Drug Sales and Inventory Control System for Pharmaceutical Stores

¹ Mr. Harish Raju Bundele, ²Mr. Akash Vikas Wagh,³Mr. Uday Vinod Tayade,
⁴Mr. Suraj Mahendra Wasekar,⁵Mr. Ram Prashant Pophali, ⁶Prof. Akhil M. Jaiswal

1,2,3,4,5,6Department of Computer Science & Engineering,
HVPM College of Engineering & Technology, Amravati, India
harishbundele2605@gmail.com, akashvikaswagh@gmail.com, udaytayade245@gmail.com,
surajwasekar77@gmail.com, rampophali30@gmail.com, akhilmjaiswal@gmail.com

Abstract: *The Pharmacy Management System is a web-based application developed using ASP.NET Web Forms, C#, and Microsoft SQL Server to automate and streamline retail pharmacy operations. The system replaces traditional manual processes with a structured digital platform, reducing errors, improving efficiency, and ensuring better data management. It supports three user roles Administrator, Manager, and Cashier each with controlled access to system functionalities. The application integrates key modules such as drug inventory management, purchase processing, point-of-sale billing, expiry tracking, and financial accounting. It implements advanced features like First Expiry First Out (FEFO) batch selection, GST-compliant tax calculations (CGST, SGST, IGST), real-time stock monitoring, and automated expiry alerts. The system ensures data integrity through transactional stored procedures and maintains a complete audit trail for all user activities. Additionally, it provides comprehensive reporting for sales, inventory, and financial performance, enabling better decision-making. Overall, the proposed system enhances operational efficiency, ensures regulatory compliance, and offers a reliable solution for managing pharmacy workflows in a modern healthcare environment.*

Keywords: Pharmacy Management System, Inventory Management, Healthcare Information System

I. INTRODUCTION

The rapid growth of the healthcare and pharmaceutical sectors has significantly increased the demand for efficient and reliable pharmacy management systems. Retail pharmacies handle a large volume of daily transactions, including drug sales, inventory updates, supplier coordination, and financial

record-keeping. Traditionally, many pharmacies rely on manual methods or basic software tools, which are often inefficient, error-prone, and difficult to manage as the scale of operations grows[1].

Manual record-keeping systems pose several challenges such as inaccurate stock tracking, difficulty in monitoring drug expiry dates, errors in billing and tax calculations, and lack of real-time insights into business performance. These limitations can lead to serious consequences, including financial losses, regulatory non-compliance, and risks to patient safety due to the sale of expired medicines[2].

To address these challenges, the Pharmacy Management System is designed as a comprehensive web-based solution that automates and integrates all core pharmacy operations. The system is developed using ASP.NET Web Forms, C#, and Microsoft SQL Server, providing a robust and scalable platform for managing pharmaceutical workflows[3].

The application introduces a role-based access control mechanism with three user roles Administrator, Manager, and Cashier ensuring secure and organized system usage. It incorporates advanced features such as batch-wise inventory tracking, First Expiry First Out (FEFO) drug dispensing, GST-compliant billing, automated expiry alerts, and financial ledger management[4]. By digitizing and centralizing pharmacy operations, the system improves accuracy, enhances efficiency, and provides real-time visibility into inventory, sales, and financial data. This enables better decision-

making, reduces operational risks, and ensures compliance with regulatory requirements. The proposed system thus serves as a practical and effective solution for modern retail pharmacy management[5].

II. LITERATURE ANALYSIS

The literature on pharmacy and pharmaceutical inventory management highlights the critical role of computerized systems in improving efficiency, accuracy, and decision-making in medical stores. Studies by Ogwo Eme, Uchenna Ugboaja, Faustina Uwazuruike, and Chukwu Ukpai demonstrate how computer-based systems using RAD methodology can effectively replace manual processes, reducing errors and enabling features like expiry alerts and sales tracking. Research by Dr. Sonu P emphasizes the importance of proper inventory control in minimizing costs, avoiding wastage, and ensuring continuous availability of medicines. Similarly, the work of Tejas Dhumal, Shital Ghadge, and Dr. Pushpalata S. Patil focuses on real-time inventory tracking, automated reordering, and improved operational efficiency through user-friendly systems. Furthermore, the study by Mir Mohammed Junaid Basha and Sonali Tukaram Wani explores advanced inventory techniques such as ABC, VED, EOQ, and JIT, particularly during the COVID-19 pandemic, to maintain optimal stock levels and manage supply chain disruptions. Collectively, these studies highlight the need for integrated, automated, and intelligent pharmacy management systems to enhance performance, reduce losses, and ensure effective healthcare service delivery.

