Technology-Driven Expiry Management of Products

Kavanashree V R[1], Mamatha T M[2], Sampada Ganapati Ambig[3], Soujanya[4], Ajay Prinston Pinto[5]
[1,2,3,4]*Department of AI & DS, SIT, Valachil, Mangalore – 574143, Karnataka, India*
[5]*Assistant Professor, Department of AI & DS, SIT, Valachil, Mangalore – 574143, Karnataka, India*
doi.org/10.64643/IJIRTV12I12-206594-459

Abstract*—Monitoring the expiry dates of packaged foods helps maintain their safety, reduces wastage, and aids in better inventory management. Identifying and monitoring the expiry labels through manual means has been challenging since there has been inconsistency in labeling methods, damages to the package as well as the variety of foods that an average household or retailer deals with. This research paper aims to develop an automated expiry management system that uses Optical Character Recognition Technology in identifying and monitoring expiry dates. This system will allow users to upload images of packaged foods whose expiry dates will then be identified by the OCR technology and determine the time left before the date expires. Depending on how much time is left before the expiry date, the system classifies the food into either safe, soon expiry, and expired while sending appropriate notifications. In cases when the uploaded image is unclear, manual input of the information is supported. Besides managing expiry dates, other additional functionality modules like donation management and sales analysis have been incorporated.

Index Terms*—Donation Management, Expiry Date Detection, Food Safety, Food Waste Reduction, Inventory Management, Optical Character Recognition (OCR), Packaged Food Monitoring, Sales Analytics.

I. INTRODUCTION

Management of product expiry dates has become increasingly relevant in domestic and commercial scenarios because failure in managing the expiry date of products will result in hazards to health, loss in terms of money, and wastage. In the context of consumable foods and other perishable products, the expiry label holds significance in indicating the usability and shelf-life of such products. This process cannot be done efficiently by humans due to factors such as variation in expiry label design, damage to packaging, and having a large number of items to check. From previous researches carried out in a similar context, it is known that verifying printed expiry labels using manual methods increases repetitiveness and chances of mistakes especially when dealing with bulk numbers of items [1], [2]. Hence, there is a need for automated mechanisms to detect expiry labels.

The recent development in the field of OCR technology has facilitated the automation process for extracting printed text information from the packaging of products with high precision. Prior studies have proven that using the combination of intelligent text recognition techniques and preprocessing images through OCR-based systems can enable the extraction of expiration dates from packaging materials, bills, and drug labels [3], [4]. Additionally, the deployment of digital inventory management systems suggests that alerting mechanisms, combined with monitoring product movement, can minimize waste and optimize resource utilization [5]. However, current approaches are either restricted to specific product types or necessitate significant manual labor, making them less efficient in real-world settings.

Failure to monitor expiry dates properly leads to wastage of products globally, which poses financial and environmental problems [6]. Current research has revealed that the implementation of OCR technology helps in enhancing the ability of extracting information printed on the product label [7].

In response to these inadequacies, this study proposes the Technology-Driven Expiry Management of Products System, an online platform that leverages OCR and advanced data processing methods to automate the tracking process of products with expiry dates. The proposed technology enables users to load product labels into the system, whereupon it automatically scans and processes the manufacturing and expiry dates of items to determine their remaining shelf lives. From the gathered information, the system classifies products into Safe, Expiring Soon, or

Expired, while at the same time alerting users about any changes in the status of the products. Moreover, the system integrates a feature for donating expiring products and a sales analysis dashboard for retail establishments.

II. LITERATURE SURVEY

The growing concern about food safety, waste management, and nutritional awareness has led to more research into smart food monitoring systems. Early studies on food expiration and shelf-life management stress the importance of proper expiration dating for ensuring food safety across supply chains. Labuza et al. [8] discuss the science behind expiration dating and its role in managing cold chains. Shehzad [9] looks at predictive AI models for estimating food spoilage and shelf life. These foundational works emphasize the need for reliable expiry tracking mechanisms in today's food systems.

