SHELFSENSE: EXPIRY MANAGEMENT SYSTEM

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ABSTRACT

The ShelfSense: Expiry Management System is an intelligent web-based application developed to help users efficiently manage inventory items and monitor product expiry dates. Many households, shops, pharmacies, and small businesses face problems such as product wastage, financial loss, and health risks due to improper tracking of expiry dates. Traditional inventory management methods are mostly manual and do not provide timely notifications or proper waste management support.

The proposed system collects and manages product details such as product name, category, quantity, manufacturing date, and expiry date using a centralized digital platform. The application processes this data using backend logic and generates alerts for products that are nearing expiry or already expired. By continuously monitoring product shelf life, the system helps users reduce wastage and improve inventory organization.

The project also integrates a smart dashboard that provides visual analysis of inventory status, expiry trends, and waste statistics through charts and graphical reports. In addition, the system includes an AI-based assistant that provides suggestions related to food preservation, product handling, waste reduction, and eco-friendly disposal methods.

1. INTRODUCTION

Inventory management and expiry monitoring play an important role in households, pharmacies, supermarkets, restaurants, and small businesses. Many users struggle with managing products efficiently, tracking expiry dates, and reducing unnecessary wastage. Traditional inventory tracking methods such as handwritten records, spreadsheets, or manual checking are time-consuming and often lead to errors, product spoilage, and financial losses.

Expired products such as food items, medicines, cosmetics, and household goods can create serious health risks and environmental pollution if not managed properly. Most existing systems mainly focus on stock management and do not provide intelligent expiry monitoring, real-time notifications, or disposal guidance. As a result, users often fail to identify products that are close to expiry and cannot maintain proper waste management practices.

With advancements in modern web technologies, intelligent inventory systems are becoming more effective in improving product monitoring and reducing wastage. Automated expiry tracking systems can continuously analyze stored product information, identify expiry patterns, and generate timely alerts for users. Such systems help users make informed decisions and improve inventory efficiency.

The ShelfSense: Expiry Management System is developed to provide a smart and efficient solution for inventory management, expiry tracking, and sustainable waste disposal. The system allows users to add products, monitor expiry dates, receive automated notifications, and manage disposal activities through a centralized platform.

In addition, the proposed system integrates dashboard analytics and AI-based recommendations to improve user experience and inventory productivity..

2. OBJECTIVES OF THE PROJECT

The major objectives of the ShelfSense: Expiry Management System are:

1. To develop a web-based platform for tracking inventory items and monitoring expiry dates..
2. To reduce product wastage by providing timely alerts and notifications for near-expiry products..
3. To simplify inventory management using centralized product storage and monitoring features.
4. To provide barcode-based product management for faster and more accurate product entry.
5. To generate dashboard analytics and visual reports for inventory tracking and waste analysis.
6. To provide AI-based suggestions for product preservation, waste reduction, and disposal management.
7. To help users identify expired products and manage them using eco-friendly disposal methods.
8. To securely store and manage user inventory records and notification settings.
9. To provide a responsive and user-friendly interface for households and small businesses..
10. To support future scalability and integration with AI, cloud services, and mobile applications.

3. LITERATURE SURVEY

Modern inventory management systems are increasingly being used in households, supermarkets, pharmacies, and businesses to improve stock monitoring and reduce product wastage. Traditional inventory systems mainly focus on product quantity and billing management but often fail to provide proper expiry tracking and intelligent waste management features.

Expiry date tracking systems are designed to monitor product shelf life and generate alerts before products become unusable. These systems help users avoid financial loss and reduce health risks caused by expired products. Many modern applications provide automated notifications through emails, mobile alerts, or dashboard reminders. However, several existing systems lack user-friendly interfaces and proper visualization tools for tracking expiry trends and waste statistics.

Barcode-based inventory systems have significantly improved inventory operations by reducing manual data entry errors. Barcode scanning technologies allow users to quickly add and identify products using mobile cameras or barcode scanners. This improves efficiency and accuracy, especially in environments with large inventories.

Notification and alert systems are another important part of modern inventory applications. These systems continuously monitor expiry dates and generate alerts for products nearing expiration. Advanced systems also provide customizable reminder settings based on user preferences. Despite these improvements, many existing applications still lack intelligent analysis and proper waste disposal guidance.

