International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 03 | Mar 2024 www.irjet.net p-ISSN: 2395-0072

Sentiment Analysis in POS system using machine learning algorithms

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Abstract – *The focus of the research is to propose the integration of machine learning techniques into point-of-sale (POS) systems in order to boost client experiences and optimize performance. These systems can forecast demand, optimize inventory levels, and customize consumer experiences by evaluating past sales data, predictive models, and natural language processing. The interfaces for recommendation systems offer sales personnel and consumers clear recommendations that work with a variety of devices. With data privacy and smooth integration upheld, this integration is a strategic move toward modernizing retail operations, encouraging loyalty, and boosting revenue development. This information can be used to continuously refine product offerings and identify areas for improvement, enhancing the overall shopping experience. Balancing technical finesse with user-centric design, the recommendation system interfaces provide intuitive and actionable suggestions to both customers and sales staff. The system's adaptive capabilities cater to diverse devices, fostering engagement through user- friendly interfaces. Ultimately, the integration of a recommendation system into a POS project represents a strategic step forward in modernizing retail operations. It redefines the shopping experience by marrying technology with customer-centricity, fostering loyalty, and fueling revenue growth while keeping data protection and seamless integration at its core.*

Key Words**: **Sentiment Analysis,POS system, Inventory management, Sales Forecasting, Recommendation.

1.INTRODUCTION

This Point of Sale (POS) system proposed in this project marks a significant advancement in retail technology, aimed at revolutionizing the traditional checkout process. Our POS system integrates cutting-edge features, including sales forecasting through algorithm and dynamic product recommendations powered by Convolutional Neural Network (CNN) algorithms. By leveraging these advanced algorithms, the system not only enhances transaction accuracy and inventory management but also creates a personalized shopping experience for customers. The integration of ARIMA allows for precise sales predictions, optimizing inventory levels and operational efficiency. Simultaneously, the CNN algorithm processes product images, providing customers with real-time, visually-driven recommendations. As businesses embrace digital transformation, our POS system emerges as a crucial tool, fostering a seamless blend of technology, data analytics, and customer-centric retail operations. The integration of advanced data analysis, machine learning algorithms, and user experience enhancement to create a dynamic shopping environment. The recommendation system's primary objective is to provide personalized product suggestions to customers based on their preferences, purchase history, and browsing behavior. This involves the collection, analysis, and utilization of customer data to offer targeted recommendations, ensuring a more engagement.

1.1 Paper Reviewed

Proposed a deep learning-based medical material inventory management model is constructed through the reasonable classification of material management methods. This model effectively utilizes the data by analyzing disaster data in different regions and establishes a corresponding inventory management model according to the classification standards.[1]

They have implemented low efficiency of knowledge acquisition; this paper proposes a knowledge service framework based on case set. Three knowledge retrieval methods are designed based on parts keywords, customer orders and manufacturing processes. Additionally, a VSM based (vector space model) knowledge recommender method.[2]

A step-enhancement of memory retention (SEMR) model which integrates the cross-enhancement- effects of multiple historical behaviors under different time windows to characterize user interest. In addition, we use some extended correction methods to eliminate the effect of discontinuous records. Numerical experiments using real TV viewing data validate the efficiency of our proposed model and methods, which reduce the average prediction error to 0.3, outperforming the traditional models by around 50%.[3]

Sentiment analysis of a large number of user reviews on e-commerce platforms can effectively improve user satisfaction. This paper proposes a new sentiment analysis model-SLCABG, which is based on the sentiment lexicon and combines Convolutional Neural Network (CNN) and attention- based Bidirectional Gated Recurrent Unit (BiGRU). In terms of methods, the SLCABG model combines the advantages of sentiment lexicon and deep learning.[4]

This will produce a new method-using machine learning that will help for accurate prediction. This method collects the previous data of a store and analyze those data. Gathering the important information process those data and get prepared for using in method. Applying related algorithms towards the process data. We know K-Nearest Neighbor, Support Vector Machine, Gaussian Nave Bayes, Random Forest, Decision Tree Classifier and regressions have recently used an algorithm for prediction.[5]

2. System Architecture

The overall sales and product data feeds into a recommendation engine, which generates personalized product suggestions. Users access recommendations through web and mobile interfaces or in-store POS terminals, while feedback is collected for system improvement. Data is stored and managed in databases, and integration with POS systems and external sources enhances functionality. The architecture aims to enhance customer experiences, boost sales, optimize inventory management, and support data-driven decision-making.

