An Efficient Pharmacy Management System for Healthcare Retail Automation

Author

1. Ms. P. Revathy

Assistant Professor

PG & Research Department of Computer Science

Sri Ramakrishna College of Arts & Science

Coimbatore – 641006

revathy@srcas.ac.in

2.Priyangha S

PG & Research Department of Computer Science

Sri Ramakrishna College of Arts & Science

Priyanghasubbu@gmail.com

Abstract

Advances in web and mobile application technology have significantly changed the nature of healthcare services; nonetheless, many retail pharmacies currently employ manual or semi-automatic systems for managing their medicine stocks, monitoring the expiry dates of medicines, and processing customer orders. These conventional systems cause inconsistency in data, postponing decision-making processes and thereby inviting more operational mistakes. In this context, this paper describes an optimized web-based Pharmacy Management System capable of automating and managing essential activities related to a pharmacy via a dedicated and interactive web-based interface. The developed web-based system is implemented using React JS for the frontend and Node JS/Express JS for server functionalities, along with MongoDB for the management of data securely and effectively. These systems also incorporate essential facilities like secure user log-in mechanisms, role-based access management, online live monitoring of medicine stocks, automatic notifications for nearing stocks and expiry medicines, and efficient order management. Through a real-time implementation and a relevant case study, it is shown that the automated web-based system can effectively minimize manual labour, increase data correctness, and ensure improved operational efficiency and subsequent scalability.

Keywords

Pharmacy Management System, Healthcare Automation, Inventory Management, Expiry Tracking, Web Application, Role-Based Access Control, MongoDB, React JS, Node JS

I. INTRODUCTION

Pharmacies are very important in the healthcare system as they help in the safe and timely distribution of medicines to patients. Effective pharmacy management is not only important for business success but also for public health and patient safety. Unfortunately, many small and medium-scale pharmacies are still using manual or semi-automated systems for managing medicine inventories, tracking expiry dates, and handling customer transactions. These conventional systems often cause operational inefficiencies, stock inaccuracies, delayed billing, and difficulties in tracking medicine availability.

One of the biggest problems in managing pharmacies is the accuracy of inventory records. Medicines are special products that require special storage and have fixed expiry dates. If the expiry dates of medicines are not tracked properly, there will be financial losses due to unsold expired medicines, and more importantly, there will be serious health risks to patients. Manual systems have a high possibility of human errors and make it difficult to track low-stock or near-expiry medicines.

Moreover, the growing need for faster healthcare services also necessitates faster processing of orders and billing by pharmacies. Customers demand faster services, correct billing, and instant access to medications. Manual billing processes not only lead to increased waiting times but also provide opportunities for errors in calculations and data duplication. Hence, automation in pharmacy retail processes has become a need rather than a want.

The ever-increasing pace of web technology and database management systems also enables web-based solutions to provide real-time inventory management, secure authentication, automated notifications, and centralized data management. Web-based pharmacy management systems provide scalability, flexibility, and accessibility while ensuring the secure management of sensitive data. By combining inventory management, expiry date management, order management, and role-based access control in a single platform, pharmacies can greatly benefit from improved efficiency and accuracy in data management.

This paper proposes an Efficient Pharmacy Management System for Healthcare Retail Automation to overcome the shortcomings of existing systems. The proposed system is developed using advanced web technologies to offer secure user authentication, real-time stock management, automated expiry notifications, and optimized billing processing. The aim of the proposed system is to improve productivity, minimize manual efforts, and ensure accurate data management in pharmacy retail settings.

II. LITERATURE REVIEW

Digital transformation in healthcare management has greatly increased the efficiency of operations in hospitals, clinics, and retail pharmacies. Various studies have pointed out that automated inventory management systems have decreased discrepancies in stock, minimized wastage, and increased transparency in tracking medicines. It has been found that digital inventory management systems can decrease stock-related errors by as much as 30% and increase the speed of decision-making with real-time access to stock and expiry information.

