

A Result Paper on Medical Shop Stock Management System

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<p><i>Type: Article</i> <i>Received: 24 March 2026</i> <i>Revised: 09 April 2026</i> <i>Accepted: 27 May 2026</i> <i>Published: 06 June 2026</i></p>	<p>The Medical Shop Stock Management System is a secure, user-friendly, and offline-first mobile application developed to simplify and automate the daily operations of medical shops and pharmacies. In many small and medium medical stores, stock management and billing are still performed manually, which often leads to issues such as incorrect stock records, difficulty in tracking expiry dates, medicine wastage, and billing errors. The proposed system provides a complete digital solution by integrating features such as batch-wise inventory management, automated billing, barcode-based medicine entry, low-stock alerts, and near-expiry notifications. One of the key features of the system is the implementation of the FEFO (First Expire First Out) algorithm, which ensures that medicines with the nearest expiry dates are sold first, thereby reducing wastage and preventing the sale of expired medicines. The application is developed using the Flutter framework for cross-platform compatibility and uses SQLCipher-encrypted SQLite database to ensure data security and privacy. It also includes patient refill reminder functionality to improve medication adherence for long-term treatments. The system follows an offline-first approach, allowing it to function without continuous internet connectivity, making it suitable for rural and low-network areas. Overall, the system improves efficiency, reduces manual errors, enhances data security, and provides a reliable solution for modern pharmacy management.</p> <p>Keywords: Medical Shop Management System; Pharmacy Inventory Management; FEFO Algorithm; Barcode Scanning; Offline-First Application; SQLCipher Encryption; Medicine Stock Management.</p>

How to Cite This Article

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Introduction

Early Medical shops and pharmacies play a very important role in the healthcare system, as they are responsible for providing medicines and healthcare products to patients in a timely and accurate manner. Every day, a large number of customers visit medical stores to purchase prescribed medicines, which makes it essential for shopkeepers to maintain proper records of stock, billing, and patient-related information. However, in many small and medium-sized medical shops, these operations are still performed manually using paper registers or basic spreadsheet systems. Such traditional methods are time-consuming, prone to human errors, and inefficient in handling large volumes of data. These issues often result in incorrect stock management, difficulty in tracking expiry dates, medicine wastage, and financial losses [1].

One of the major challenges faced by medical shops is the management of medicine inventory, especially when dealing with multiple batches of the same medicine having different expiry dates. Without a proper system, it becomes difficult to ensure that medicines are sold before they expire. The lack of automated expiry tracking can lead to serious consequences, including the sale of expired medicines, which can pose health risks to patients and damage the reputation of the pharmacy. Research studies have shown that improper inventory control and lack of expiry management are significant contributors to medicine wastage in healthcare systems [2].

Another important issue is the inefficiency of manual billing systems. In traditional setups, billing is often done manually or with basic software that does not integrate with stock management. This increases the chances of calculation errors and delays in customer service. In addition, most existing systems do not provide features such as low-stock alerts, expiry notifications, or patient refill reminders, which are essential for efficient pharmacy management. Modern digital solutions have demonstrated that automated billing and inventory tracking can significantly improve operational efficiency and reduce errors [3].

To overcome these challenges, the proposed Medical Shop Stock Management System is developed as a mobile application that automates and simplifies pharmacy operations. The system is built using the Flutter framework, which enables cross-platform development and provides a user-friendly interface. It uses SQLCipher-encrypted SQLite database to securely store all data on the device, ensuring privacy and protection of sensitive information. The system follows an offline-first approach, allowing it to function without continuous internet connectivity, which makes it highly suitable for rural and low-network areas [4].

A key feature of the proposed system is the implementation of the FEFO (First Expire First Out) algorithm, which ensures that medicines with the nearest expiry dates are sold first. This helps in reducing medicine wastage and prevents the sale of expired medicines. Additionally, the system includes barcode scanning for fast and accurate stock entry, automated billing for quick invoice generation, low-stock and near-expiry alerts for better inventory control, and patient refill reminders to improve medication adherence. The integration of these features into a single application provides a comprehensive and efficient solution for modern pharmacy management [5].

Overall, the Medical Shop Stock Management System aims to replace manual processes with a secure, automated, and user-friendly digital system. It enhances efficiency, reduces errors, improves patient safety, and supports better decision-making for medical shop owners. By leveraging modern mobile technologies and intelligent inventory management techniques, the system contributes towards improving healthcare service delivery at the local level.