Waste management and disposal systems are becoming increasingly important due to growing environmental concerns. Smart disposal systems encourage recycling, composting, and waste segregation to reduce environmental pollution. However, most traditional inventory systems do not integrate disposal management with expiry tracking.

4. EXISTING SYSTEM

Traditional methods of managing inventory and expiry dates mainly include notebooks, spreadsheets, and manual product checking. These systems require continuous human monitoring and are prone to errors, inefficiency, and product loss. Users often forget expiry dates due to busy schedules and lack of proper tracking systems.

Most existing inventory systems focus only on stock management and billing operations rather than expiry monitoring and waste reduction. These systems generally do not provide automated alerts for near-expiry products, which increases the risk of product spoilage and unnecessary wastage.

Many currently available applications also lack proper visualization features such as graphical reports, expiry analytics, and waste statistics. Users are unable to monitor product usage trends and make informed inventory decisions effectively.

Another drawback of existing systems is the absence of eco-friendly disposal management. Most applications do not provide guidance regarding recycling, composting, or proper disposal methods for expired products. This leads to poor waste handling practices and increased environmental pollution.

In addition, many traditional systems have complex interfaces and require technical knowledge, making them difficult for regular household users and small businesses. Therefore, there is a need for an intelligent and user-friendly inventory management system that can automate expiry tracking, notifications, analytics, and disposal management efficiently.

Traditional inventory and expiry management systems are mostly manual and inefficient. In households, supermarkets, pharmacies, restaurants, and small businesses, people generally depend on handwritten notes, memory, printed labels, or spreadsheets to manage products and monitor expiry dates. These methods require continuous manual checking and are highly prone to errors, negligence, and mismanagement. As the number of stored products increases, it becomes difficult for users to monitor all items regularly, which often leads to expired products being forgotten or wasted.

One of the major limitations of the existing system is the absence of automated expiry tracking. Users must manually inspect products to identify items that are near expiry or already expired. Due to busy schedules and lack of proper monitoring tools, many users fail to check expiry dates on time. This results in food wastage, financial losses, and health risks caused by the accidental consumption of expired food items, medicines, or cosmetics.

Many existing inventory management applications mainly focus on stock quantity management and billing operations rather than expiry monitoring and waste reduction. These systems are designed primarily for inventory counting and sales management, but they do not provide intelligent features such as expiry alerts, product lifecycle monitoring, or waste analysis. As a result, users cannot effectively manage perishable goods or reduce unnecessary product spoilage.

Another drawback of traditional systems is the lack of proper notification and reminder mechanisms. Most systems do not provide real-time alerts for products nearing expiry. Even when reminder features are available, they are often limited and not customizable according to user preferences. Without timely notifications, users may overlook important expiry dates and fail to take preventive actions such as consuming, donating, or disposing of products before they become unusable.

Existing systems also suffer from poor visualization and analytical support. Many applications only provide simple tables or text-based records without graphical reports or dashboard analytics. Users are unable to analyze inventory trends, product usage patterns, waste statistics, or expiry frequency effectively. This lack of data visualization makes decision-making difficult and prevents users from improving inventory planning and purchasing habits.

Another important limitation is the absence of integrated waste disposal management. Traditional inventory systems do not provide guidance regarding safe and eco-friendly disposal methods for expired products.

5. PROPOSED SYSTEM

The proposed ShelfSense: Expiry Management System is an intelligent inventory and expiry tracking application developed to help users manage products efficiently and reduce wastage. The system continuously monitors product expiry dates and provides automated alerts for products nearing expiry or already expired.

The application allows users to add, update, search, and categorize products along with manufacturing and expiry details..

