



Development of Point of Sale System Using FIFO Method at Toko Inti Peraga Mandiri Pekanbaru

Kumala Sari Tri Wahyuni¹, Faisal Amir², Riyanto³

^{1,2,3}Manajemen Informatika (Kampus Kab. Pelalawan), Politeknik Negeri Padang

Email: malakstw@gmail.com¹, faisal@pnp.ac.id², riyanto@pnp.ac.id³

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Corresponding Author: Kumala Sari Tri Wahyuni

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ABSTRACT

Advancements in information technology have driven the adoption of systems that facilitate rapid and accurate data management, including the handling of goods and inventory in pharmacies. Bintang Singgalang Pharmacy currently faces challenges in managing product data, sales transactions, and inventory—issues that could lead to recording errors, stockouts, and overstocking. This research aims to develop a web-based Point of Sale (PoS) information system to assist in managing products, suppliers, sales transactions, and stock levels, while also providing recommendations for inventory requirements for the upcoming period. The system was developed using the Waterfall methodology, utilizing PHP and the Laravel framework, with MySQL serving as the database. Key features include the management of product data, categories, units, suppliers, sales transactions, stock outflows, and reports, as well as inventory requirement forecasting using the three-period Single Moving Average (SMA) method. System functionality was validated through Black Box Testing, while forecasting accuracy was evaluated using Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE). The results indicate that the system facilitates more structured data and transaction management. A MAPE value of 34.57% for the Hand Sanitizer 100ml case indicates a relatively high error rate; therefore, the SMA3 results should be interpreted with caution and cannot be generalized to all products. The user acceptance test, involving only 2 respondents, achieved a score of 95.33%, categorized as Highly Accepted; however, this is a preliminary test with limited generalizability. Research limitations and future development suggestions are explicitly discussed.

Keywords: Apotek Bintang Singgalang; Inventory; Laravel; Point of Sale; Single Moving Average

1. INTRODUCTION

The development of information technology has brought progress in various fields, including healthcare, where web-based information systems help data management become faster, more accurate, and easier to search than manual recording [1]. One field that benefits from information technology is pharmacy services, particularly in managing sales transactions and drug inventory. The use of a Point of Sale (PoS) system can support transaction recording, sales reporting, and inventory management in an integrated manner [2].

Apotek Bintang Singgalang still conducts sales processes manually and has not yet implemented a Point of Sale (PoS) system; therefore, recording transactions and calculating purchases take longer and may lead to errors. The increasing volume of sales transaction data also makes it difficult for the pharmacy to determine the quantity of goods that should be purchased for the next period. These conditions may result in stock shortages or excess inventory. Accordingly, a system is needed that can integrate sales transactions, inventory management, and demand forecasting to support more effective decision-making.

Several previous studies have developed web-based PoS systems for pharmacies. Rayhan et al. designed a website-based PoS system at Apotek Berjaya Farma to improve operational efficiency and sales reporting [5]. Tullah et al. developed an object-based PoS system at Apotek Bersama Medika [7]. Other studies have examined web-based pharmacy information systems and inventory management

using forecasting methods, including Single Moving Average, to estimate future stock requirements [8], [9]. These studies provide a foundation for developing an integrated pharmacy information system.

Based on this description, previous studies have generally focused on only one aspect, namely the PoS system, inventory system, or implementation of the Moving Average method. Thus, the integration of sales transactions, stock management, and demand forecasting into a single web-based system remains an area that can be further developed. This study addresses this gap by combining these functions in the information system of Apotek Bintang Singgalang.

This study aims to develop a web-based PoS information system at Apotek Bintang Singgalang that integrates the management of item data, suppliers, sales transactions, and inventory, while implementing the three-period Moving Average method to generate recommendations for the quantity of goods to be purchased in the following period.

2. RESEARCH METHODS

2.1 Research Design

This study employed a system development approach (Research and Development) using the Waterfall method. The Waterfall method is a software development model carried out sequentially, starting from requirements analysis, system design, implementation, testing, and maintenance [10].

