., transactions), but also to integrate sales, inventory, reporting, and decision-support activities. It is in the context of micro, small, and medium enterprises (MSMEs) that a computerized information system minimizes possible manual recording errors and helps managers make decisions based on stored transaction data [1] [2] [3]. Haka Farma Pharmacy is a medicine retailer located in Cikarang Barat, Bekasi, West Java. The pharmacy sells medicines, medical devices, and other pharmaceutical products. As transaction volume grows, managing stocks becomes more complex. The existing POS system can record sales, manage stock, and produce daily reports, but it has no forecasting feature to estimate future medicine demand. Consequently, stock purchasing takes place manually, and this can either result in shortages or excess inventory [4] [5].

Forecasting ability is a necessity here since it translates historical sales records into functional information on which to base future inventory planning and procurement decisions. The Simple Moving Average (SMA) approach has been adopted in the study owing to its computational simplicity, ability to be

implemented into web-based applications, and successful performance of generating short-term demand forecasts in case of sufficient historical transaction information [6] [7] [8]. Leveraging past sales trends, SMA offers a feasible method to forecast future demand for a product with moderate implementation complexity. This study aims to analyze the application of the SMA method towards the forecasting of medicine sales using historical transaction history collected within the Point of Sales (POS) system of Haka Farma Pharmacy and to analyze how the forecast can aid in improvement of the accuracy and effectiveness of inventory procurement planning. Making accurate demand predictions can avoid loss of inventory, and prevent overstock, thereby improving inventory management as it pertains to total value. This paper's primary contribution lies in the development and implementation of an SMA-based forecasting module embedded into a web-based POS information system. Whereas traditional POS systems mainly operate as recording systems and reporting systems, the proposed system combines functionalities including product management, sales transaction processing, reporting, forecasting visualization, and forecasting accuracy evaluation on a single platform. This comprehensive integration allows pharmacy management to access real-time analytical insights and make decisions based on more objective, data-driven

information concerning the stock replenishment and management of inventory, leading to optimized operational efficiency and sustainable business performance.

**2. Research Method**

This study used the Waterfall system development model because the research scope and functional requirements were defined before implementation. The stages consisted of requirement analysis, system design, implementation, and verification. Requirement analysis identified the current POS process, the limitation of manual stock planning, and the need for a forecasting module [9]. System design described actors, data flow, user interfaces, and database relationships using UML diagrams [10]. Implementation used PHP with the Laravel framework and MySQL as the database engine. Verification was performed using black box testing to evaluate system functions from the user's perspective [11].

Data were collected through observation of the pharmacy transaction process, interviews with relevant users, and literature study. Observation was used to identify daily sales and stock management practices at Haka Farma Pharmacy. Interviews clarified the operational needs of the owner, admin, and cashier. Literature study was used to support the use of POS, web-based systems, and forecasting methods in information system development [12] [13] [14]. The SMA method calculates the average of actual sales values from a fixed number of previous periods [15]. In this study, the period length was three months. The formula used is  $SMA = (X_t + X_{t-1} + X_{t-2}) / 3$ , where X represents actual sales data. Forecast accuracy was evaluated using Mean Absolute Deviation (MAD), Mean Squared Error (MSE), and Mean Absolute Percentage Error (MAPE). Next Pos Sales Forecasting System Flow on Figure 1.

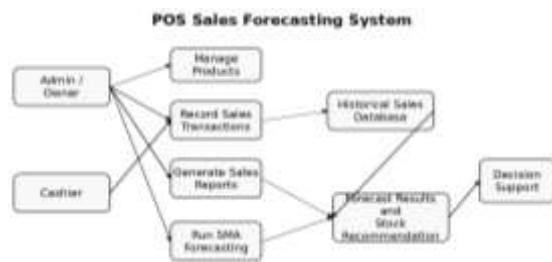


Figure 1. Pos Sales Forecasting System Flow

Figure 1 summarizes the main system flow. Admin or owner users maintain products, read reports, and run forecasting, while cashiers record sales transactions. Historical sales data stored in the database become input for the SMA forecasting process, and the resulting stock recommendation supports purchasing decisions. System design is carried out using Unified Modeling Language (UML) as a system modeling tool. UML is a visual modeling method used in designing and creating object-oriented system through several diagrams, such as Use Case Diagram, Activity Diagram, Sequence Diagram, and Class Diagram [16]. To complete the system design description, the UML

models used in this study are presented as follows. Next Use Case Diagram on Figure 2.