Recent advancements center on automating expiration date detection with computer vision and OCR technologies. Dospinescu [10] proposed a mobile-based method that combines OCR with cloud-based image classification to efficiently find food expiration dates. Similarly, Gong et al. [11] introduced a camera-based system that can detect and recognize expiration dates directly from packaging, improving usability in real-time scenarios. Deep learning techniques have further improved recognition accuracy. Florea and Rebedea [12] used neural networks for expiration date detection, while Lotfy and Solima [13] enhanced CNN-based text recognition models for multilingual settings, including Arabic labels.

OCR has also been explored in related areas like receipt analysis and medical packaging. Kaderabek [14] studied OCR for extracting organized data from food purchase receipts. Kavin S [15] applied OCR techniques to extract expiration dates from pharmaceutical packaging, focusing on accuracy and reducing errors. These studies highlight how adaptable OCR-based systems can be across different fields, although issues like lighting conditions and text variability remain.

Reducing food waste has been another important research topic. Liegeard and Manning [16] looked at how smart applications can influence consumer behavior and significantly decrease household food waste. Complementing this, Marimuthu et al. [17] provided a detailed review of food loss throughout supply chains, identifying technological solutions as key. Systems like the SLED tracking model proposed by Mamidala [18] use machine learning algorithms to monitor shelf life and prevent foodborne illnesses. Nu et al. [19] showed how AI-driven decision making can improve waste reduction strategies at scale.

IoT and smart monitoring systems extend these capabilities even further. Alagarsamy and Gowthaman [20] developed an IoT-based food supply monitoring system that provides real-time alerts during food distribution, which improves transparency and safety. Polo [21] emphasized the integration of AI and OCR-based label verification systems to enhance traceability within food supply chains. Additionally, Fatorchian [22] discussed the role of Industry 5.0 technologies in achieving sustainable food chain management and reducing waste.

Mobile applications and user-centered systems are vital in delivering these technologies to end users. Studies like the leftover food management system presented at MysuruCon [23] show how effective mobile platforms can connect surplus food with demand. Moreover, barcode-based and nutrition tracking applications have been widely studied for enhancing dietary awareness and helping users make healthier choices [24][25]. These systems often rely on large databases, which can affect performance when data is incomplete.

Despite these advancements, several gaps still exist in current research. OCR accuracy in real-world situations remains a challenge because of variations in packaging design and environmental factors. Database scalability and coverage also influence system reliability. Recent studies suggest combining machine learning with cloud-based systems and continuous data updates to improve performance [26][27].

These insights support the development of an integrated Mobile Scanner App that merges OCR, allergen detection, nutritional analysis, and expiry tracking into a single, user-friendly solution.

III. METHODOLOGY

1. Overview of Proposed System

The proposed system is an advanced technology-based expiration management system which helps users and shopkeepers track product expiration dates while reducing waste and making better inventory choices. The system enables users to input product details through multiple methods such as image upload, live camera capture, and manual entry, making it flexible and user-friendly.

The system processes the expiry date, calculates the remaining shelf life, and provides timely alerts. The complete product lifecycle management system includes multiple functions which enable demand analysis and reusable product recommendations while also providing donation assistance to users.

2. System Architecture

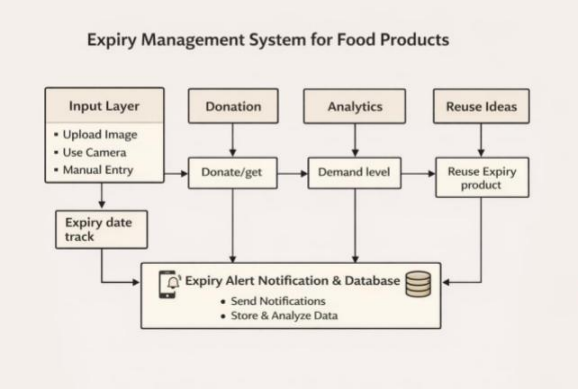

Figure 1: Block Diagram of Expiry Management frame work

3. Input Processing Module

The system accepts product details through three input methods: Image Upload Users upload product images containing expiry dates, Camera Capture Users can capture real-time images to perform scanning, Manual Entry The system requires users to input expiry dates through direct entry.