LITERATURE WORK

Author and Year	Methods	Future Scope//ISSU
Ogwo Eme, Uchenna Ugboaja C. A., Faustina Odinakachi Uwazuruike, Chukwu Uka Ukpai (2018)	Used Rapid Application Development (RAD); developed a computer-based drug sales and inventory system using Visual Basic and MS Access; included modules for sales, drug registration, inventory tracking, reporting, and expiry alerts.	Upgrade to web/cloud-based systems; improve UI/UX; add multi-user and multi-branch support; integrate advanced billing and accounting; enhance security and predictive analytics.
Dr. Sonu P	Focused on inventory control and pharmacy store management; emphasized proper stock handling, cost reduction, expiry tracking, and supply chain management.	Development of automated inventory systems; real-time monitoring; integration with supply chain; improved cost control and storage management techniques.
Tejas Dhumal, Shital Ghadge, Dr. Pushpalata S. Patil	Developed an inventory management system with modules for product categorization, real-time stock updates, expiry tracking, automated reordering alerts, and sales monitoring.	Implementation of AI-based forecasting; cloud-based systems; integration with billing/accounting; enhanced security and scalability; smart inventory tracking technologies.
Mir Mohammed Junaid Basha, Sonali Tukaram Wani	Reviewed pharmaceutical inventory methods during COVID-19; applied ABC, VED, EOQ, JIT, fuzzy logic, and statistical analysis to optimize inventory control.	Integration of combined inventory techniques in automated systems; intelligent inventory models; improved stock monitoring; better budget allocation; advanced forecasting tools.

III. WORKING METHODOLOGY

The working methodology of the Pharmacy Management System is based on a structured, modular, and transaction-driven approach that integrates all pharmacy operations into a unified workflow. The system follows a three-tier architecture consisting of the Presentation Layer (ASP.NET Web Forms), Business Logic Layer (C# and stored

procedures), and Data Layer (SQL Server database). Each module is designed to perform specific tasks while ensuring seamless interaction with other modules.

The overall functioning of the system can be explained through the following key processes:

1. User Authentication and Role Management

The system begins with a secure login process where users (Admin, Manager, Cashier) authenticate using their credentials. Passwords are stored as hashed values, and access is granted based on role-based permissions. This ensures that sensitive operations are restricted to authorized users only.

2. Drug and Inventory Management

The Admin or Manager maintains the drug catalog, including details such as drug name, category, manufacturer, price, and GST rates. Inventory is managed at the batch level, where each batch contains information like batch number, manufacturing date, expiry date, and stock quantity. The system continuously updates stock levels after every purchase, sale, or return transaction.

3. Purchase and Stock Update Process

When new stock is required, a purchase order is created and sent to suppliers. Upon receiving the stock, batch details are entered into the system. The inventory is automatically updated, and stock movement is recorded. This ensures accurate tracking of all incoming stock.

4. Billing and Sales Processing

The Point-of-Sale (POS) module allows the cashier to search for drugs using an autocomplete feature. The system retrieves available batches and automatically selects them based on the FEFO (First Expiry First Out) principle. The cashier enters the quantity, and the system calculates the total amount, including GST (CGST, SGST, or IGST). Once the sale is confirmed, the system records the transaction, updates stock levels, and generates an invoice.

5. Expiry Monitoring and Alerts

The system continuously monitors the expiry dates of all drug batches. Automated alerts are generated for drugs nearing expiry. Expired or near-expiry drugs are flagged as "Do Not Sell," preventing their use during billing. This ensures patient safety and reduces financial losses.

6. Financial Accounting and Ledger Management

All financial transactions, including sales, purchases, payments, and returns, are recorded in customer and supplier ledgers. The system follows a running balance approach, allowing users to track outstanding payments and account history in real time.

7. Reporting and Analysis

The system generates various reports such as sales reports, inventory status, purchase summaries, and profit analysis. These reports help management make informed decisions and monitor overall business performance.