2.1 Proposed System

Designed to transform retail operations. Leveraging advanced algorithms such as ARIMA for precise sales forecasting and CNN for dynamic product recommendations, the system aims to optimize inventory management and Inventory management and enhance the experience.

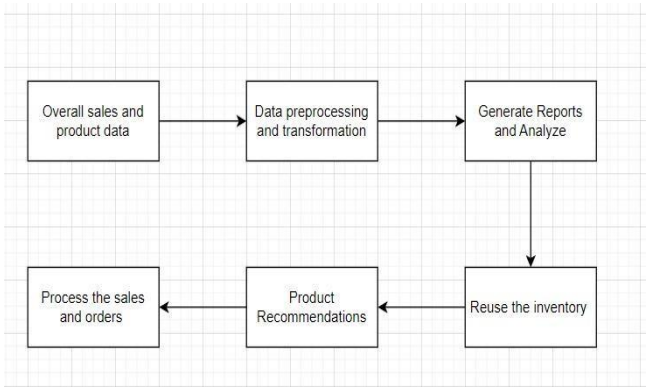

Fig -1: Proposed System of POS

This integrated POS system offers a seamless blend of technology and data analytics, providing real-time insights for businesses. It focuses on increasing transaction accuracy, improving operational efficiency, and delivering personalized customer interactions. With features like e-commerce integration and loyalty programs, the proposed system seeks to position itself at the forefront of modern retail, offering adaptability and a customer-centric approach.

2.2 System Flow

The process begins at the "Start Sale" step, where an item is entered into the system by scanning or reading it. Following this, two simultaneous actions take place: getting the description of the item and getting its price. These actions converge at the "Process Sale" decision point, where a check is made to determine if the current item is the only one being processed.

If it is the only item, a new list of items is created; if there are other items, the current item is added to an existing list. Subsequently, the sale is calculated and updated, leading to three concurrent actions: giving change to the customer, printing a receipt, and updating the inventory to reflect the sale. After these actions are completed, the sale is finalized. The flowchart concludes with a decision point where, if an item is recorded (presumably returned or recorded for some other reason), the process moves to "Recorded Item"; otherwise, the process ends, indicating the sale is complete and no further action is required.

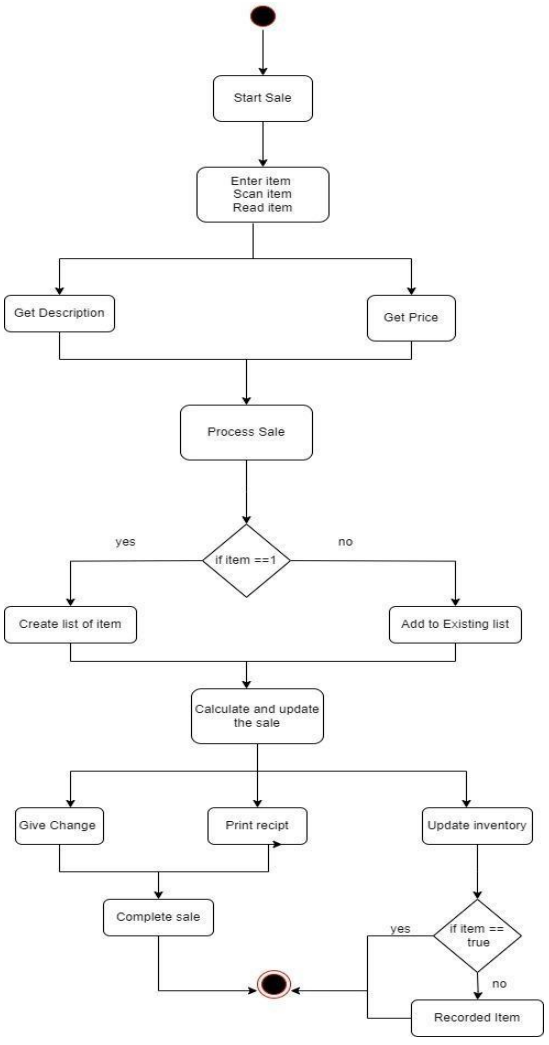

Fig. 2- System flow of the POS system

2.3 Equations

The equations are the classic ARIMA model has three components: Auto-regressive, integrated (differencing), and Moving-Average. These are then linearly combined to form the model:

