



## Inventory Forecasting System Using LSTM for Vape Store

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### ABSTRACT

*Inventory management remains a critical challenge for small and medium-sized retail businesses, including Gonvapestore, a vape retailer in Bali, where stock decisions are often made intuitively. This study aims to design and implement a stock forecasting system using the Long Short-Term Memory (LSTM) algorithm to enhance the accuracy of monthly inventory predictions. The research follows the Knowledge Discovery in Database (KDD) process, encompassing data selection, preprocessing, and time series transformation through a sliding window approach. The LSTM model was developed using TensorFlow and Keras, and its forecasting accuracy was evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Mean Absolute Percentage Error (MAPE) metrics. Experimental results show that the LSTM model achieved superior performance compared to ARIMA, with RMSE and MAE values of 3.14 and 2.71, respectively, versus 6.05 and 5.21 for ARIMA. Product-level evaluation using MAPE indicates that Icy Lychee achieved a relatively low error rate of 37%, while Icy Mango (50%) and Icy Watermelon (52%) exhibited higher error rates, suggesting model performance may vary across product categories. These results demonstrate the LSTM model's superior ability to capture nonlinear sales patterns compared to traditional statistical approaches. The model was integrated into a Django-based web system with a real-time visualization dashboard and sales logging features. The proposed system offers a practical and intelligent decision-support tool for retail inventory management, reducing stockout and overstock risks through data-driven forecasting.*

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## 1. Introduction

Indonesia's trade sector continues to grow significantly, driven by digital transformation and increased public demand. One of the rapidly expanding segments is the vape industry, which has gained traction due to increased awareness of the health risks associated with traditional cigarettes. Vape stores have emerged in urban areas offering a wide range of devices, liquids, and accessories. However, this growth also brings operational challenges, especially in inventory management [1],[2]. Gonvapestore, a vape retail store based in Bali, has experienced frequent stockouts and overstock situations due to decisions based solely

on intuition. These inefficiencies affect operational continuity, customer satisfaction, and business profitability. To mitigate these risks, accurate stock forecasting is essential. Previous studies have explored various forecasting models, including ARIMA, Artificial Neural Networks (ANN), and Long Short-Term Memory (LSTM) networks. LSTM has shown high effectiveness in handling time series data due to its ability to capture long-term dependencies [3],[4]. For instance, Hurtado-Mora et al. implemented an LSTM-based forecasting model with customized loss functions and hyperparameter tuning to enhance sales prediction accuracy [5],[6]. This study proposes the development of a stock forecasting system using the LSTM model trained on historical vape product sales data. Unlike prior studies that focused solely on model performance, this research emphasizes practical implementation in a Django-based web platform and incorporates blackbox testing to ensure system reliability[7],[8]. The novelty lies in the system's integration of forecasting accuracy with user-centered design tailored for SMEs in the retail sector.

## 2. Method

This study adopts the Knowledge Discovery in Database (KDD) process to develop a forecasting system using the Long Short-Term Memory (LSTM) algorithm. The KDD methodology includes five main stages: data selection, preprocessing, transformation, data mining, and evaluation.

### Data Selection

The dataset used in this study consists of historical sales records of vape liquid products from Gonvapestore, covering the period from 2019 to 2023. These records were obtained from the store's transaction archives.

### Preprocessing

In this stage, the dataset was cleaned to remove missing or duplicate values. Numerical features were normalized to ensure compatibility with the input structure required by the LSTM network.

### Transformation

The cleaned data was reshaped into time series format using a sliding window method, where each input sample consists of a sequence of previous sales values used to predict the next value.

### Data Mining (LSTM Model Construction)

The LSTM model was built using TensorFlow and Keras. The architecture includes an input layer, one or two LSTM hidden layers, and a dense output layer to generate the sales forecast. The model was trained for 10 epochs using the Adam optimizer and Mean Squared Error (MSE) as the loss function. A 30-day lookback window was applied to capture temporal dependencies [9],[10].

### Evaluation

Model performance was evaluated using Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE), which measure the deviation between actual and predicted values. The LSTM model was compared with an ARIMA baseline to assess accuracy and robustness [11], [12].