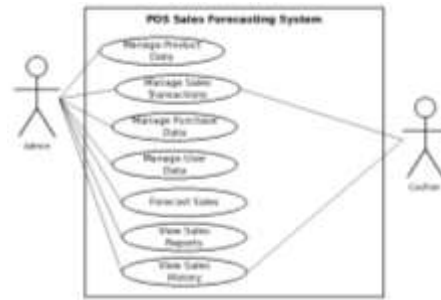


Figure 2. Use Case Diagram

A Use Case Diagram is a diagram that shows the interaction between a system and external parties or users [17]. Figure 2 illustrates the actors and primary interactions in the proposed POS sales forecasting system. The admin has the most complete access rights, including managing products, purchase data, forecasting, and reports, while the cashier focuses on sales transactions and can review transaction history relevant to daily operations. Next Activity Diagram for Product Management on Figure 3.

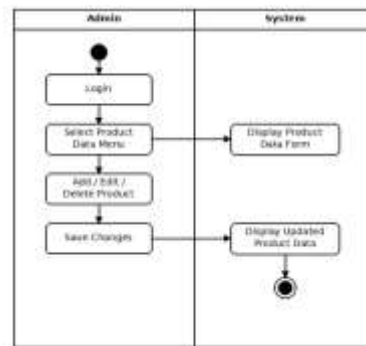


Figure 3. Activity Diagram for Product Management

An activity diagram serves to illustrate the following of activities within an information system. It does not describe the nature of actors but is solely used to illustrate the workflow or activities within the system [18]. Figure 3 is Activity Diagram for product management activity diagram shows that the admin logs into the system, opens the product menu, and performs add, edit, or delete actions on product records. After the command is confirmed, the system stores the changes and refreshes the product data displayed to the user. Next Activity Diagram for Sales Management on Figure 4.



Figure 4. Activity Diagram for Sales Management

The sales management activity diagram describes the cashier workflow. After logging in, the cashier opens the sales menu, selects products and quantities, chooses the payment option, saves the transaction, and receives a sales receipt generated by the system. Next Activity Diagram for Purchase Management on Figure 5.

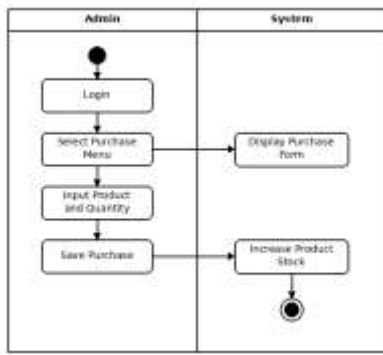


Figure 5. Activity Diagram for Purchase Management

The purchase management activity diagram explains how the admin records incoming stock. The admin logs in, opens the purchase form, enters product and quantity information, and saves the data. The system then automatically updates the product stock in the database. Next Activity Diagram for Sales Forecasting on Figure 6.

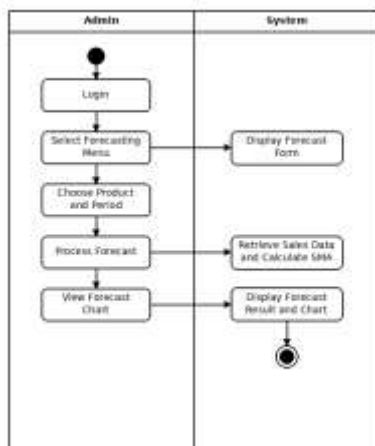


Figure 6. Activity Diagram for Sales Forecasting

The sales forecasting activity diagram begins when the admin logs in and selects the forecasting menu by selecting a product and the forecasting period, where

the system retrieves the historical sales data to perform the Simple Moving Average calculation, and displays the forecasting along with chart visualization. Next Activity Diagram for Reporting on Figure 7.