Literature Review

The literature review is an important part of the project as it helps to understand the existing research, technologies, and systems related to pharmacy management and healthcare automation. The Medical Shop Stock Management System focuses on inventory control, expiry management, billing automation, and patient reminder systems. Various research studies and existing systems have been analysed to identify their strengths, limitations, and research gaps.

One of the important areas studied is pharmacy inventory management systems. Many researchers have proposed digital systems to replace manual stock handling in medical shops. These systems focus on maintaining accurate stock records, reducing human errors, and improving operational efficiency. According to recent studies, digital inventory systems significantly improve tracking of medicines and reduce losses caused by poor stock management [6]. However, many of these systems are limited to basic stock recording and do not include advanced features such as batch-wise tracking or expiry management. Another major focus of the literature is medicine wastage and expiry control. Improper stock rotation and lack of expiry tracking are identified as major causes of medicine wastage in healthcare systems. Research shows that the implementation of inventory control techniques such as FEFO (First Expire First Out) can effectively reduce wastage and improve stock utilisation [7]. Systems that do not follow proper expiry management practices often fail to prevent the sale of expired medicines, which can lead to serious health risks and financial losses.

Barcode technology is also widely studied in pharmacy management systems. Barcode-based systems allow fast and accurate data entry, reducing dependency on manual input. Studies have shown that barcode scanning improves efficiency, minimises human errors, and enhances the overall reliability of inventory systems [8]. Patient medication adherence is another important area considered in the literature.

Many patients, especially those with chronic diseases, fail to take medicines regularly or forget to refill prescriptions. Research studies indicate that reminder systems, such as SMS or mobile notifications, can significantly improve medication adherence and patient outcomes [9]. This highlights the importance of integrating reminder features into pharmacy management systems.

Security and data privacy are critical aspects in healthcare applications. Several studies have highlighted the risks associated with storing sensitive data in unsecured systems. It is recommended to use encryption techniques and secure authentication mechanisms to protect patient and business data. Mobile health applications that implement strong security measures such as encrypted databases and biometric authentication provide better protection against data breaches [10]. From the analysis of existing systems and research work, it is observed that most solutions focus on individual features such as billing, inventory, or reminders. Very few systems provide a complete integrated solution that combines inventory management, expiry tracking, billing, and patient reminders in a secure and offline environment. Additionally, many modern systems depend on internet connectivity, which makes them unsuitable for rural and low-network areas.

The proposed Medical Shop Stock Management System addresses these limitations by providing an integrated, secure, and offline-first solution. It combines batch-wise inventory management, FEFO-based expiry control, barcode scanning, automated billing, and patient reminder features into a single application. By analysing the gaps in existing systems, the proposed system aims to provide a more practical, efficient, and user-friendly solution for pharmacy management.

Working Principle

The working principle of the Medical Shop Stock Management System explains how the application performs different operations such as authentication, stock management, billing, alert generation, and reporting in a systematic and efficient manner. The system is designed using a modular and offline-first approach, where each component performs a specific function and interacts with other modules to ensure smooth operation.

User Authentication and System Access

The system starts with a secure authentication process. When the application is launched, the user is required to enter a PIN or use biometric authentication such as fingerprint or face recognition.

- The authentication module verifies user credentials using encrypted storage.
- If the credentials are valid, the user is granted access to the dashboard.
- If the credentials are invalid, access is denied.

This ensures that only authorised users can access sensitive data. Secure authentication mechanisms are essential in healthcare applications to protect data privacy and prevent unauthorised access [11].

Medicine Stock Entry and Management

Once logged in, the user can add new medicines to the system. Each medicine is stored with batch-level details.

- User enters details such as medicine name, batch number, expiry date, quantity, and price.
- The system validates the input data.
- The data is stored in the SQLCipher encrypted database.

The system supports batch-wise inventory management, which allows multiple batches of the same medicine to be stored separately. This improves accuracy and helps in tracking expiry dates effectively [12].

Barcode-Based Medicine Entry

The system includes barcode scanning functionality for faster stock entry.

- The mobile camera scans the barcode of the medicine.
- The system decodes the barcode and retrieves relevant information.
- Fields are automatically filled, reducing manual input.

This feature improves speed and reduces human errors in data entry. Barcode technology has been widely used in healthcare systems to enhance accuracy and efficiency [13].