8. Data Integrity and Security

All critical operations are executed using transactional stored procedures. If any step fails during a transaction, the entire operation is rolled back to maintain data consistency. Additionally, an audit log records all user activities for accountability and security.

In summary, the working methodology ensures that all pharmacy operations—from procurement to sales and reporting—are automated, accurate, and interconnected. This integrated approach enhances efficiency, minimizes errors, and provides real-time control over pharmacy management processes.
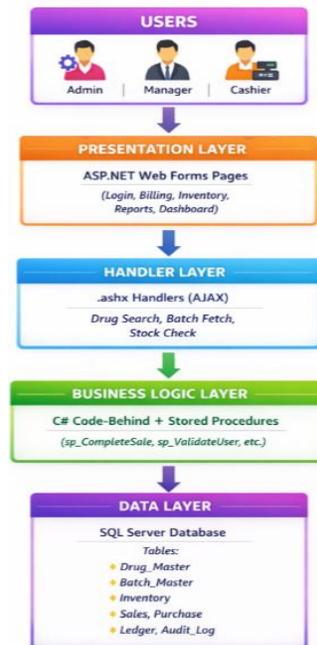
Figure 1. System Diagram

IV. RESULTS AND DISCUSSION

The Pharmacy Management System was implemented and tested using a simulated dataset consisting of drug records, suppliers, users, and transaction history. The objective of testing was to evaluate system performance, accuracy, reliability, and usability under real-world operational conditions.

Results:

The system successfully fulfilled all major functional requirements. User authentication worked correctly with proper role-based access control, ensuring that Admin, Manager, and Cashier roles could access only their permitted modules. The billing module performed efficiently, with drug search autocomplete responding within the expected time limit and FEFO-based batch selection correctly prioritizing drugs with the nearest expiry dates.

GST calculations were accurate for both intra-state (CGST and SGST) and inter-state (IGST) transactions, ensuring compliance with taxation rules. Inventory updates were automatically triggered after each purchase, sale, or return, maintaining consistency between batch-level and overall stock records. The expiry management module generated timely alerts and successfully restricted the sale of expired drugs.

Financial accounting features, including customer and supplier ledgers, operated correctly with real-time balance updates and accurate payment allocation. The reporting module generated detailed and structured reports for sales, inventory, and financial analysis, supporting effective decision-making.

Performance testing indicated that the system handled transactions efficiently, with billing operations completing within a short response time and no data inconsistencies observed during concurrent usage. All critical test cases, including stock validation, transaction rollback, and audit logging, were executed successfully.

Discussion:

The results demonstrate that the system significantly improves operational efficiency compared to traditional manual methods. Automation of billing, inventory tracking, and tax calculation reduces human errors and saves time. The implementation of FEFO ensures better stock utilization and minimizes losses due to expired drugs.

The use of transactional stored procedures enhances data integrity by ensuring that all operations are executed atomically. The role-based access control mechanism strengthens system security and prevents unauthorized access to sensitive data. Additionally, the real-time reporting and dashboard features provide valuable insights into business performance.

However, certain limitations were observed. The system is dependent on a continuous server connection, limiting its usability in offline scenarios. It is currently designed for single-branch operation and does not support multi-branch management. Furthermore, advanced analytics and demand forecasting capabilities are not included in the current version.