This method was selected because the requirements of the system to be developed had been clearly identified, allowing the development process to be carried out systematically and in a structured manner. The research stages followed the workflow below:

1. Requirements Analysis: identifying user needs and system functional requirements through observation and interviews.
2. System Design: designing the user interface, database, and system modeling.
3. Implementation (Coding and Development): translating the design into a program using PHP (Laravel) and MySQL.
4. Testing: testing the system using Black Box Testing and evaluating the accuracy of the Moving Average method using MAPE.
5. Maintenance: ensuring that the system continues to operate properly and improving it when errors or new requirements are identified.

2.2 Research Object and Dataset

The research object was the sales, purchasing, and inventory transaction processes at Apotek Bintang Singgalang. The data used for forecasting consisted of outgoing-goods sales data from January 2026 to July 2026. The data were obtained from the pharmacy's transaction records and used to calculate the forecast of item requirements for the following period.

2.3 Data Collection Techniques

Data were collected through observation and interviews with the pharmacy owner regarding sales transactions, goods purchasing, stock management, and the process of determining purchase quantities. Before data collection, the researcher obtained written permission from the owner of Apotek Bintang Singgalang. The collected data were used for research and system development purposes.

2.4 Research Tools and Materials

The physical computer components or devices used during system development and system testing included:

1. PC/Laptop : Lenovo IdeaPad Slim 3 14IAH8
2. Processor : Intel Core i5-12450H Gen-12

3. RAM : 8 GB
4. SSD : 512 GB

Software or platforms supporting system development included:

1. Operating System : Windows 11 64-bit
2. DBMS : MySql (8.0.30)
3. Local Server : Laragon (PHP 8.3.17)
4. Tools : Draw.io, Composer (2.8.12)
5. Browser : Chrome Version 151.0.7922.76 (64-bit)
6. Text Editor : Visual Studio Code (Laravel Framework 10.48.22)

2.5 System Design

1. System Architecture Design

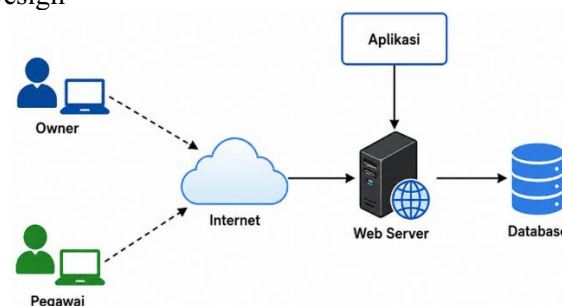


Figure 1. System Architecture Design

The system architecture illustrates the relationship between users (Owner and Staff), the application Point of Sale, web server, and database. Users access the application through a computer/laptop connected to the internet and log in according to their access rights. Each request is forwarded to the web server, which runs the application logic for authentication, sales transactions, item data management, and inventory processing. The database stores system data so that they can be accessed and managed in an integrated manner.