### System Implementation and Testing

The forecasting model was integrated into a web-based system using the Django framework. The system provides a dashboard interface for users to input sales data and

visualize forecast results. Blackbox Testing was employed to verify system functionality, ensuring each feature operates according to specifications.

### 3. Result and Discussions

This section presents the results of the system implementation and LSTM model evaluation. The developed system features multiple interfaces to facilitate user interaction, such as login authentication, data entry, and sales visualization. Additionally, forecasting accuracy was evaluated and compared with a baseline ARIMA model using RMSE and MAPE metrics.

#### Login Interface

The login page is the first view when users access the system. It ensures that only authorized users can access the forecasting dashboard by verifying the correct username and password.

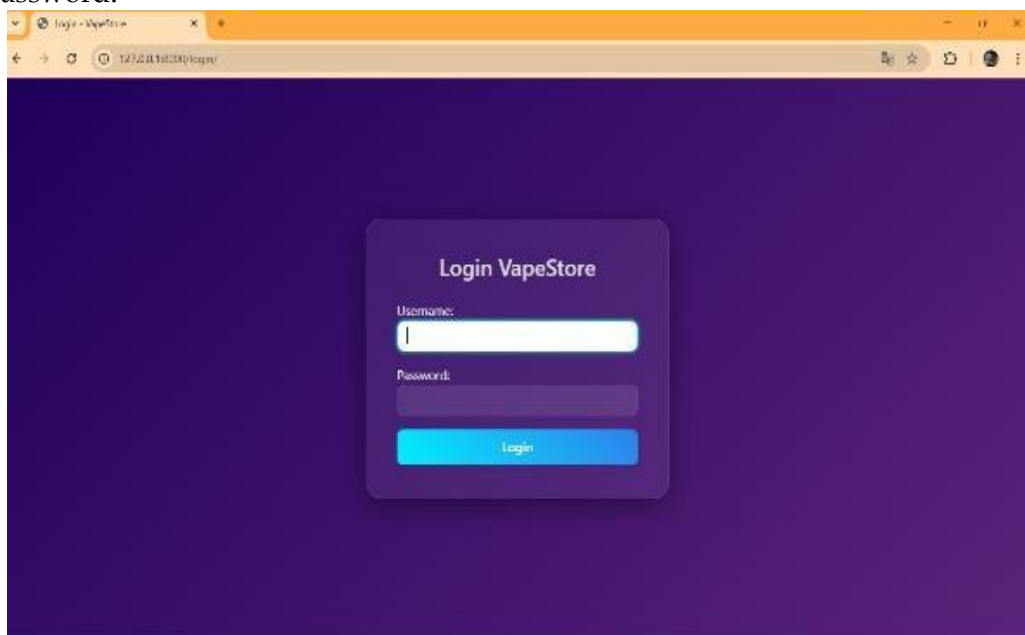


Figure 1. Login Page

#### Failed Login Notification

If incorrect credentials are entered, the system prevents access and prompts the user with an error message. This mechanism secures the forecasting system from unauthorized usage.