The model is often compactly written ARIMA (p, d, q) where p, d, and q refer to the order of auto regressors, differencing and moving-average components respectively. ARIMA adds a seasonality component to each factor of the ARIMA equation to produce SARIMA (p, d, q)(P, D, Q)m:

Where:

y': differenced time series, through both regular, d, and seasonal, D, differencing

P: number of seasonal auto-regressors

ω: coefficients of the seasonal autoregressive components

Q: number of seasonal moving-average components

η: coefficients of the seasonal forecast errors

m: length of season.

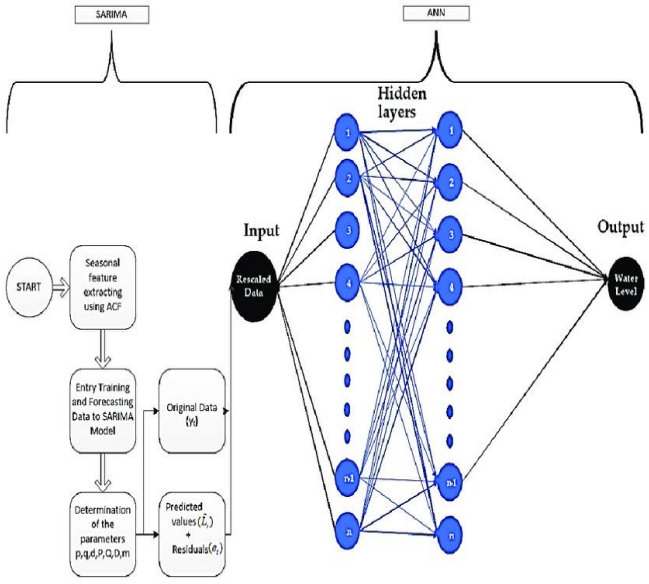

Fig. 3- SARIMA Model working

Now we are building different models for each item of the menu and make a data frame of respective RMSE to detect which model is best among all.

1st Model:-

Winter Exponential Smoothing with Additive Seasonality and Additive Trend Model

$$st=\gamma*(yt-\ell t)+(1-\gamma*)st-m$$

2nd Model:-

Holt Method Model

$$|yt+h|t=[\ell t+(\phi+\phi 2+\cdots+\phi h)bt]st+h-m(k+1).$$

3. Results

After We present the outcomes of our implementation and testing efforts. We report key findings such as the system's accuracy in processing transactions, its speed, and its reliability. Additionally, we provide data on how well the system managed inventory and customer information, detailing any issues encountered during real-world usage.