To improve usability the system supports multiple data formats which include DD/MM/YYYY and DD -MM-YYYY and DD:MM: YYYY and DD Month YYYY. The system can process product labels because it has developed a flexible parsing system which handles different international labeling requirements.

4. Expiry Calculation Module

The system calculates the number of days remaining before the product expires by comparing the current date with the expiry date.

Days Remaining = Expiry Date − Current Date

The result determines which product category should be used to classify the products as: Safe, Near Expiry and Expired.

5. Notification and Alert System

The system generates alerts based on expiry status:
Green → Safe
Yellow → Near expiry
Red → Expired

Users receive notifications about Days remaining Immediate action required This process enables people to make decisions or consume products at the right moment.

6.Analytics and Demand Forecasting Module

The system provides a graphics analytics module that guides retailers to:

- Monthly demand trend
- Seasonal usage of the product

This helps in:

- Avoiding overstocking
- enabling better planning for detaining data

7. Suggestion (Reuse) Module

The system suggests reuse options for expired products to minimize waste creation.
Example: Expired perfume → used as drawer freshener
This feature promotes: Sustainability and Smart reuse practices.

8. Donation Module

The system enables users to donate products that are nearing expiry (e.g., 3–7 days remaining).
Workflow: The system identifies products which are about to expire. The system recommends donation. The user can select items which they want to donate.

This helps: The program reduces waste. The program provides assistance to communities which need support.

9. Workflow of the System

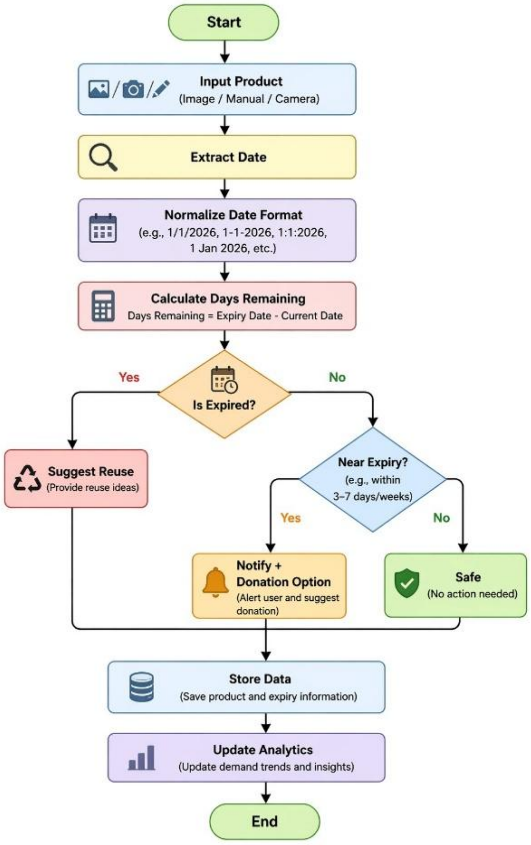

Figure 2: Workflow of the Proposed System

Table 1: Functional Modules of Proposed System

Module	Description
Input Module	Accepts product data
Expiry Calculator	Computes remaining days
Notification	Alerts user
Analytics	Shows demand trends
Suggestion	Provides reuse ideas
Donation	Supports product donation

These modules collectively enable efficient tracking, analysis, and management of product expiry.

The overall workflow of the proposed system is illustrated in Figure 2. Products enter the system through three distinct methods which include image upload, camera capture, and manual entry. The system first extracts date information from the data before it proceeds to standardize the date format and calculate the remaining shelf life. The system triggers appropriate actions which include notification to users and donation suggestions and reuse recommendations based on the expiry status. The data storage process completed with final data storage enables the organization to use it for analytical purposes.

IV. RESULTS AND DISCUSSION

1.System Implementation Results

The Expiry Date Scanner System was developed into a web-based application through successful implementation of its proposed design. The system integrates multiple modules which handle product input and expiry calculation and notifications and analytics and reuse suggestions and donation support functions. The system was tested using different input methods such as image upload and camera capture and manual entry. The results show that the application efficiently tracks product expiry and provides useful insights to users.