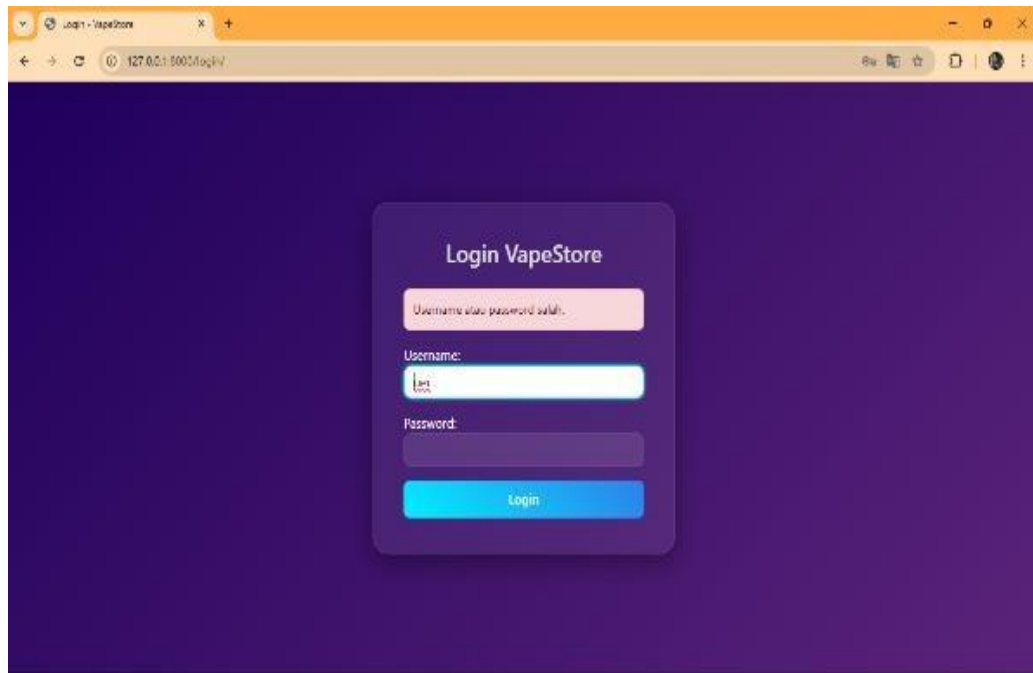


Figure 2. Failed Login Notification

### Dashboard View

Once logged in, users are directed to the dashboard. This interface displays stock forecasting results in graphical form, providing a visual representation of predicted sales trends for the upcoming months.

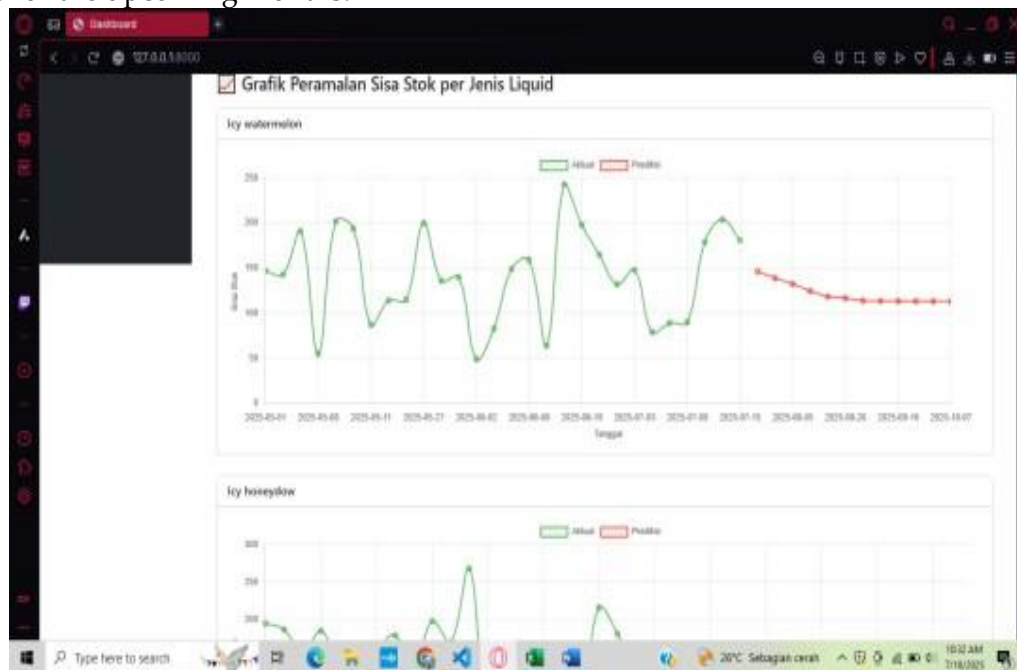


Figure 3. Dashboard Visualization

### Sales Entry Page

Users can input recent sales data directly through this page. New data entries are automatically processed and included in the next forecasting cycle.