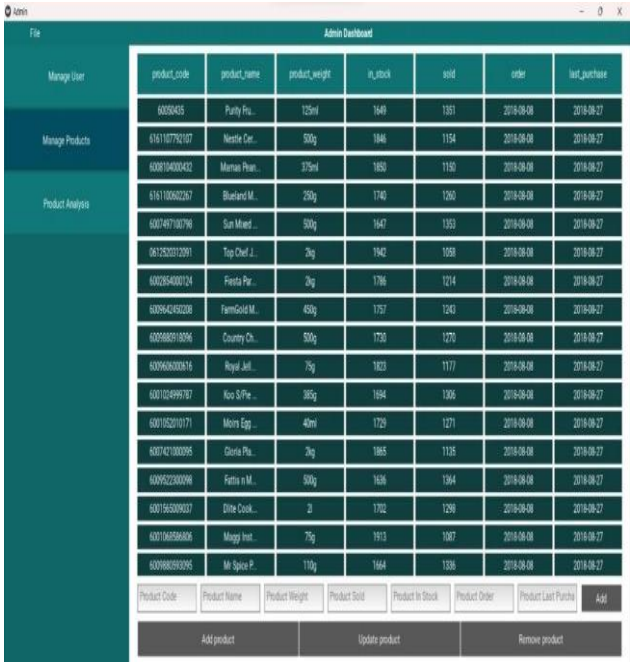

Fig. 4-Admin Screen to manage products

It organize and manipulate various aspects of a product catalog, including adding, editing, categorizing, and tracking inventory and sales data. This dashboard streamlines product management tasks, enhancing control and visibility over the entire product portfolio.

The Results and Discussion sections collectively serve to validate the effectiveness of our POS system and provide insights into its real-world performance and user experience. These findings will be invaluable for system refinement and future development, with a focus on enhancing both customer satisfaction and operational efficiency. We also explore potential improvements, such as optimizing the user interface for better customer experience and enhancing security measures to protect against fraud.

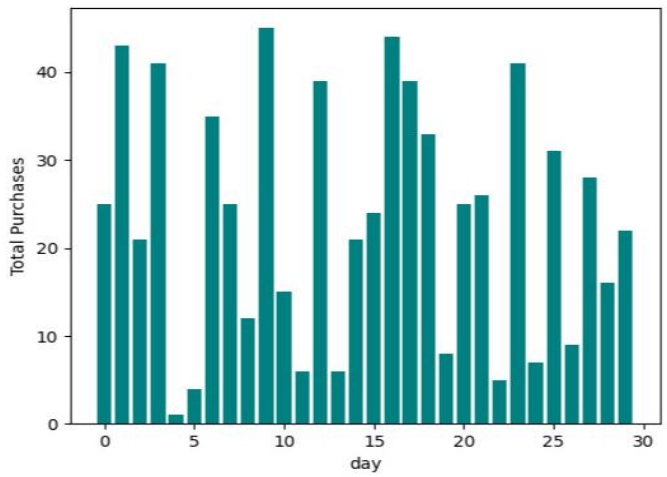

Fig. 5-Sales report

A POS screen showcases the sales transaction interface, typically displaying items, prices, and a payment total, enabling cashiers to process customer purchases efficiently. It provides a user-friendly and intuitive interface for handling sales transactions in retail or service businesses.

Table -1: Algorithms Used

SR.NO	WINTER EXPONENTIAL SMOOTHING RMSE	HOLT METHOD RMSE	SIMPLE EXPONENTIAL MODE RMSE
0	0.005	2.044	0.495
1	0.000	8.175	1.980
2	0.005	2.044	0.495
3	0.005	2.044	0.495
4	0.005	0.000	0.000

4. CONCLUSIONS

The inventory analysis revealed patterns of demand and consumption, helping to optimize stock levels and minimize overstock or stockout situations. Furthermore, the product analysis highlighted the best- performing and least-performing products, enabling informed decisions on product offerings and marketing strategies. In conclusion, the insights derived from inventory and product analysis play a pivotal role in enhancing operational efficiency and profitability for our business. By understanding our inventory needs and product performance, we are better equipped to meet customer demands, reduce waste, and improve overall resource allocation. These findings offer a strong foundation for informed decision-making and will guide us in tailoring our inventory management and product strategies to remain competitive and meet the evolving needs of our target audience. It provides a user-friendly platform for tasks like adding, modifying, or deactivating user accounts and managing user roles and access rights.

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the successful completion of this project integrating advanced forecasting models into the Point of Sale (POS) system. First and foremost, we extend our deepest appreciation to our project supervisor Prof.Sonali Karthik whose guidance, support, and invaluable insights have been instrumental throughout the entire duration of this project. Their expertise and encouragement have been indispensable in steering us in the right direction and overcoming various challenges along the way. We are also immensely grateful to the entire team involved in the project, whose dedication, collaboration, and hard work have been vital in bringing this vision to fruition. Each team member's unique skills and contributions have played a crucial role in the development, implementation, and testing phases of the project.

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