2. User Interface and Functional Output

The system provides a user-friendly interface with multiple features to enhance usability and functionality.

1)Product Input Module

The system allows users to enter product details through three methods which include image upload and camera capture and manual entry.

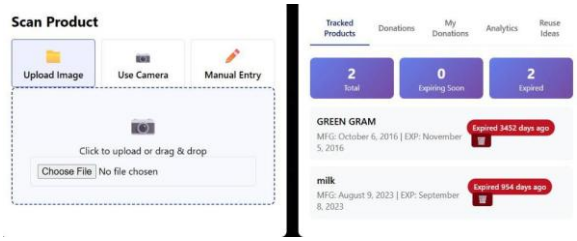

Figure 3: Product Input Module Interface

2)Analytics Dashboard

The analytics module provides visualizations of product demand trends which show different product demand trends across multiple product categories.

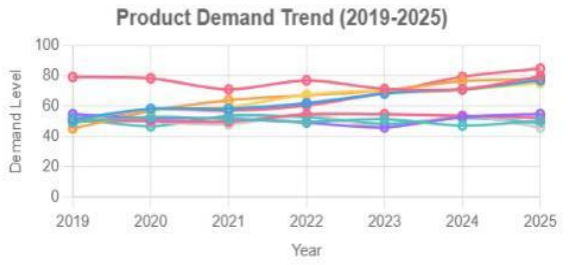

Figure 4: Analytics

3)Reuse Suggestion Module

The system provides eco-friendly reuse ideas for expired products which help to reduce waste and promote sustainable practices.

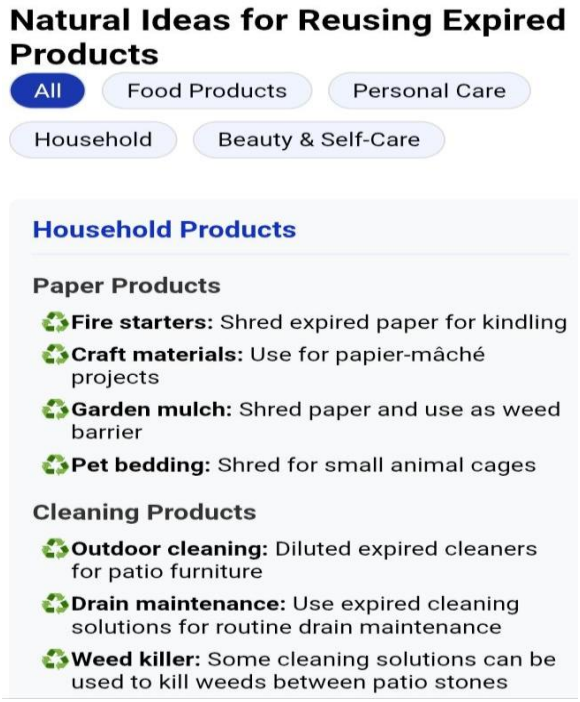

Figure 5: Reuse Suggestion Interface

4)Donation Module

The donation feature allows users to share near-expiry or unused products by providing necessary details which encourages social responsibility.