Database technology is an essential area in the automation of healthcare retailing. NoSQL databases such as MongoDB are gaining popularity because of their flexible schema design, faster data retrieval, and scalability. Unlike relational databases, NoSQL databases support the dynamic modification of data without any impact on system performance. This is very helpful in pharmacy settings where product information, batch numbers, and pricing models keep changing constantly.

Security and access control are essential aspects of healthcare software systems. Role-Based Access Control (RBAC) models are highly recommended to limit system access according to user roles such as administrator and pharmacist. Research highlights the importance of appropriate implementation of authentication techniques to prevent data breaches and unauthorized system manipulation. Token-based authentication techniques such as JSON Web Tokens (JWT) are widely used to ensure secure sessions and protect confidential data such as medicine information and billing details.

However, despite these advances in technology, it is a fact that many small to medium-scale pharmacies are still using disorganized or semi-digital systems. The current solutions available are only concerned with billing or inventory management but do not provide a comprehensive platform that can integrate stock management, expiration notices, order processing, and analysis. Moreover, many of the commercial solutions available are costly and complicated, making them unsuitable for small retail pharmacies. Hence, there is a requirement for a cost-effective, scalable, and comprehensive web-based Pharmacy Management System that can integrate inventory management, secure authentication, automated notifications, and analysis capabilities in a single platform. The proposed system will work towards filling this requirement by offering a complete and efficient digital solution for healthcare retail automation.

III. PROPOSED SYSTEM / METHODOLOGY

The proposed Pharmacy Management System is a web-based application developed to automate and manage pharmacy retail business. The system is designed using a client-server architecture where the frontend communicates with the backend services using secure RESTful APIs. The system offers a centralized digital platform where administrators and pharmacists can manage medicines, track stock, monitor expiry dates, handle customer orders, and generate reports efficiently.

The system uses role-based access control to guarantee data security and system safety. Administrators are tasked with managing users, roles, and system configurations, while pharmacists are granted access to manage medicine information, update stock levels, handle orders, and track expiry notifications. This well-organized access control system protects against illegal data modifications and guarantees safe system usage.

The primary functionality of the proposed system is inventory management. Each record of the medicines contains details like the name of the medicine, batch number, manufacturer, expiry date, available quantity, and cost of the medicine. The proposed system automatically triggers notifications when the stock reaches a certain level. The functionality of the proposed system regarding the management of the expiry date is also used to determine the medicines that are going to expire soon and automatically triggers notifications to the pharmacist in advance.

The order and billing management system of the proposed system is fully automated. When a customer purchase is made, the proposed system automatically calculates the total cost and an invoice. At the same time, the proposed system automatically updates the stock level in the database.

The system also has reporting and analysis capabilities that offer daily sales reports, stock reports, and expiry reports. The system helps pharmacy owners make better decisions. In general, the proposed system modernizes the operations of pharmacies by replacing manual systems with an efficient, secure, and scalable computerized system.

A. System Overview

The proposed Pharmacy Management System is a web application that aims to automate and optimize retail healthcare operations. The system eliminates the need for manual record-keeping by using a centralized digital platform to track medicine stock, monitor expiration dates, handle customer orders, and provide billing reports.

The system uses a client-server model, where the frontend communicates with the backend APIs to handle user requests. The backend uses business logic to handle requests and interact with the database for secure data storage and retrieval. The system also uses

role-based access control, enabling administrators and pharmacists to carry out their operations securely.

B. Frontend Design and User Interface

The frontend of the proposed Pharmacy Management System is developed using React JS to provide a responsive and user-friendly interface. The design is focused on simplicity, accessibility, and professional presentation so that administrators, pharmacists, and customers can use the system efficiently. The design works perfectly on desktops as well as mobile devices.

B.1 Authentication Pages

The authentication module includes Login, Register, and Forgot Password pages. The Login page is used by existing users to access the system securely using their credentials. The Register page is used by new users to register themselves in the system by providing necessary details such as name, email, and password. The Forgot Password page helps users to recover their accounts in case of losing credentials. These pages are used to access the system securely and protect sensitive pharmacy information.