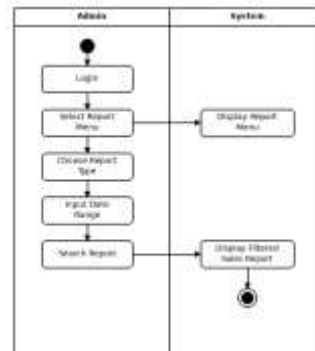


Figure 7. Activity Diagram for Reporting

The reporting activity diagram shows that the admin logs in, opens the report page, chooses the desired transaction report, inputs a specific date or period, and executes the search. The system reads the stored transaction data and displays the report based on the selected filter. Next Sequence Diagram for Product Management on Figure 8.

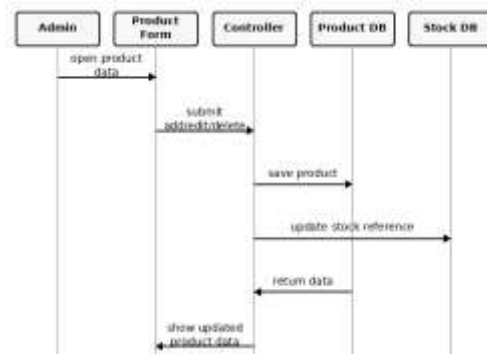


Figure 8. Sequence Diagram for Product Management

A Sequence Diagram serves the purpose of illustrating the interactions between system components. Their primary purpose is to show the sequence of messages sent between objects and how each object interacts in executing a process [19]. Figure 8 presents the sequence of interactions among the admin, product form, controller, product database, and incoming-product database. The system processes the request only after the admin submits a product action, ensuring that product records are stored and updated consistently. Next Sequence Diagram for Purchase Data on Figure 9.

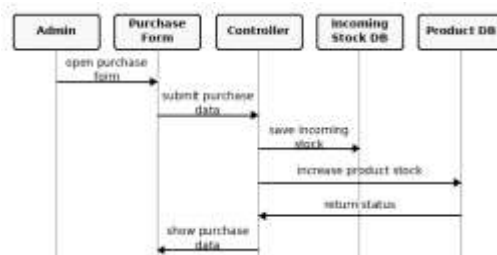


Figure 9. Sequence Diagram for Purchase Data

The purchase sequence diagram shows the communication flow between the admin, purchase form, controller, incoming-product database, and product database. When purchase data are submitted, the controller validates the request and updates both the incoming stock record and the product stock record. Next Sequence Diagram for Sales Transactions on Figure 10.

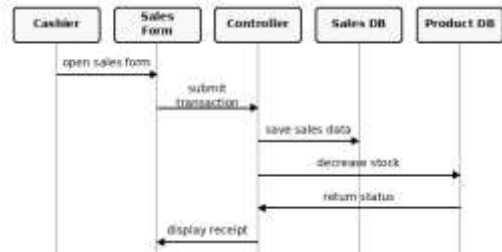


Figure 10. Sequence Diagram for Sales Transactions

The sales transaction sequence diagram involves the cashier, sales form, controller, sales database, and product database. Once the cashier inputs and saves a sales transaction, the controller stores the sales data and synchronizes the remaining stock information.



Figure 11. Sequence Diagram for Forecasting

The forecasting sequence diagram explains how the admin, forecasting form, controller, sales database, and product database interact. After the admin requests the forecasting process, the controller retrieves historical sales data, performs the forecasting computation, and returns the prediction results to the interface. Next Sequence Diagram for Reporting on Figure 12.



Figure 12. Sequence Diagram for Reporting

The reporting sequence diagram shows the interaction between the admin, report form, controller, sales database, and incoming-product database. The report is displayed after the controller receives a reporting request and fetches the required transaction and stock data from the database. Next Class Diagram on Figure 13.

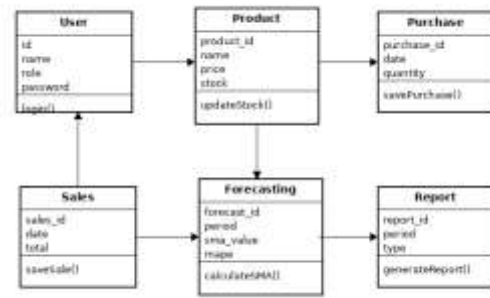


Figure 13. Class Diagram

A Class Diagram describes the static structure of the proposed system based on defining the classes that will be used to design system [20]. It shows the main classes and their relationships, including user, product, purchase, sales, forecasting, and reporting entities. This model helps explain how data are organized and how the application components exchange information during system execution.