The system mainly consists of the following modules:

1. User Authentication Module
2. Product Management Module
3. Expiry Tracking Module
4. Notification & Alert Module
5. Dashboard & Visualization Module
6. Database Management Module

6. SYSTEM REQUIREMENTS

6.1 Hardware Requirements

- Intel Core i3 Processor or Higher
- 4 GB RAM
- 10 GB Hard Disk
- Laptop/Desktop System
- Keyboard and Mouse
- Internet Connection

6.2 Software Requirements

- Operating System: Windows / Linux
- API Testing Tool: Postman
- Frontend: HTML, CSS, JavaScript, React.js
- Backend: Node.js, Express.js
- Database: MongoDB
- Libraries: Chart.js, JWT, Nodemailer, Axios

7. SYSTEM ARCHITECTURE

The ShelfSense: Expiry Management System is designed using a modular and scalable architecture that integrates inventory management, expiry tracking, notification services, dashboard analytics, disposal management, and AI-based assistance into a single platform. The system architecture ensures efficient communication between different modules and supports secure and reliable data processing.

The architecture mainly consists of three important layers: the Frontend Layer, Backend Layer, and Database Layer. These layers work together to provide smooth system functionality and an interactive user experience. The modular structure of the system also allows future enhancements and feature integration without affecting the overall performance of the application.

The Frontend Module provides an interactive and responsive user interface developed using React.js, HTML, CSS, and JavaScript. This module allows users to register, log in, add products, monitor expiry dates, receive notifications, view dashboard analytics, and manage disposal records. The responsive design ensures that the system can run smoothly on desktops, laptops, tablets, and mobile devices. The frontend communicates with the backend through RESTful APIs and dynamically updates data without requiring page reloads.

The Backend Module is developed using Node.js and Express.js. It acts as the core processing unit of the system and handles all business logic and server-side operations. The backend receives requests from the frontend, validates user inputs, processes product and expiry information, generates notifications, and communicates with the MongoDB database. It also manages authentication, expiry calculations, dashboard analytics, and disposal management functionalities.

One of the most important modules in the architecture is the Expiry Tracking and Notification Module. This module continuously monitors stored product expiry dates and identifies products that are close to expiry or already expired. Based on predefined conditions, the system automatically generates alerts and reminders for users through dashboard notifications and email services. This automation reduces manual monitoring effort and helps minimize product wastage.

The Dashboard and Visualization Module displays inventory statistics, expiry trends, and waste analysis using charts, graphs, and summary cards. This module helps users understand product usage patterns and monitor inventory conditions effectively. The graphical reports improve decision-making by providing visual insights related to inventory performance and disposal activities.

The Disposal Management Module is another important part of the architecture. This module helps users manage expired products responsibly by providing eco-friendly disposal suggestions such as recycling, composting, and waste segregation methods. The system also stores disposal history records for future analysis and sustainability monitoring.

The AI Assistant Module enhances the intelligence of the system by providing suggestions related to product storage, food preservation, inventory management, and waste reduction techniques. The AI assistant interacts with stored product data and improves user experience by offering smart recommendations and guidance.

The Database Management Module uses MongoDB as the primary database system. It stores user records, product details, expiry dates, notifications, dashboard analytics, and disposal history securely and efficiently. MongoDB provides flexibility, scalability, and fast data retrieval, making it suitable for handling dynamic inventory-related information.

The User Authentication Module ensures secure system access and data protection. Users can create accounts and log in securely using email and password authentication. The module uses password encryption and token-based authentication techniques to prevent unauthorized access and maintain data privacy.

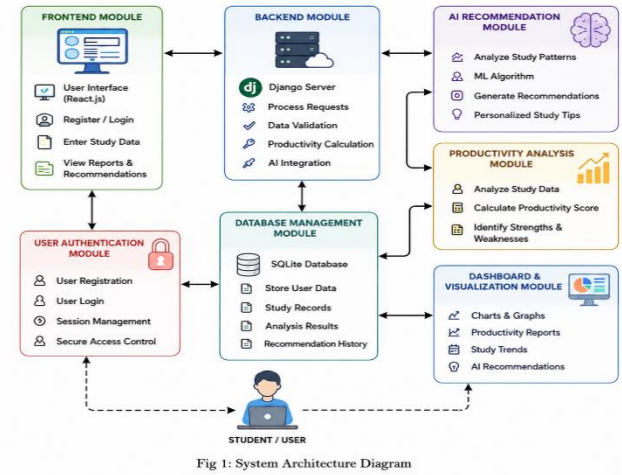

Fig 1: System Architecture Diagram

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8. DATA FLOW DIAGRAM

The Data Flow Diagram (DFD) of the ShelfSense: Expiry Management System represents the movement of data between users, processes, and the database. It provides a clear understanding of how information is collected, processed, stored, and displayed within the system. The DFD helps visualize the interaction between different modules involved in inventory management, expiry monitoring, notification handling, dashboard analytics, and disposal management.