Medicine Search and Selection

During billing or stock checking, the user can search for medicines.

- The system provides a search functionality based on medicine name.
- It retrieves all available batches of the selected medicine.
- The data is displayed in a structured format.

Efficient searching ensures quick access to data, which is important for handling multiple customers efficiently.

FEFO-Based Batch Selection

The system implements the FEFO (First Expire First Out) algorithm for selecting medicine batches during billing.

- All batches of a selected medicine are retrieved.
- The batches are sorted in ascending order of expiry date.
- The system selects the batch with the nearest expiry date.
- Quantity is allocated from that batch first.

This ensures that medicines nearing expiry are sold first, reducing wastage and preventing expired medicine sales. Inventory control techniques like FEFO are proven to improve stock utilisation and reduce losses [14].

Billing and Invoice Generation

The billing module handles the sale of medicines and generates invoices.

- User selects medicines and enters required quantity.
- The system applies FEFO logic to allocate stock.
- Total amount is calculated automatically.
- Invoice is generated in digital format.
- Stock is updated in the database.

The billing process is performed using atomic transactions to ensure data consistency. Automated billing systems improve efficiency and reduce calculation errors [15].

Stock Update Mechanism

After each transaction, the system updates the stock.

- Sold quantity is deducted from the selected batch.
- If a batch becomes empty, it is marked as out of stock.
- The updated data is stored in the database.

This ensures real-time stock tracking and prevents inconsistencies.

Alert and Notification System

The system continuously monitors stock conditions and generates alerts.

- Low stock alert when quantity falls below threshold
- Near expiry alert when expiry date is close
- Out of stock alert when quantity is zero

Notifications are generated using local notification services. This helps shopkeepers take timely action and maintain proper inventory.

The working principle of the system demonstrates how different modules interact to provide a secure, efficient, and automated solution for managing pharmacy operations. By combining features such as FEFO-based inventory management, barcode scanning, automated billing, and alert systems, the application improves accuracy, reduces manual work, and enhances overall efficiency.

Methodology

The methodology of the Medical Shop Stock Management System defines the systematic approach followed for the design, development, and implementation of the application. The project adopts a structured and modular methodology to ensure efficient development, proper integration of components, and reliable system performance. The methodology includes the selection of development model, problem-solving approach, algorithm design, database handling, and security implementation.

Modular Development Approach

The system is developed using a modular approach, where each functionality is implemented as a separate module.

Modules:

1. Authentication Module
2. Inventory Management Module
3. Billing Module
4. FEFO Processing Module
5. Alert and Notification Module
6. Reporting Module

Each module is independently developed and later integrated into the main system. This approach improves maintainability, scalability, and debugging efficiency [17].

Divide and Conquer Strategy

The project uses the divide-and-conquer technique to handle complex problems.

- Large problems such as stock management and billing are divided into smaller tasks
- Each task is solved independently
- Results are combined to form the final output

For example, the billing process is divided into:

- Medicine selection
- Batch sorting
- Quantity allocation
- Invoice generation

This approach reduces complexity and improves performance [18].

FEFO Algorithm Methodology

The FEFO (First Expire First Out) algorithm is a key methodology used in the system.

Steps:

1. Retrieve all batches of a selected medicine
2. Sort batches based on expiry date (ascending order)
3. Select the batch with the nearest expiry
4. Allocate quantity from selected batch
5. Repeat until required quantity is fulfilled

This method ensures that medicines are sold before expiry, reducing wastage and improving stock efficiency. Inventory control techniques such as FEFO are widely recommended in healthcare systems [19].

Database Management Methodology

The system uses SQLCipher encrypted SQLite database for storing data securely.

Approach:

- Data is stored in structured tables
- Transactions are used for critical operations
- CRUD operations (Create, Read, Update, Delete) are implemented.
- Transaction Handling:
- Billing operations are executed as atomic transactions
- If any step fails, the transaction is rolled back
- Ensures data consistency and integrity

Efficient database management improves performance and reliability of the system [20].

Security-First Approach

Security is a major concern in healthcare applications. The system follows a security-first methodology.

Security Measures:

- AES-256 encryption using SQLCipher
- PIN-based authentication
- Biometric authentication
- Secure storage of credentials

This ensures that sensitive data such as patient details and billing information are protected from unauthorised access.

Offline-First Architecture

The system is designed using an offline-first approach.