2. Use Case Diagram

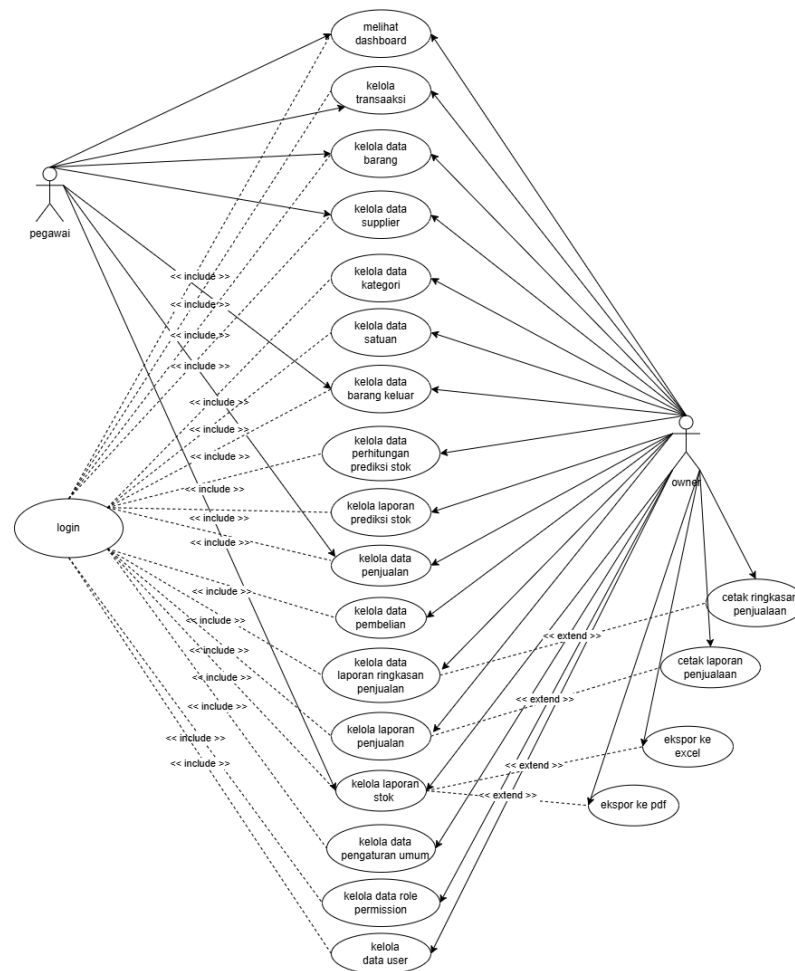


Figure 2. Use Case Diagram

The use case diagram illustrates the interaction of the two main actors, namely Staff and Owner, with the system functions. Staff are responsible for daily operations such as logging in, managing transactions, item data, categories, units, and sales. The Owner has additional access, including managing stock forecasts and viewing reports, as well as monitoring system operations.

2.6 Single Moving Average Forecasting Method

The system applies the three-period Single Moving Average (SMA) method to generate a forecast of item requirements for the following period. The calculation uses the following formula:

$$SMA_3 = \frac{(X_1 + X_2 + X_3)}{3} \quad (1)$$

Where: SMA_3 is the forecast for the next period; X_1 , X_2 , and X_3 are the sales/requirement data for the three periods preceding the month being forecast. Forecasting is performed only for items with sales data for at least three periods.

2.7 Data Analysis Techniques

Functional system testing was conducted using Black Box Testing to ensure that each feature operated according to user requirements, focusing on the system's inputs, processes, and outputs without examining the program code structure. Testing covered 30 scenarios involving login, item category and unit management, supplier data, sales transactions, stock management, and reports. Forecasting accuracy was evaluated using Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE), calculated using the following formulas:

$$MAE = \frac{1}{n} \sum_{i=1}^n |Actual_i - Prediction_i| \quad (2)$$

$$MAPE = \frac{1}{n} \sum_{i=1}^n \left| \frac{(Actual_i - Prediction_i)}{Actual_i} \right| \times 100\% \quad (3)$$

Where: n is the number of data points tested, Actual_i is the actual requirement/sales value in month i, and Forecast_i is the SMA3 result for month i.

User Acceptance Testing (UAT) was conducted to measure user acceptance of the system. The test involved two respondents (one Owner and one Staff member) using a five-point Likert-scale questionnaire (1–5) with 15 questions covering four variables: system quality, information quality, service quality, and system benefits. The results were calculated as a percentage of the maximum possible score.

3. RESULTS AND DISCUSSION

3.1 System Implementation Results

A web-based Point of Sale (PoS) Information System was successfully developed using the Laravel framework and MySQL database. The system provides features for managing item data, categories, units, suppliers, sales transactions, outgoing goods, reports, and a dedicated page for calculating stock forecasts using the Single Moving Average method.

1. Dashboard Page

The Dashboard page can be accessed by users after successfully logging in and is used to access the menus available in the system.