In the ShelfSense system, the data flow begins when the user registers or logs into the application using secure authentication credentials. The user then interacts with the system by entering product details such as product name, category, quantity, manufacturing date, and expiry date. These details are transmitted securely to the backend server through API requests.

The Product Management Module processes the received information and stores it in the MongoDB database. The stored product data is continuously monitored by the Expiry Tracking Module, which calculates the remaining shelf life of products and identifies items nearing expiry or already expired. The processed information is then forwarded to the Notification Module for alert generation.

The Notification and Alert Module generates dashboard notifications and email reminders based on predefined expiry conditions. These alerts are displayed to users to help them take timely action before products become unusable. The notification system improves inventory efficiency and reduces product wastage by automating the monitoring process.

The Dashboard and Analytics Module retrieves data from the database and displays inventory statistics, expiry trends, waste analysis, and disposal records through charts, graphs, and summary cards. The dashboard helps users analyze product conditions, identify waste patterns, and make informed inventory decisions.

The Disposal Management Module receives information regarding expired products from the expiry tracking process. The module provides eco-friendly disposal suggestions such as recycling, composting, and waste segregation methods. Disposal records are then stored in the database for future monitoring and sustainability analysis.

The AI Assistant Module interacts with inventory data, expiry records, and disposal history to generate intelligent recommendations related to food preservation, storage techniques, inventory planning, and waste reduction practices. These suggestions are displayed to users through the frontend interface.

The Backend Module acts as the communication bridge between all system components. It handles request processing, data validation, API management, authentication, and database communication. All processed data flows securely between the frontend, backend, and database layers to ensure smooth system functionality.

The Database Management System stores all user information, product records, notifications, analytics data, and disposal history in an organized manner. Proper data flow ensures accurate monitoring, fast retrieval, and efficient management of inventory operations.

Overall, the Data Flow Diagram of ShelfSense demonstrates how the system integrates inventory tracking, expiry monitoring, notification services, analytics, and disposal management into a centralized and automated workflow. The efficient flow of data improves system performance, reduces manual effort, and enhances the overall user experience.

The Data Flow Diagram (DFD) of the ShelfSense: Expiry Management System represents the movement of data between users, system processes, and the database. It shows how product information such as product name, category, quantity, and expiry date is entered by users, processed by the backend server, and stored in the MongoDB database.

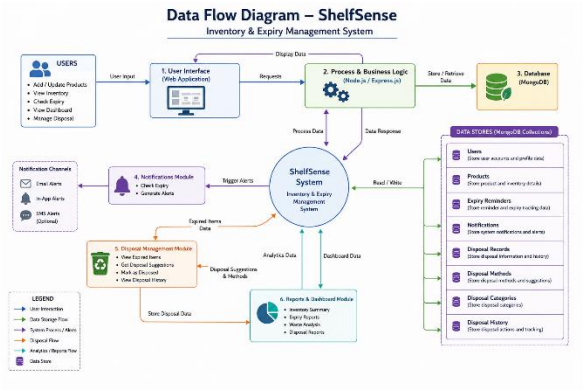

Fig 2: Data Flow Diagram

9. DATABASE DESIGN

The database design of the ShelfSense: Expiry Management System is developed using MongoDB, a NoSQL document-oriented database that provides flexibility, scalability, and efficient data storage. The database is structured to manage inventory records, user information, expiry tracking data, notifications, dashboard analytics, and disposal history efficiently. Proper database design helps maintain data consistency, secure storage, and fast retrieval operations throughout the system.

The primary collection in the database is the User Collection, which stores essential user details such as user ID, name, email address, encrypted password, role, and account settings. This collection is responsible for maintaining authentication information and user-related records securely. Passwords are stored using encryption techniques to ensure data privacy and protection from unauthorized access.