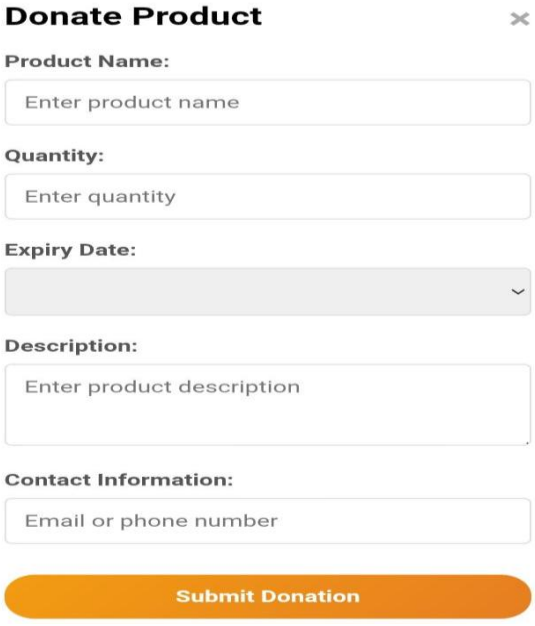

Figure 6: Donation Module Interface

3. Functional Evaluation

Table 2: Performance Evaluation of System Modules

Module	Function Performed	Outcome / Result
Input Module	Accepts product data	Successfully handles inputs
Expiry Calculator	Calculates remaining days	Accurate expiry detection
Notification	Generates alerts	Timely user notifications
Analytics	Analyzes product trends	Clear demand visualization
Suggestion	Provides reuse ideas	Reduces product wastage
Donation	Enables product sharing	Supports donation process

The system successfully integrates all modules, and each component performs its intended function effectively. The expiry calculation is accurate, and the notification system ensures timely alerts.

4. Analytical Results

The analytics module presents product demand trends over time through graphical representation. The observed trends indicate that certain product categories maintain consistent demand, while others vary based on usage patterns.

The insights assist users and shopkeepers to manage their inventory more efficiently while decreasing waste of products.

5. Discussion

The results demonstrate that the proposed system effectively addresses the problem of product expiry management.

The integration of multiple features enhances usability and functionality. The multi-input system improves accessibility for users, while the analytics module provides decision-making support. The reuse suggestion feature contributes to environmental sustainability, and the donation module promotes social good.

The system provides an effective solution which enables users to manage product expiry through a practical interface and efficient system functions.

V. CONCLUSION

The research presented in this paper introduces a technology-based system which manages the expiration of products. The system uses Optical Character Recognition (OCR) technology to read product labels and extract manufacturing and expiry dates, which it uses to determine the product's current status. The analysis results provide users with information about product safety, which shows whether they can use the product or the product has reached its expired state. The system gains additional capabilities through its built-in donation management system and its sales analytics dashboard, which together facilitate the distribution of products that are close to their expiration date while improving inventory management.

Households and commercial establishments can achieve better waste reduction and operational efficiency through the proposed system. The implementation of advanced machine learning methods in the future will enhance OCR accuracy, which will enable better performance in different operational settings. The development of a mobile application, which provides users with immediate product scanning capabilities and notification services, will make the system more practical and user-friendly.

VI. FUTURE SCOPE

The system achieves its full potential when Optical Character Recognition (OCR) technology is added because it allows automatic extraction of product expiry dates from labels which saves work time and increases precision. Machine learning techniques allow the analysis of past data which helps predict future product demand to create better inventory control systems that prevent excess stock.

The system can be extended into a mobile application which provides real-time notifications to users, thus making it easier for users to access the system. The system can achieve centralized data handling through cloud-based storage, which allows users to access synchronized data from multiple devices. The donation module needs to improve its operation through partnerships with outside organizations and platforms, which will enable them to handle distribution for products that are close to their expiration date. The system will gain better performance through the addition of barcode and QR code scanning functions, which will make it easier for users to enter product information.

REFERENCES

[1] J. R. Jeevith, S. P. Shankar, S. S. Nukala, and S. Kandarp, "A Smart Platform for Reducing Food Wastage Through Donation," in *Proc. IEEE Conf.*, 2021.

[2] X. Chen et al., "Automatic Recognition of Expiry Date Information on Food Packages," in Artificial Intelligence Applications and Innovations. Cham, Switzerland: Springer, 2018.

[3] J. Read et al., "Optical Character Recognition for Food Purchase Receipt Analysis," J. Survey Stat. Methodol., 2021.

[4] S. C. P. Shirley et al., "OCR-Based Extraction of Batch and Expiry Dates from Product Packaging," in Proc. Int. Conf. Smart Systems, 2024.

[5] Eurostat, Food Waste and Sustainable Consumption in the European Union. Luxembourg: European Commission, 2024.

[6] Food and Agriculture Organization of the United Nations (FAO), Global Food Loss and Food Waste Report. Rome, Italy: FAO, 2023.