### 3. Result and Discussion

The forecasting module allows the user to select a product, choose the SMA period, process historical sales data, and view the predicted value for the next period. The module also presents charts and error values for easier interpretation. Next Forecasting Interface on Figure 14.



Figure 14. Forecasting Interface

Table 1 shows the Paracetamol sales data used for the three-month SMA calculation. Forecast values begin in July because three previous months are required for the first calculation. Next Paracetamol Actual Sales and SMA Forecast on Table 1.

Table 1. Paracetamol Actual Sales and SMA Forecast

Month	Actual Sales	3-Month SMA Forecast	Absolute Error
Apr 2025	235	-	-
May 2025	230	-	-
Jun 2025	260	-	-
Jul 2025	238	242	4
Aug 2025	245	243	2
Sep 2025	240	248	8
Oct 2025	270	241	29
Nov 2025	248	252	4
Dec 2025	-	253	-

The calculation indicates that December 2025 stock planning should consider a forecast of 253 units for Paracetamol. The largest error occurred in October 2025 because actual sales increased sharply from 240

units in September to 270 units in October, while the forecast based on the previous three months was 241 units. This sudden increase produced an absolute percentage error of 10.74%. Next Actual Sales and SMA Forecast Visualization on Figure 15.



Figure 15. Actual Sales and SMA Forecast Visualization

Table 2 summarizes the accuracy measurement. The MAPE value of 3.16% is below 10%, so the prediction is categorized as highly accurate for this case. This result indicates that SMA is feasible as a decision-support method for short-term stock planning at Haka Farma Pharmacy. Next forecast accuracy results on Table 2.

Table 2. Forecast Accuracy Results

Metric	Value	Interpretation
MAD	9.40	Average absolute error in units
MSE	188.20	Squared error average
MAPE	3.16%	Highly accurate (<10%)

The workflow in Figure 16 shows how the forecasting feature operates in the system. The user selects the product and SMA period, the system retrieves historical sales data, calculates the average of the previous three periods, generates the forecast value, calculates error values, and displays the chart and recommendation. Functional testing was conducted using black box testing. The tested features included authentication, product management, sales transactions, reporting, forecasting, and error calculation. All test scenarios produced the expected output. Next SMA Calculation Workflow on Figure 16.



Figure 16. SMA Calculation Workflow

Table 3. Black box testing summary

No	Feature	Expected Output	Status
1	Login	Dashboard or error message appears	Success
2	Product data	Product data can be added, edited, and deleted	Success
3	Sales transaction	Transaction and total payment are stored	Success
4	Sales report	Report appears based on selected period	Success
5	Sales forecasting	SMA forecast result appears	Success
6	Error calculation	MAD, MSE, and MAPE are displayed	Success

The user questionnaire also indicated that the system was understandable and helpful for daily operations. The highest average scores were found in transaction data storage and the ability of prediction to help avoid stock shortages or excess stock. These results strengthen the practical value of adding forecasting to the POS system. The login page provides the initial interface for system access. It contains username and password fields for registered users, namely admin and cashier accounts. The system verifies user credentials before granting access to the next page. Because this application is intended for internal pharmacy operations, account registration and password recovery are controlled by the main administrator to maintain data security. Next login page on Figure 17.



Figure 17. Login Page

The cashier dashboard shows the number of product records and the total sales in the current period. It also provides navigation to product and sales menus so that the cashier can quickly proceed with daily transaction recording. Next Cashier Dashboard on Figure 18.



Figure 18. Cashier Dashboard

The sales transaction menu enables cashiers to record and manage sales transactions where resulting data is stored and subsequently utilized as historical input for

demand forecasting and inventory decision-making replenishment, and inventory management. Next processes. Next Sales Transaction Page on Figure 19. Forecasting Menu Page on Figure 22.