The Product Collection is one of the most important parts of the database design. It stores all inventory-related information such as product name, category, quantity, barcode details, manufacturing date, expiry date, purchase date, and storage details. Each product record is associated with a specific user through a user ID reference, ensuring proper data segregation and multi-user support within the system.

The Notification Collection stores information related to expiry alerts and reminders. This collection maintains details such as notification type, product status, alert message, notification time, and delivery status. The notification module uses this collection to generate dashboard alerts and email reminders for products that are near expiry or already expired.

The Disposal Records Collection stores details about expired products and disposal activities. It maintains information regarding disposal methods such as recycling, composting, waste segregation, and general waste handling. Disposal history records are preserved for future monitoring, sustainability analysis, and waste management reporting.

The Dashboard Analytics Collection stores statistical and analytical data related to inventory performance, expiry trends, waste statistics, and disposal activities. These records are used to generate graphical reports, charts, and summary cards displayed on the user dashboard. The analytics module helps users understand inventory usage patterns and make better purchasing decisions.

The AI Assistant Data Collection stores recommendation history and user interaction records related to AI-generated suggestions. This collection helps maintain personalized recommendations for inventory planning, food preservation, storage techniques, and waste reduction strategies.

The database design also includes schema validation and indexing techniques to improve system performance and maintain data integrity. Validation ensures that only correct and complete records are stored in the database, while indexing improves search speed and query performance during inventory operations.

The backend communicates with the MongoDB database using schema models and database queries. CRUD operations (Create, Read, Update, Delete) are performed efficiently to support real-time updates across the system. Whenever users add, update, or delete product information, the changes are reflected immediately on the dashboard, notification system, and disposal management module.

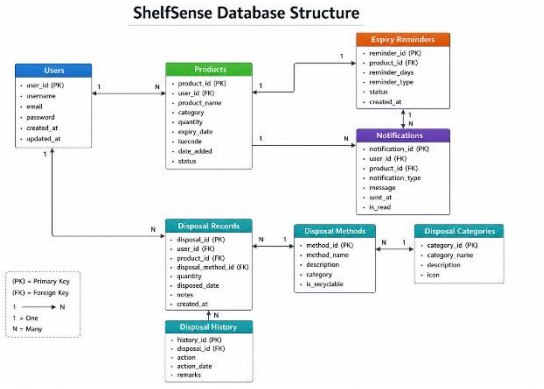

Fig 3: Database Structure

10. MODULE DESCRIPTION

10.1 User Authentication Module

The User Authentication Module is responsible for managing secure access to the ShelfSense application. It allows users to create accounts using personal details such as username, email, and password. The module ensures that only authorized users can access inventory management features, expiry reports, disposal records, and dashboard analytics.

10.2 Product Management Module

The Product Management Module allows users to add, update, delete, search, and categorize products within the system. Users can enter product details such as product name, category, quantity, manufacturing date, expiry date, and barcode information.

10.3 Notification & Alert Module

The Notification and Alert Module is responsible for generating automated alerts and reminders regarding product expiry. The system sends dashboard notifications and email reminders whenever products are close to expiry or already expired.

The module continuously checks stored expiry records and triggers alerts based on predefined notification conditions. Users can receive timely reminders to consume, donate, or dispose of products before they become unusable.

10.4 Dashboard & Visualization Module

The Dashboard & Visualization Module processes inventory records, expiry data, waste statistics, and disposal history to generate graphical reports and analytical insights. The module displays charts, graphs, summary cards, and statistical reports related to inventory performance and expiry trends.