[7] M. Ahmed, A. Khan, and S. Ali, "Rule-Based OCR System for Product Label and Receipt Recognition," Int. J. Comput. Appl., vol. 185, no. 12, pp. 15–22, 2022.

[8] T. Labuza, D. Belina, and F. Diez, "Food Safety Management in the Cold Chain through 'Expiration Dating'," Dept. Food Science and Nutrition, Univ. Minnesota, Minneapolis, MN, USA.

[9] K. Shehzad, "Predictive AI Models for Food Spoilage and Shelf-Life Estimation," Ravensbourne University London, London, U.K.

[10] O. Dospinescu, "A Mobile Approach to Food Expiration Date Determination Using OCR and On-Cloud Image Classification," Faculty of Economics and Business Administration, Alexandru Ioan Cuza University, Iași, Romania.

[11] L. Gong, M. Yu, W. Duan, X. Ye, K. Gudmundsson, and M. Swainson, "A Novel Camera Based Approach for Automatic Expiry Date Detection and Recognition on Food Packages," Univ. Lincoln, Lincoln, U.K.

[12] V. Florea and T. Rebedea, "Expiry Date Recognition Using Deep Neural Networks," Univ. POLITEHNICA Bucharest, Bucharest, Romania.
[13] M. Lotfy and G. Solima, "CNN Optimized Text Recognition with Binary Embeddings for Arabic Expiry Date Recognition," J. Publication, vol. 11, 2024.
[14] A. Kaderabek, "Exploring Optical Character Recognition (OCR) as a Method of Capturing Data from Food Purchase Receipts," Univ. Michigan, Ann Arbor, MI, USA, Nov. 2023.
[15] K. S., "OCR-Based Extraction of Expiry Dates in Medicine Packaging for Error-Free Data Entry," in Proc. 7th Int. Conf. Circuit, Power and Computing Technologies (ICCPCT), 2024, doi: 10.1109/ICCPCT61902.2024.10673325.
[16] J. Liegeard and L. Manning, "Use of Intelligent Applications to Reduce Household Food Waste," J. Publication, pp. 1048–1061, Jan. 2019.
[17] S. Marimuthu, A. Saikumar, and L. S. Badwaik, "Food Losses and Wastage Within Food Supply Chain: A Critical Review of Its Generation, Impact, and Conversion Techniques," J. Publication, vol. 6, pp. 661–676, May 2024.
[18] S. Mamidala, "The SLED (Shelf-Life Expiration Date) Tracking System: Using Machine Learning Algorithms to Combat Food Waste and Food-Borne Illnesses," Pennsylvania, PA, USA.
[19] Y. Nu, E. Belavina, and K. Girotra, "Using Artificial Intelligence to Reduce Food Waste," SC Johnson College of Business, Cornell Univ., Ithaca, NY, USA.
[20] G. Alagarsamy and N. Gowthaman, "Intelligent IoT Based Food Supply Monitoring System with Alert Messages in Transmission and Distribution Environment," 2022.
[21] L. Polo, "The Role of AI and OCR-Based Label Verification Systems in Enhancing Food Traceability and Supply Chain Transparency," South Florida International College, USA.
[22] H. Fatorchian, "Advancing Food Chain Sustainability: Harnessing the Power of Industry 5.0 for Waste Efficiency," Leeds Beckett Univ., Leeds, U.K.
[23] "Development of Leftover Food Management System Using Efficient Hunger Search Techniques," in Proc. IEEE Mysore Sub Section Int. Conf. (MysuruCon), 2021.
[24] A. Smith, "Mobile Food Recognition and Calorie Estimation Using Deep Learning," in Proc. IEEE Conf., 2021.
[25] J. Chen, "Barcode-Based Nutrition Information Systems for Smart Shopping." Cham, Switzerland: Springer, 2020.
[26] R. Patel, "Cloud-Based Food Product Information Retrieval Systems." Amsterdam, The Netherlands: Elsevier, 2022.
[27] Y. Zhang, "Deep Learning Approaches for Robust OCR in Real-World Environments," IEEE Access, 2023.