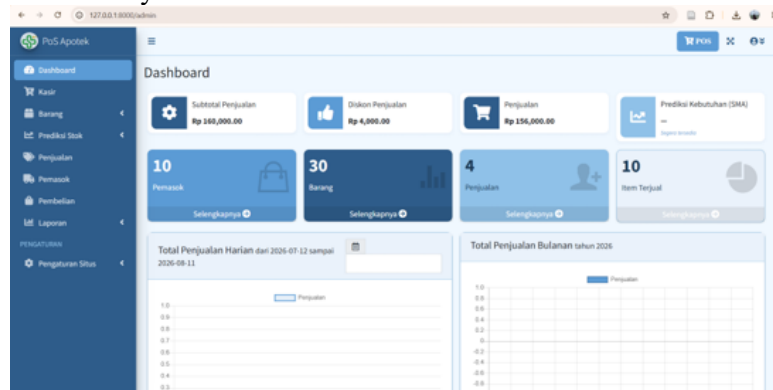


Figure 3. Dashboard Page

2. Stock Forecast Calculation Page

This page displays the results of forecasting item requirements using the three-period Single Moving Average method, which serve as recommendations for the quantity of goods to be purchased in the following period.

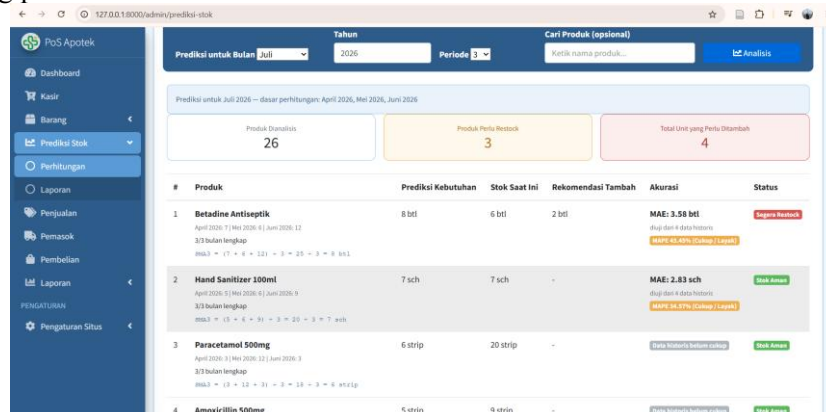


Figure 4. Stock Forecast Calculation Page

3.2 Case Study of the Single Moving Average Method: 100 ml Hand Sanitizer

The three-period Single Moving Average method (SMA₃) was tested in a case study forecasting the demand for 100 ml Hand Sanitizer using historical sales data from January to July 2026 (3, 4, 4, 5, 6, 9, and 11 units). Accuracy testing was performed at four data points ($n = 4$), namely the forecasts for April, May, June, and July 2026. The calculation results are presented in Table 1.

Table 1. Summary of SMA₃ Calculations

Tested Month	SMA ₃ Basis	Forecast	Actual	Absolute Error
April 2026	Jan, Feb, Mar	3,667	5	1,333
Mey 2026	Feb, Mar, Apr	4,333	6	1,667
June 2026	Mar, Apr, Mey	5,000	9	4,000
July 2026	Apr, Mei, Jun	6,667	11	4,333

Based on Table 1, the Mean Absolute Error (MAE) was calculated as the average of the absolute differences between actual and forecast values at the four test points, as follows:

$$MAE = \frac{1,333 + 1,667 + 4,000 + 4,333}{4}$$

$$MAE = \frac{11,333}{4}$$

$$MAE = 2,833 \text{ unit} \approx 2,83 \text{ unit}$$

The Mean Absolute Percentage Error (MAPE) was calculated as the average percentage error relative to the actual value, as follows:

$$MAPE = \frac{\left[\frac{1,333}{5} + \frac{1,667}{6} + \frac{4,000}{9} + \frac{4,333}{11} \right]}{4} \times 100\%$$

$$MAPE = \frac{[0,2667 + 0,2778 + 0,4444 + 0,3939]}{4} \times 100\%$$

$$MAPE = \frac{1,3828}{4} \times 100\%$$

$$MAPE = 34,57\%$$

Table 2. Verification of Manual and System Calculation Results

Metric	Manual Calculation	System Results
MAE	2,83 unit	2,83 unit
MAPE	34,57%	34,57%

The comparison in Table 2 shows that the MAE and MAPE values generated by the system are exactly the same as those obtained through manual calculations. Therefore, the Single Moving Average calculation implemented in the system is considered computationally valid.