Features:

- All operations are performed locally
- No dependency on internet connectivity
- Data is stored in local database

This approach ensures uninterrupted operation even in rural or low-network areas.

The methodology adopted for the Medical Shop Stock Management System ensures systematic development and effective problem solving. By using incremental development, modular design, FEFO algorithm, and secure database techniques, the system provides a robust and efficient solution for pharmacy management.

System Architecture

The system architecture of the Medical Shop Stock Management System is designed to provide a secure, efficient, and scalable solution for pharmacy management. By using a layered approach, integrating hardware components, and implementing offline-first functionality, the system ensures reliable performance and improved user experience. The architecture supports all major functionalities such as inventory management, billing, alerts, and reporting, making it a complete and practical solution.

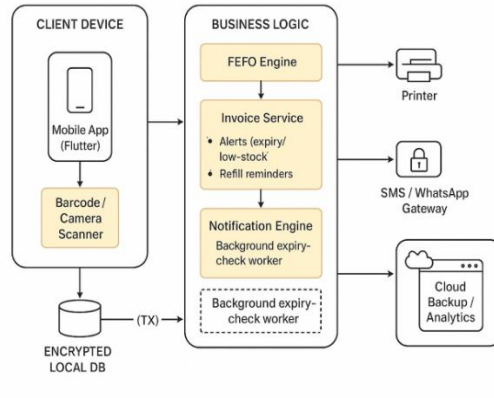


Fig 1. System Architecture Diagram

Overview of System Architecture

The architecture of the system is divided into multiple layers, each responsible for specific functionalities. These layers work together to provide a complete and efficient solution for managing pharmacy operations.

1. Presentation Layer (User Interface)
2. Business Logic Layer
3. Data Layer (Database)
4. Hardware Integration Layer

This layered architecture helps in separating concerns, improving code organisation, and simplifying maintenance [21].

Presentation Layer (User Interface)

The Presentation Layer is responsible for interacting with the user. It provides various screens and interfaces through which the user can perform operations.

Components:

- Login Screen
- Dashboard Screen
- Medicine List Screen
- Stock Entry Screen
- Billing Screen
- Alerts Screen
- Reports Screen

Features:

- User-friendly design
- Easy navigation
- Fast response

The UI is developed using Flutter, which provides a rich and responsive interface across different devices. A well-designed user interface improves usability and enhances user experience [22].

Business Logic Layer

The Business Logic Layer is the core of the system. It handles all processing and decision-making operations.

Major Components:

- Inventory Manager: Handles stock entry, update, and deletion
- FEFO Processor: Implements expiry-based batch selection
- Billing Engine: Manages billing calculations and invoice generation
- Notification Engine: Generates alerts and reminders

Responsibilities:

- Processing user requests
- Applying FEFO algorithm
- Managing transactions
- Coordinating between UI and database

This layer ensures that all operations are performed correctly and efficiently.

Data Layer (Database)

The Data Layer is responsible for storing and managing all system data securely.

Database Used:

- SQLCipher (Encrypted SQLite)

Tables:

- Medicine Table
- Stock Batch Table
- Bill Table
- Bill Item Table
- Patient Table
- Supplier Table

Features:

- Data encryption using AES-256
- Secure storage of sensitive data
- Fast data retrieval

The use of encrypted databases ensures data privacy and protection, which is essential in healthcare applications [23].

Hardware Integration Layer

The system integrates with device hardware to enhance functionality.

Components:

- Camera: Used for barcode scanning
- Biometric Sensor: Used for authentication

Data Flow in the System

The flow of data in the system follows a structured path:

- User interacts with UI (Presentation Layer)
- Request is sent to Business Logic Layer
- Logic is processed (e.g., billing, FEFO selection)
- Data is stored/retrieved from Database Layer
- Results are displayed back to user

This structured data flow ensures smooth communication between components and efficient processing [24].

Result & Discussion

The The result and discussion section presents the outcomes obtained after the successful implementation and testing of the Medical Shop Stock Management System. This section evaluates how effectively the system meets the objectives and solves the problems identified in the existing manual system. The performance of different modules such as authentication, inventory management, billing, alerts, and reporting is analysed in detail.