B.2 Dashboard Page

The Dashboard page is the central control panel of the system. The page provides necessary information such as the total number of medicines, total orders processed, low stock alerts, and expired medicines. This summary page helps administrators and pharmacists to understand the current operational status of the pharmacy and take necessary decisions

B.3 Medicine Management Pages

The medicine management pages enable pharmacists to view, create, edit, and delete medicine entries. The View Medicines page displays medicines in a systematic table format with search and filter functionality. The Add Medicine page enables the creation of entries including medicine name, type, price, stock quantity, and expiry dates. The Edit Medicine page enables the modification of existing data, while the Medicine Details page provides a comprehensive summary of each medicine entry. This ensures effective inventory management.

B.4 Stock and Alert Pages

The software has specific pages for stock level and expiry date tracking. The Low Stock Alerts page lists

medicines that have reached a certain low stock level. The Expiry Alerts page lists medicines that are approaching their expiry dates. These pages enable pharmacists to take proactive measures to prevent losses and ensure patient and staff safety.

B.5 Order Management Pages

The order management page enables pharmacists to create new orders, view order lists, and access order details. The software automatically computes charges and stock level changes after each transaction. The Prescription Upload page enables the safe uploading of prescription documents to corresponding orders.

B.6 Customer Interface Pages

The customer interface has a home page for browsing available medicines, a cart page for managing items in the cart, a checkout page for confirming purchases, and an order history page for viewing past purchases. The pages ensure a convenient purchasing experience.

B.7 Profile and Settings Pages

The Profile page enables users to view and modify their personal information. The Settings page enables users to modify account preferences and manage login information. The pages ensure personalized and secure user management.

C. Backend System

The backend of the proposed Pharmacy Management System is developed using Node.js and Express.js. Data validation, business logic, authentication, and interaction with the MongoDB database are all handled by the application's backend, or central processing unit. The backend of the application handles secure login, appropriate transaction processing, and proper communication between

C.1 Authentication Module

The Authentication Module is responsible for performing user registration and login tasks. The Authentication Module of the application is based on JWT (JSON Web Token) authentication, which generates secure session tokens after the successful completion of the login task. The user passwords are encrypted before they are stored in the database for added security.

C.2 Role-Based Access Control Module

The system applies Role-Based Access Control (RBAC) to restrict system access based on user roles such as Admin, Pharmacist, and Customer. Each user has been assigned some privileges based on their roles. System administrators have the ability to manage user and system settings, pharmacists have the ability to manage medicines and order processing, while customers can only manage purchasing actions. This module improves system security and accountability.

C.3 Medicine Management Module

The Medicine Management Module is designed to handle all operations related to medicine records. The module offers functionality to add new medicines, update stock levels, modify expiry dates, delete expired records, and search for medicine details to be viewed. Before storing or modifying any information, the backend system checks all input information for consistency and accuracy to prevent any system errors.

C.4 Stock Monitoring Module

The Stock Monitoring Module is responsible for monitoring the quantities and expiry dates of medicines stored in the database. Once the stock level goes below a certain threshold, the system automatically sends a low stock message. Similarly, medicines that are nearing their expiry dates are also flagged to avoid the distribution of expired medicines.

D. Database Design

The proposed system utilizes MongoDB, which is referred to as the NoSQL database. The application chooses MongoDB because it is flexible and allows for scalability and high performance. The above qualities are useful for handling multiple users in the tea shop application.

D.1 Data Collections

The database of the proposed system uses a collection-based approach provided by MongoDB, which is useful for the efficient storage of data in tea shops. The data collections are also responsible for the storage of a certain type of data that is required for the smooth functioning of the application.

The Users table contains information about customers as well as administrators of tea shops. The table covers logins, contact details, roles, and personal preferences.

In the Menu Items list, all the data pertaining to the items that the tea shop provides is stored. These include the category, name of the item, price, description, status of the item, and image information of the respective teas, coffees, snacks, and beverages the tea shop may have in the store. These help the system to generate a proper online menu that is organized and easy to maintain in case any corrections are to be made in the future.