Overall, the system performs reliably and meets its intended objectives. It provides a robust, efficient, and scalable solution for managing pharmacy operations, with scope for further enhancements in future versions.
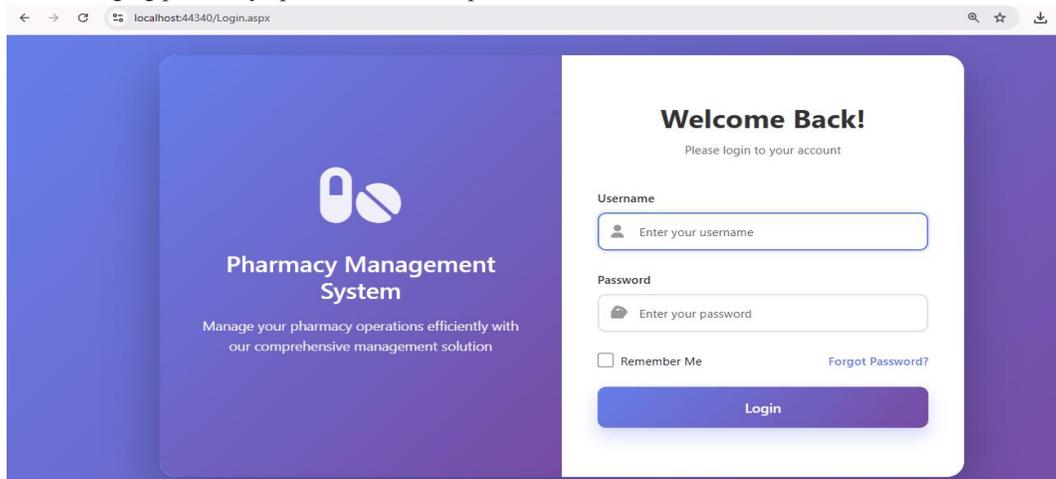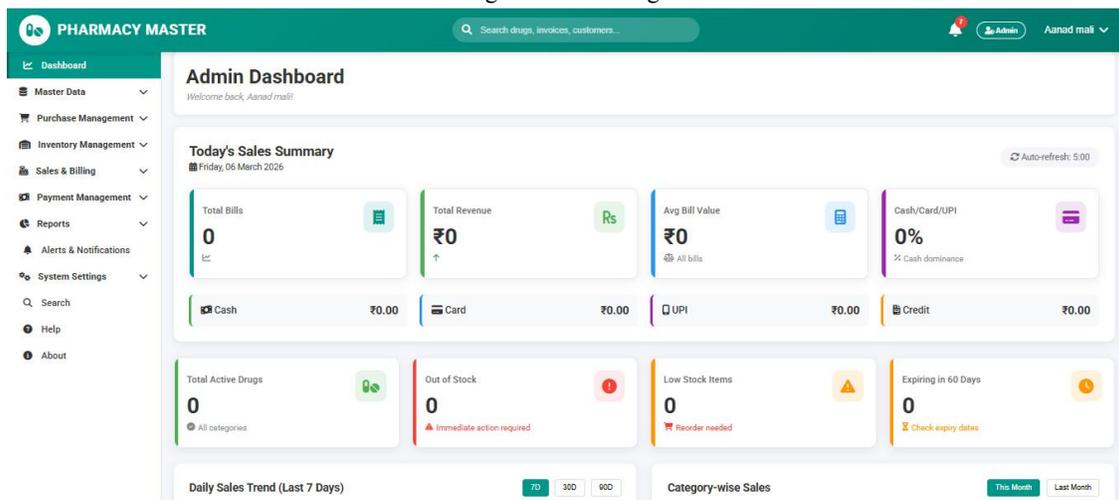