Implementation Results

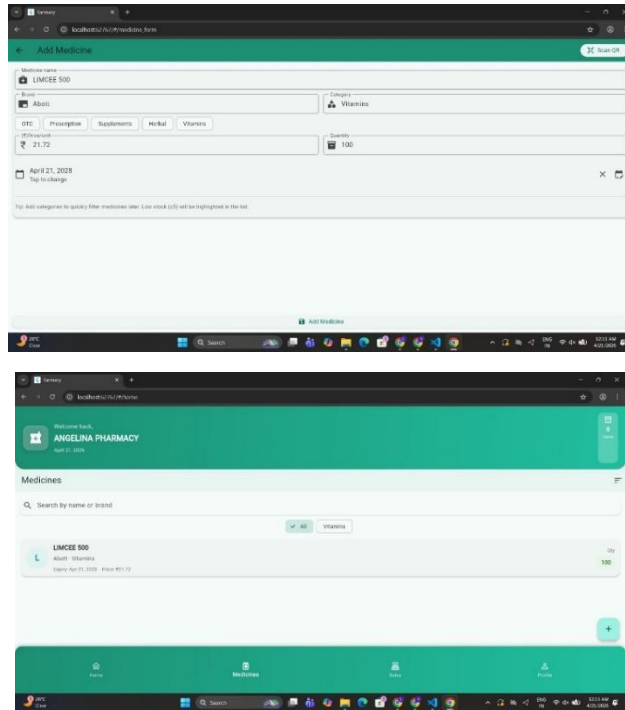
The system was successfully developed as a mobile application using Flutter and tested on Android devices. All modules were implemented and integrated properly. The application was able to perform all core functions such as stock management, billing, and alert generation without any major issues.

Key Results:

- Successful login using PIN and biometric authentication
- Accurate storage and retrieval of medicine data
- Efficient batch-wise inventory management
- Proper functioning of FEFO algorithm

- Automated billing with real-time stock updates
- Generation of alerts for low stock and near expiry
- Patient refill reminders working correctly

The system demonstrated stable performance during testing and handled multiple operations smoothly.



User Interface Results

The graphical user interface (GUI) of the application was tested for usability and responsiveness.

Observations:

- The interface is simple and easy to use
- Navigation between screens is smooth
- Data entry is fast and efficient
- Screens such as dashboard, billing, and stock entry are clearly designed

The user-friendly design makes the system suitable even for users with basic smartphone knowledge.

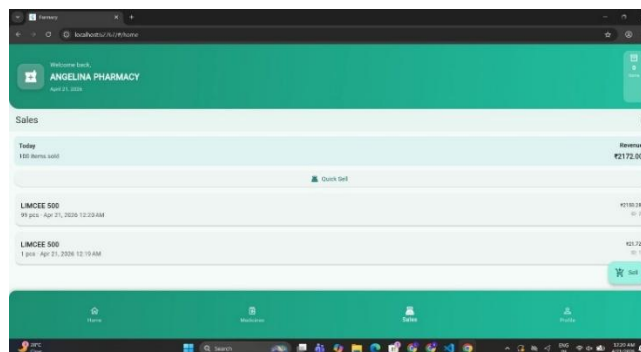
Performance Analysis

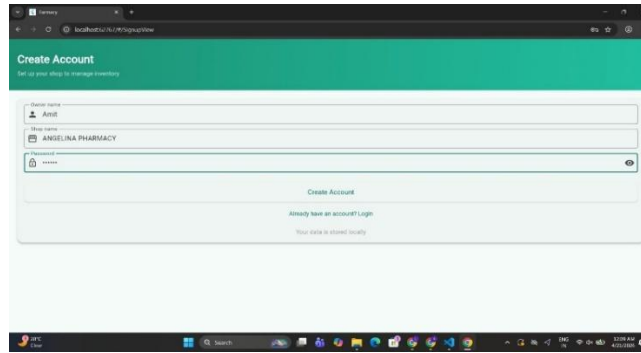
The system performance was evaluated based on speed, efficiency, and reliability.

Results:

1. Application startup time is within acceptable limits
2. Billing process is completed quickly (within few seconds)
3. Data retrieval from database is fast
4. No significant lag observed during operations

The use of local database and optimised queries ensures high performance.