The Orders collection stores all data related to customer orders such as some selected items, their quantities, customization possibilities, order status, payments, and timestamps for the orders placed by the customers.

The collection 'Reservations' holds information related to the pre-arranged tea reservations, such as the tea times reserved, customer information, as well as the status of the reservation.

Such a database design based on the collection principle helps in fast data storage and retrieval, maintenance of data consistency, and easy expansion of the system depending on the growth in the number of clients and transactions, therefore ideal for a tea shop setting.

E. Benefits of the Proposed System

E.1 Customer Benefits

The system enables customers to receive faster and more accurate services. Automated billing and stock checks mean that customers spend less time waiting in line at the pharmacy. The system ensures that customers receive accurate information about the availability of medicines.

The system also enhances customer safety by preventing the sale of expired medicines. The system enables customers to keep a record of their order history, which may be useful in the future. The system ensures that customer information is secure.

E.2 Business and Operational Benefits

The system is beneficial to pharmacy owners and staff because it reduces their workload. The system eliminates the need for manual stock checks, which may result in errors.

The system ensures that customers do not buy medicines that are near their expiry dates. The system

prevents pharmacies from incurring losses due to expired stock.
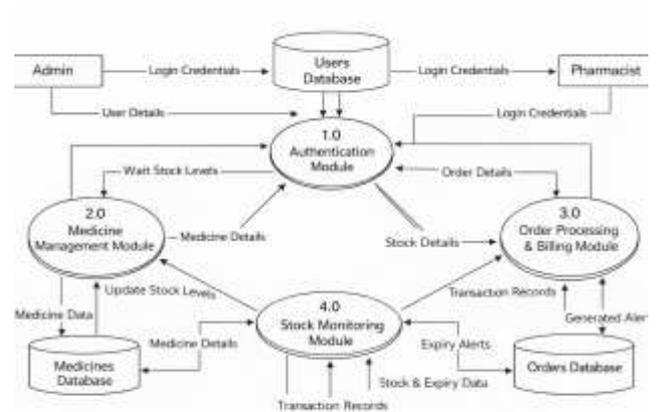
F. Data Flow Diagram

Fig. X. Data Flow Diagram of the Pharmacy Management System

The Data Flow Diagram for the Pharmacy Management System shows how data moves between users, system processes, and the database. The Administrator and the Pharmacist are the two main outside people who use the system. The authentication module checks the login information of both users by comparing it to the users database. Once their identity has been confirmed, users can use the system functions that are appropriate for their roles.

The medicines database holds the data that passes through the medicine management module when new medicines are entered or when old data is updated. The billing module processes order information when customers make transactions, and the orders database holds all the transactions that have been made. Simultaneously, the stock levels are altered to reflect the latest status of the stock.

The stock monitoring system is continuously checking the medicine database for low stock levels and approaching expiry dates. If any of the threshold conditions are satisfied, the system produces alerts and notifications for the pharmacist. This continuous flow of data ensures real-time synchronization between user interactions and database updates, allowing for accurate inventory management.

IV. IMPLEMENTATION AND RESULTS

The system was developed using React JS for the front end, Node JS and Express JS for the back end, and MongoDB for storing data. The system used JWT authentication to provide secure access.

The system tested well for real-time stock updates and expiry notifications. The system processed orders and billing faster than the manual process. The system enhanced data accuracy, minimized errors, and provided consistent performance during multiple transactions.

VI. CONCLUSION

The proposed Pharmacy Management System provides automation for inventory management, expiry notification, and billing processes. The system enhances efficiency, minimizes errors, and provides data security. The system is scalable and can be further developed with features such as AI forecasting and mobile integration in the future.

REFERENCES

1.A. Kumar, "Inventory Management in Healthcare Retail Systems," International Journal of Healthcare Technology, 2022.

2.R. Sharma, "Web-Based Retail Automation Systems," IEEE Digital Library, 2021.

3.M. Patel, "Role-Based Access Control in Healthcare Applications," Springer, 2020.

4.S. Lee, "NoSQL Databases for Scalable Web Applications," ACM Computing Surveys, 2019.