Critical Interpretation of MAPE 34.57%

The MAPE value of 34.57% falls within the category of relatively high error. According to MAPE interpretation standards, values above 20% indicate low forecasting accuracy. This is attributable to the sharp increase in demand in June and July 2026 (9 and 11 units), while SMA₃ produces forecasts based on the average of the three previous periods. Consequently, the method responds more slowly to sudden changes in demand. Therefore, the forecasting results should be used as supporting information for purchase planning rather than as the sole basis for decision-making.

3.3 User Acceptance Test (UAT) Results

UAT involved two respondents (one Owner and one Staff member) using a five-point Likert-scale questionnaire with 15 questions. The acceptance level was calculated using the following formula:

$$Persentase = \frac{\text{Total Score Obtained}}{\text{Maximum Score}} \times 100\% \quad (4)$$

Maximum Score = $2 \times 15 \times 5 = 150$. The total score obtained was 143; therefore:

$$Persentase = \frac{143}{150} \times 100\%$$

Table 3. UAT Results by Variable

Variable	Score	Percentage	Category
System Quality	48	96,00%	Very Good
Information Quality	47	94,00%	Very Good
Service Quality	48	96,00%	Very Good
System Benefits	48	96,00%	Very Good
Average	47,67	95,33%	Very Good

The UAT results showed an average acceptance rate of 95.33%, categorized as very good. All variables were in the very good category, with the highest scores for system quality, service quality, and system benefits (96%), while information quality received the lowest score (94%). Nevertheless, all variables indicated a very good level of user acceptance.

3.4 Discussion

This study successfully integrates a Point of Sale (PoS) system, inventory management, and demand forecasting into a single unified system. Compared to the study by Abdillah and Akmal, which applied the Simple Moving Average (SMA) method to a perfume store POS system, this research incorporates forecasting accuracy evaluations using MAE and MAPE while critically contextualizing the results. A study by Herlambang et al. [13] at Apotek Haka Farma reported a MAPE of 3.16% for paracetamol, which is significantly lower than the findings of this study (34.57%). This discrepancy may stem from variations in data characteristics; while Herlambang et al. utilized data with more stable patterns, this study encountered sharp demand spikes in June and July 2026. International literature also demonstrates that Exponential Smoothing methods often yield superior accuracy compared to Simple Moving Average for data exhibiting trends or seasonality, [11], [12]. This indicates that to enhance forecasting accuracy, future research should compare SMA with alternative methods, such as Weighted Moving Average (WMA) or Exponential Smoothing (ES).

4. CONCLUSION

Based on the design, development, and testing results, a web-based Point of Sale (PoS) Information System was successfully developed for Apotek Bintang Singgalang using Laravel and MySQL. The system effectively manages item data, suppliers, sales transactions, and stock levels in an integrated manner. A three-period Simple Moving Average method was successfully implemented to generate inventory purchase recommendations based on historical sales data. Testing results on a 100ml Hand Sanitizer case study showed an MAE value of 2.83 units and a MAPE of 34.57%. This relatively high MAPE value indicates that the SMA₃ method cannot yet be claimed as highly accurate for products exhibiting sharp upward demand patterns. The system's computational results exactly matched manual calculations, confirming the system's computational validity. Black Box testing across 30 scenarios demonstrated that all core system functions operate according to requirements. Finally, User Acceptance Testing (UAT) involving two respondents yielded an acceptance rate of 95.33%, falling into the 'excellent' category; however, this result represents a limited preliminary test and cannot be generalized.

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