Figure 19. Sales Transaction Page

The form includes the sales date, payment method, product name, price, quantity, discount, grand total, customer payment, and change. Once the transaction is saved, the data become part of the historical sales dataset used later in the forecasting process. Next Admin Dashboard on Figure 20.



Figure 20. Admin Dashboard

The admin dashboard presents broader system monitoring features than the cashier view. It allows the administrator to access product data, purchase information, sales reports, forecasting menus, and other management features required to supervise the pharmacy business process comprehensively. Next Sales Report Page on Figure 21.



Figure 21. Sales Report Page

The sales report module provides complete analysis insights from transaction logs stored in the system. Through product-specific and time-based filtering capabilities, administrators can create custom reports and analyze historical sales performance across selected periods. These historical datasets are essential for identifying sales patterns and trends that support business analysis. Moreover, the acquired sales records are the basis for forecasting activities and provide detailed information for sales projections and more informed decisions regarding inventory planning, stock



Figure 22. Forecasting Menu Page

The forecasting menu page is designed to help users perform sales prediction using historical data stored in the system. On this page, the admin selects the target product and the forecasting period before executing the Simple Moving Average process. Next Forecasting Result Page on Figure 23.



Figure 23. Forecasting Result Page

Sales forecasts derived from the Simple Moving Average (SMA) method based on historical sales records are shown where the system automatically analyzes transaction data from previous periods and calculates the estimated sales demand for the upcoming period as an easy-to-read format, this module enables pharmacy management to make more objective, data-driven decisions regarding inventory procurement, stock replenishment, and overall inventory planning. The forecast chart module provides a visual comparison between actual sales performance and forecasted values over a specified period. This helps managers keep track of sales behavior, find trends from the past, and evaluate how reliable forecasting proves itself. In showing actual sales figures as solid blue lines and predicted values as dashed yellow lines, these charts make it easy to discern the difference between observed and predicted outcomes. Next Forecasting Chart Page on Figure 24.



Figure 24. Forecasting Chart Page

The graphical representation is also helpful for interpretation, so the graphical form helps to show similarities or differences easily, making it very easy to visualize trends quickly. Therefore, this forecasting chart is good as a decision-support tool for inventory planning, stock replenishment, and general demand management activities. Black box testing was conducted to verify whether every main feature of the POS information system worked according to the functional requirements. The test scenarios covered authentication, product data management, sales transactions, sales reporting, sales forecasting with the Simple Moving Average method, and the display of forecasting accuracy values such as MAD, MSE, and MAPE. The detailed test results are presented in Table 4.

Table 4. Black box testing results

Feature Tested	Test Scenario	Expected Result	Status
Login	Enter a valid username and password	Dashboard page is displayed	Pass
Login	Enter an invalid username or password	Error message is displayed	Pass
Product Data	Add a new product record	Product data are saved	Pass
Product Data	Edit a product record	Product data are updated	Pass
Product Data	Delete a product record	Product data are deleted	Pass
Sales Transaction	Add a sales transaction	Transaction data are saved	Pass
Sales Transaction	Calculate the total payment	Total payment is displayed	Pass
Sales Report	Display a report for a selected period	Sales report data are displayed	Pass
Sales Forecasting	Select a product and SMA period	Forecasting result is displayed	Pass
Error Calculation	Display MAD, MSE, and MAPE values	Accuracy result is displayed	Pass

The test results show that all evaluated functions performed successfully. This indicates that the developed web-based POS system is functionally suitable for supporting transaction recording, data management, reporting, and sales forecasting activities

at Haka Farma Pharmacy.

#### 4. Conclusion

This research produced a web-based POS information system with a sales forecasting feature for Haka Farma Pharmacy. The system integrates product management, sales transactions, sales reporting, forecasting, and accuracy evaluation in one application. The Simple Moving Average method was implemented by averaging the previous three months of sales data. In the Paracetamol case, the system generated a December 2025 forecast of 253 units and achieved a MAPE value of 3.16%. Black box testing showed that all main functions worked successfully. Therefore, the proposed forecasting feature can support stock purchase planning and reduce the risk of shortages or overstocking. Future research can compare SMA with Weighted Moving Average, Exponential Smoothing, or other forecasting models to improve accuracy when sales fluctuate sharply.

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