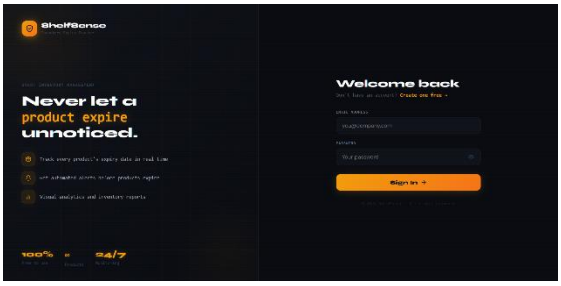

Fig 4: Voter Registration Interface

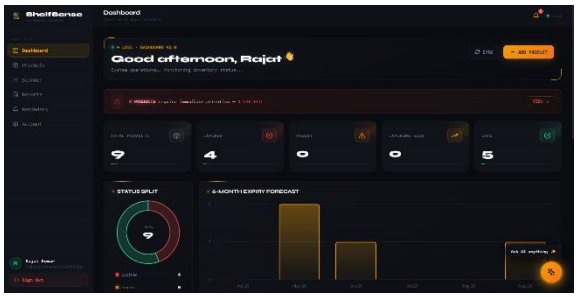

Fig 5: Dashboard

11. IMPLEMENTATION

The implementation of the ShelfSense: Expiry Management System is carried out using modern web technologies to provide a responsive, scalable, and user-friendly application. The system is developed using React.js, Node.js, Express.js, and MongoDB.

The frontend of the application is designed using React.js along with HTML, CSS, and JavaScript. The frontend provides responsive user interfaces such as login pages, dashboard pages, product management forms, disposal management sections, and notification panels. React components help create dynamic webpages and improve user interaction

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12. ALGORITHMS USED

12.1 Expiry Monitoring Algorithm

The Expiry Monitoring Algorithm is used to continuously monitor stored product expiry dates and calculate remaining shelf life. The algorithm compares the current system date with product expiry dates stored in the database.

The process includes:

1. Retrieving product expiry data from the database.
2. Comparing current date with stored expiry date.
3. Identifying near-expiry and expired products.
4. Updating product status automatically.

The algorithm helps identify products requiring immediate attention and improves inventory monitoring efficiency.

12.2 Notification Generation Algorithm

The Notification Generation Algorithm generates alerts and reminders for users regarding product expiry. The system scans inventory records periodically and identifies products approaching expiration.

The algorithm generates dashboard notifications and email reminders based on predefined conditions. This helps users receive timely alerts and take preventive actions before products expire.

13. RESULTS AND DISCUSSION

The ShelfSense project was successfully implemented and tested for inventory management, expiry tracking, notification handling, and disposal management

functionalities. The system efficiently stored and managed product records while continuously monitoring expiry dates and generating accurate alerts for users.

The Product Management Module successfully allowed users to add, update, search, and delete inventory records. Product details were stored securely in MongoDB and retrieved efficiently whenever required. The barcode scanning functionality reduced manual entry effort and improved inventory accuracy.

The Expiry Tracking Module generated accurate product status updates and successfully identified near-expiry and expired products. The Notification Module produced timely dashboard alerts and email reminders, helping users reduce product wastage and financial losses.

The Dashboard & Visualization Module displayed graphical reports related to inventory trends, expiry analysis, and disposal activities effectively

14. ADVANTAGES OF THE SYSTEM

1. Reduces product wastage through automated expiry monitoring..
2. Generates timely alerts and notifications for users.
3. Simplifies inventory management using centralized product records.
4. Supports barcode scanning for faster and more accurate product entry.
5. Provides graphical dashboard analytics and visual reports.
6. Improves decision-making through inventory and waste analysis.
7. Promotes eco-friendly disposal management practices..

15. FUTURE ENHANCEMENTS

The system can be enhanced further using advanced technologies.
Future improvements include:

1. Integration of AI-based product identification using image recognition.
2. Development of Android and iOS mobile applications.
3. Cloud synchronization for remote inventory access and backup.
4. Voice assistant support for easier product management.
5. SMS and push notification integration for expiry reminders.
6. IoT-based smart storage monitoring using sensors.

16. CONCLUSION

The ShelfSense: Expiry Management System provides an intelligent and efficient solution for inventory monitoring, expiry tracking, and sustainable waste management. The system successfully automates expiry monitoring processes, reduces manual effort, and helps users minimize product wastage through timely notifications and intelligent recommendations.

The project integrates React.js, Node.js, Express.js, and MongoDB to develop a scalable, secure, and responsive web application. Features such as dashboard analytics, barcode scanning, AI assistance, and disposal management improve overall system functionality and user experience.

The project also promotes environmentally responsible waste handling practices through recycling and waste segregation guidance. By integrating inventory tracking, expiry monitoring, notifications, analytics, and disposal management into a single platform, ShelfSense becomes a practical and future-ready solution for households, shops, pharmacies, and small businesses.

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