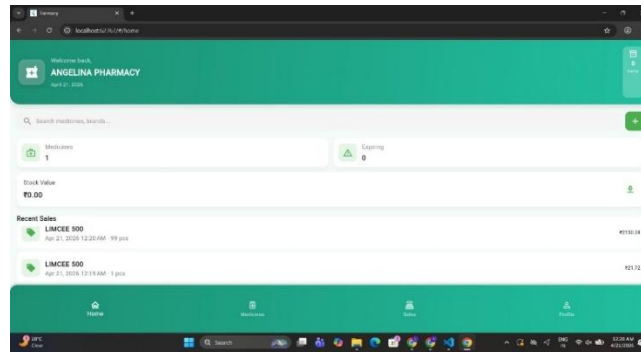
FEFO Algorithm Validation

The FEFO (First Expire First Out) algorithm was tested to ensure correct functionality.

Test Results:

- System correctly selects batch with nearest expiry
- Quantity allocation is accurate
- No expired medicines are selected for billing

Discussion: The FEFO implementation effectively reduces medicine wastage and ensures safe dispensing. This is one of the most important achievements of the system.



Alert and Notification System Results

The alert system was evaluated for its effectiveness.

Results:

- Low stock alerts are generated correctly
- Near-expiry notifications are accurate
- Alerts are displayed on time

Discussion: This feature helps shopkeepers take timely decisions and prevents stock shortages and expiry-related losses.

Patient Reminder System Results

The patient reminder module was tested for functionality.

Results:

- Patient details stored successfully
- Reminder notifications generated on scheduled time

Discussion: This feature improves medication adherence and adds value to the system beyond basic inventory management.

Comparison with Existing System

Feature	Existing System	Proposed System
Stock Management	Manual	Automated
Expiry Tracking	Not available	FEFO-based
Billing	Manual / Basic	Automated
Alerts	Not available	Available

Security	Low	High
Internet Dependency	Not required	Not required

Discussion: The proposed system significantly improves efficiency, accuracy, and security compared to traditional systems.

The Medical Shop Stock Management System successfully achieves its objectives by providing a secure, efficient, and user-friendly solution for managing pharmacy operations. The system reduces manual work, minimises errors, and improves stock management. The integration of features such as FEFO algorithm, barcode scanning, automated billing, and alerts makes it a comprehensive solution. The offline-first design ensures that the system is reliable even in areas with limited internet connectivity. Overall, the system demonstrates strong performance and practical usability in real-world scenarios. The results of the system implementation confirm that the application is capable of effectively managing medical shop operations. The system improves efficiency, ensures data security, and enhances customer service. The discussion highlights the strengths of the system while also identifying areas for future improvement.

Conclusion

The Medical Shop Stock Management System is successfully developed as a secure, efficient, and user-friendly mobile application to simplify and automate the daily operations of medical shops. In many small and medium pharmacies, traditional manual methods of stock management and billing often lead to errors, medicine wastage, and difficulty in handling large amounts of data. The proposed system effectively overcomes these challenges by providing a digital solution that integrates inventory management, billing, expiry tracking, and patient reminder features into a single platform. The system implements batch-wise inventory management along with the FEFO (First Expire First Out) algorithm, which ensures that medicines with the nearest expiry dates are sold first. This helps in reducing medicine wastage and prevents the sale of expired medicines, thereby improving patient safety. The inclusion of barcode scanning simplifies the process of medicine entry and improves accuracy, while the automated billing system reduces manual calculation errors and enhances customer service efficiency. Security is one of the key strengths of the system. The use of SQLCipher encrypted database, along with PIN and biometric authentication, ensures that sensitive data such as medicine records and billing information are protected from unauthorised access. The system also follows an offline-first approach, which allows it to function without internet connectivity, making it highly suitable for rural and low-network areas.

The alert and notification system helps shopkeepers monitor stock levels and expiry dates effectively by generating low-stock and near-expiry alerts. Additionally, the patient refill reminder feature supports better medication adherence, especially for patients undergoing long-term treatments. These features collectively improve the overall management of pharmacy operations. From the results and discussion, it is observed that the system performs efficiently, provides accurate results, and improves operational workflow. It reduces manual work, minimises errors, and enhances decision-making capabilities for medical shop owners. Although the system has certain limitations such as single-device usage and lack of cloud integration, it provides a strong foundation for future enhancements. In conclusion, the Medical Shop Stock Management System offers a practical, reliable, and scalable solution for modernising traditional pharmacy management. It not only improves efficiency and accuracy but also contributes towards better healthcare service delivery. With further improvements such as cloud synchronization, multi-user support, and AI-based stock prediction, the system can be extended into a more advanced and industry-level solution.

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