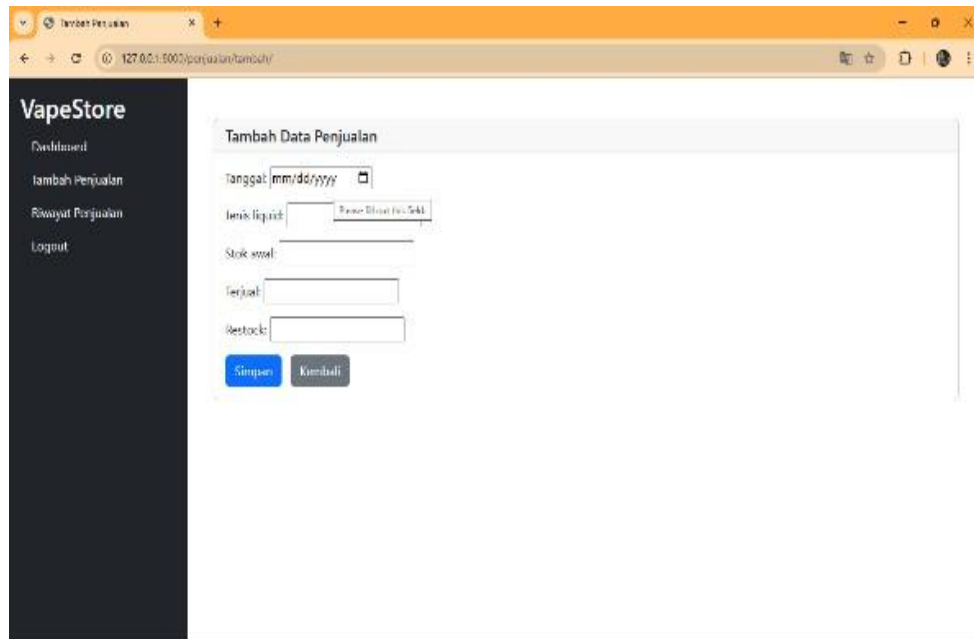


Figure 4. Add Sales Data Page

### Sales History Table

The system also displays the top 10 most recent transactions from the dataset in a tabular format to provide users with a quick reference to historical inputs.

Tanggal	Jenis Liquid	Stok Awal	Terjual	Restock	Sisa Stok
2023-12-29	icy grape	110	12	45	144
2023-12-29	icy MANGO	141	35	78	144
2023-12-29	icy lychee	79	24	65	120
2023-12-30	icy banana	176	31	46	241
2023-12-30	icy watermelon	164	12	50	202
2023-12-30	icy watermelon	55	25	83	113
2023-12-31	icy berry	67	32	27	62
2023-12-31	icy grape	39	27	56	89
2023-12-31	icy berry	141	10	57	188
2023-06-16	mango	100	90	10	20

Figure 5. Sales History Page

### Forecasting Performance Evaluation

The forecasting accuracy of the LSTM model was evaluated using RMSE and MAPE metrics. For comparison, the ARIMA model was also tested using the same dataset.

Table 1. Forecasting Performance Comparison

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Model	RMSE	MAE
LSTM	3.14	2.71
ARIMA	6.05	5.21

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Research finding is the LSTM model outperformed ARIMA with significantly lower RMSE and MAE values, indicating its superior capability in learning sales patterns. Product-level evaluation using MAPE also revealed that some products, such as Icy Lychee, achieved relatively low MAPE (37%), indicating accurate forecasting [13]. Meanwhile, other products like Icy Mango (50%) and Icy Watermelon (52%) showed higher error rates, suggesting model performance varies by product category [14]. These findings align with other studies demonstrating LSTM's superiority in capturing complex time series patterns [16], [17]. The integration of the model into a Django-based system with real-time visual feedback and sales logging makes this approach practical for small and medium-sized retail businesses.

#### 4. Conclusion

This study successfully developed a stock forecasting system for Gonvapestore using the Long Short-Term Memory (LSTM) method. The implementation followed the Knowledge Discovery in Database (KDD) process, from data selection and preprocessing to time series transformation and model evaluation. The LSTM model demonstrated strong forecasting capabilities, achieving lower RMSE and MAE values compared to the ARIMA model, indicating improved prediction accuracy. The forecasting results were integrated into a web-based platform using Django, which allows users to input sales data, visualize forecasts, and manage inventory more effectively. System testing using the blackbox method confirmed the reliability of all system functionalities. Overall, the combination of LSTM modeling and a user-friendly web interface provides a practical solution for inventory management in small-scale retail businesses. Future research may explore ensemble approaches, external factors such as promotions or seasonality, and deployment in broader retail contexts.

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