Figure 1 Home Page
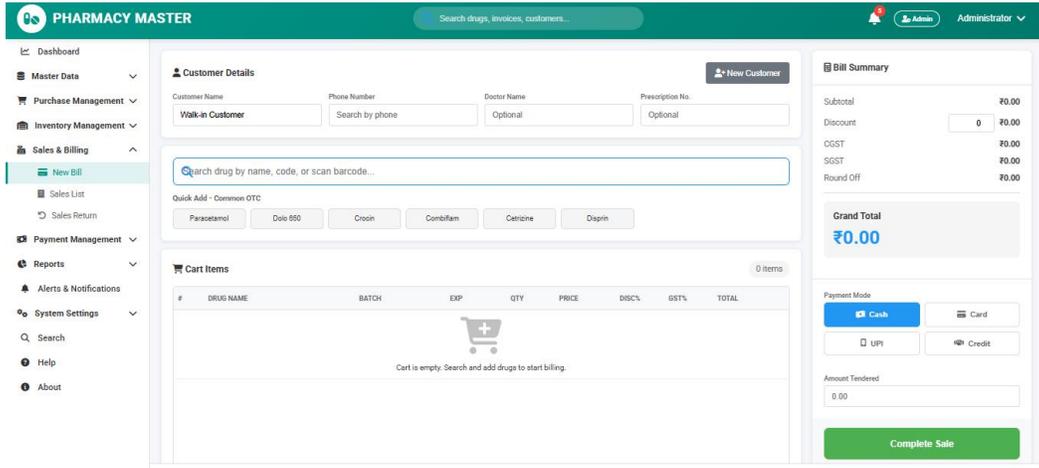

Figure 2 Admin Dashboard
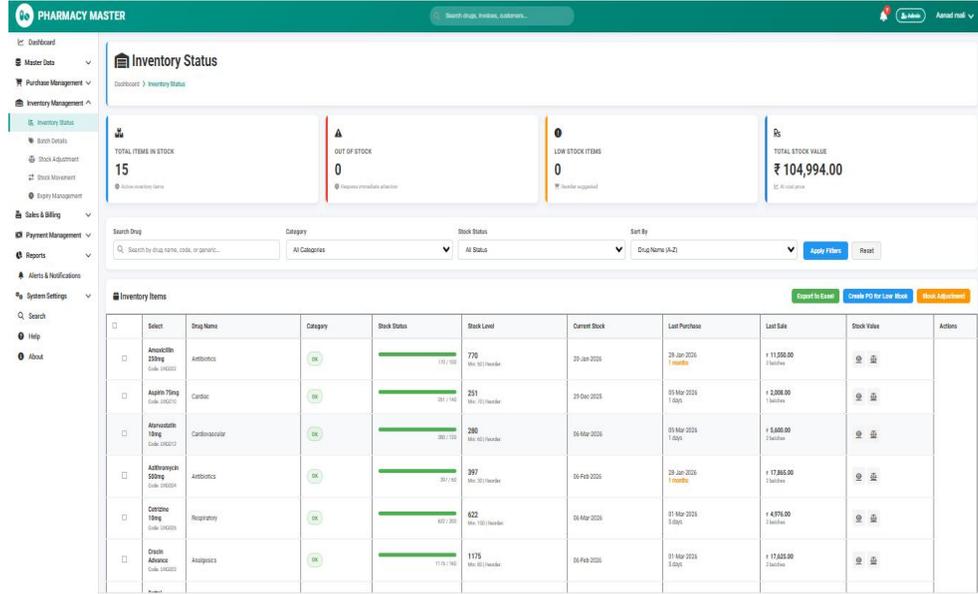
Figure 3 Billing Interface
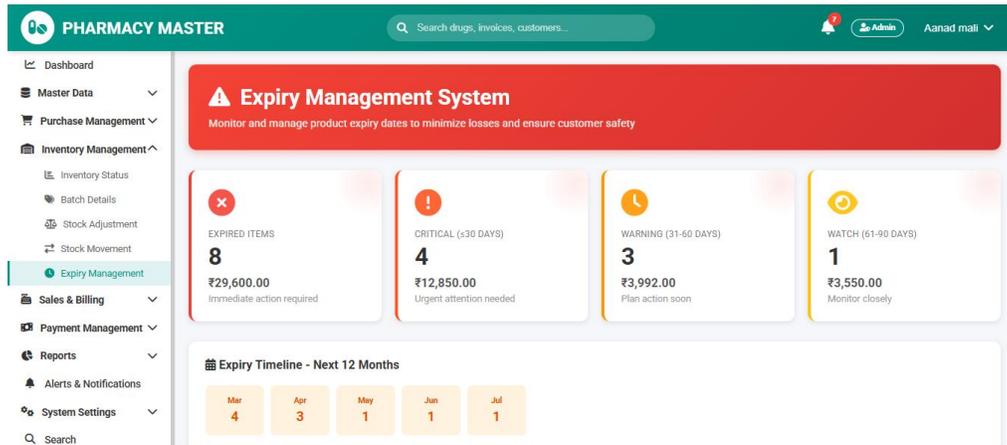

Figure 4 Inventory Status Page
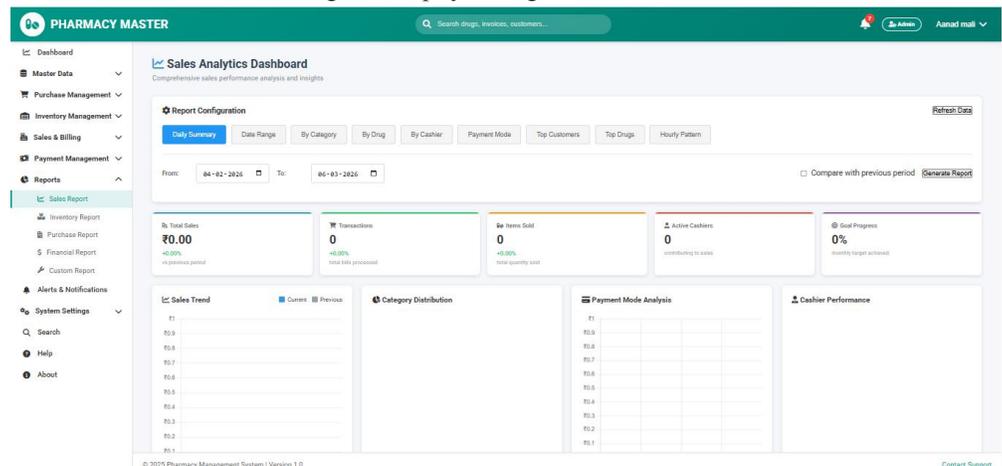
Figure 5 Expiry Management Dashboard

Figure 6 Sales Report

V. CONCLUSION

The Pharmacy Management System developed in this project provides a comprehensive and efficient solution for automating the core operations of a retail pharmacy. By integrating modules such as inventory management, purchase processing, billing, expiry tracking, and financial accounting into a single platform, the system successfully replaces traditional manual methods that are often error-prone and inefficient. The implementation demonstrates how modern web technologies ASP.NET Web Forms, C#, and Microsoft SQL Server can be effectively utilized to build a reliable and scalable application. Key features such as FEFO-based batch selection, GST-compliant billing, role-based access control, and transactional data processing ensure accuracy, security, and regulatory compliance. The system has been thoroughly tested and has shown reliable performance in handling real-time transactions, maintaining data integrity, and generating accurate reports. It improves operational efficiency, reduces the risk of errors, enhances stock management, and provides better visibility into financial and inventory data. Although the current system is designed for a single pharmacy setup and lacks advanced features like multi-branch support and predictive analytics, it establishes a strong foundation for future enhancements. With further development, the system can be expanded to include advanced functionalities such as cloud deployment, mobile access, and intelligent demand forecasting. In

conclusion, the Pharmacy Management System is a practical, effective, and scalable solution that meets the essential requirements of modern pharmacy operations and contributes to improved service quality in the healthcare sector.

REFERENCES

[1] E. Ogwo, U. U. C. A., F. O. Uwazuruike, and C. U. Ukpai, "Computer-Based Drug Sales and Inventory Control System and its Applications in Pharmaceutical Stores," 2018.

[2] S. P. Dr., "Inventory Control and Pharmacy Store Management."

[3] T. Dhumal, S. Ghadge, and P. S. Patil, "Inventory Management in a Medical Store."

[4] M. M. J. Basha and S. T. Wani, "Study of Inventory Management in Pharmaceuticals: A Review of COVID-19 Situation."

[5] D. Ramasamy et al., "Drug Inventory control analysis in a Primary level Health care facility in Rural Tamil Nadu, India," 2012, vol. 3, pp. 6.

[6] B. Kapoor and T. Mullen, "Integration of Just In Time (JIT) Inventory in Outpatient Pharmacy Information Systems," Journal of Cases on Information Technology (JCIT), vol. 14, no. 4, pp. 27–40, 2012.

[7] M. S. Mahatme, S. K. Hiware, A. T. Shinde, A. M. Salve, and G. N. Dakhale, "Medical store management: An integrated economic analysis of a Tertiary Care Hospital in Central India," Journal of Young Pharmacists, vol. 4, no. 2, pp. 114–118, 2012.

[8] A. K. Manhas, M. Aubid, S. M. A. Haroon Rashid, and A. T. Syed, "Analysis of inventory of drug and pharmacy department of a tertiary care hospital," Analysis, vol. 25, no. 3, p. 183, 2012.

[9] R. Gustriansyah, D. I. Sensuse, and A. Ramadhan, "Decision support system for inventory management in pharmacy using fuzzy analytic hierarchy process and sequential pattern analysis approach," in 2015 3rd International Conference on New Media (CONMEDIA), Nov. 2015, pp. 1–6.

[10] S. Singh, A. K. Gupta, and M. Devnani, "ABC and VED analysis of the pharmacy store of a tertiary care, Academic Institute of the Northern India to identify the categories of drugs needing strict management control," Journal of Young Pharmacists, vol. 7, no. 2, p. 76, 2015