An Approach to develop Product Expiry Alert Management System

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***Abstract* - In this project we propose an application using a machine learning algorithm designed to facilitate the automated scanning and tracking of expiry dates for food items. The aim of this system is to provide users with timely notifications regarding the expiry status of their food items, thus aiding in the reduction of food wastage and also to avoid any diseases obtained by consuming expired food. The proposed algorithm uses the text recognition technology to scan food item labels and extract relevant information such as product name and expiry date using Optical Character Recognition (OCR) text. To predict expiry dates, the algorithm employs a combination of regression and classification models trained on a comprehensive dataset of food items and their corresponding expiry dates. One of the primary features of the project is its ability to adapt to various types of food packaging and label formats, thereby enhancing its versatility and usability. Multiple images of date with different fonts which indicated the expiry date of the product are stored as a dataset in the database. The photos were obtained by capturing the expiration dates displayed on the backside of every food item. This is used to train the model for recognition of texts while scanning the product. The current date and the date specified in the text are compared by the algorithm to determine the product's expiration date. An output indicating the product's expiration date is generated if the current date is greater than the date on the product. This makes it possible for users to get notifications when a product expires. The proposed system offers a practical and reliable approach to expiry date monitoring, empowering users to make informed decisions and minimize food wastage.**

Keywords — OCR; Food Expiry; Food Wastage Management

I. INTRODUCTION

Expired food can be very bad for people as it can make them sick, cause environmental issues and lead to economic loss. When eaten after their sell-by date foods can contain harmful bacteria, toxins or reduced nutrients which all result in food poisoning. Furthermore, throwing away expired food adds to the problem of waste disposal by creating more trash that releases greenhouse gasses into the atmosphere when broken down at landfills. From an economic perspective buying items that are already expired only ends up wasting resources and money since they will not be used before going stale again anyway; while ignoring these dates also perpetuates overproduction followed by excessive consumption patterns which are unsustainable in the long run.

Food waste indeed poses a significant challenge globally, with expiration dates playing a crucial role in the process. The failure of customers to remember these dates and consume food before it spoils contributes significantly to the problem. Unfortunately, once consumers realize food has expired, it often ends up in the trash, contributing to an alarming amount of waste. However, the repercussions of consuming expired food extend beyond mere wastage. Ingesting such food can lead to severe health issues, ranging from food poisoning to potentially fatal consequences. Symptoms of food poisoning include fever, stomach cramps, dizziness, diarrhoea, and dehydration, all of which can severely impact an individual's well-being. Moreover, improperly stored expired food poses the risk of contamination by harmful bacteria and pathogens, exacerbating health risks. The apathy towards expiration dates underscores a critical need for increased awareness and responsible consumption practices to mitigate both food waste and health hazards. The Biggest threat to our world is that people don't care about the products' expiry. So, they will consume the food without the knowledge of the product's expiry date. This system proposes an enormous advantage to users who have used a product for a long time since its first use.

The United States has approximately 40% of the annual food supply that goes to waste, resulting in a staggering cost of around $218 billion for the production, transportation, processing, and disposal of this surplus food. It is particularly concerning that two-thirds of this economic loss can be attributed to household appliances materials and food waste. One of the primary contributors to this issue is that consumers forget about the expiration dates of purchased items, leading the consumers to discard the product once it exceeds the date between the manufacturing date and the expiring date. The challenge intensifies when trying to monitor the expiration dates of various items stored in a fully stocked refrigerator, making it challenging to track and remember every product's specific date. This lack of awareness and difficulty in keeping track of expiration dates greatly contribute to the significant food wastage observed annually across households in the United States.

The issue of food waste resulting from expired food presents a prevalent challenge in modern households, leading to both financial setbacks and adverse environmental repercussions. A fundamental aspect of this predicament revolves around the necessity to diminish the surplus food quantities within households. In response, we propose a strategic remedy geared towards individuals seeking to avert foodborne illnesses stemming from expired items. The primary objective centers on devising a user-centric platform that not only monitors the expiration dates of food acquisitions but also proactively notifies users in advance to mitigate unnecessary wastage effectively. Furthermore, apart from catering to household needs, this innovative system holds promise for adoption in diverse retail settings such as supermarkets, grocery stores, and other establishments where bulk food purchases are common practice, fostering a more sustainable approach to managing food inventories.

Taking expired medications may result in decreased effectiveness, safety issues, and potential health effects due to chemical degradation. Expired medications may not adequately treat the disease, worsen symptoms, or produce harmful products. Taking this medication may cause side effects, toxicity, or the development of drug reactions. Additionally, the use of expired medications may violate laws and regulations, which may result in liability or disciplinary action. Keeping track of expiration dates accurately, ensuring that medicines are stored, and destroying expired medicines as soon as possible are of critical importance in reducing these effects and protecting health.

In order to solve this issue, a smart expiry architecture was put forth that automatically determines whether the food has expired and notifies the customer via their smartphone a few days in advance. Each product has its expiration date printed on the rear, along with the manufacturing date and the number of months left before the product has entirely expired. Other than food, the suggested smart expiry system can be applied to pharmaceutical, toiletry, and cosmetic products. Products' expiration date labels include prefixes like "use by," "best before," "sell by," and "expiry." Incorrectly believing that the date indicates safety, customers occasionally misread these labels and discard food after it has passed. However, for the majority of goods, the date represents the manufacturer's best estimate of how long the product will remain at its peak quality. Machine learning techniques (K-Nearest Neighbour, Naive Bayes, and decision trees) are used to personalise similar items to eat before reaching the target in order to improve the accuracy and identity of the system. The system employs K-means integration to make the device usable for the team since it recognises the significance of client wants. By giving users timely reminders about the recycling of commonly used products, this service aims to enhance user experience and maximise future purchases.

To address the challenges posed by diverse typefaces and formatting variations in expiration dates, this research endeavours to create a novel dataset specifically tailored for training deep learning models to recognize expiry date digits accurately. Leveraging the well-known MNIST dataset as a benchmark, which provides handwritten digit images for training, testing, and validation, this study seeks to develop a more specialized dataset that reflects the typographic diversity encountered in real-world expiration date scenarios. By curating a dataset comprising expiration date samples with varying fonts, backgrounds, and alignments, the proposed approach aims to enhance the robustness and adaptability of OCR systems for accurately extracting expiry date information from product labels. Additionally, the research proposes a tailored deep learning model capable of effectively categorizing the digits present in expiration dates, ensuring reliable performance even when faced with unseen data during testing and validation. Through this concerted effort, the aim is to advance the capabilities of OCR technology specifically tailored for expiration date recognition, thereby enhancing product safety and consumer confidence in expiry date labelling accuracy.

OCR stands for Optical Character Recognition, a technology that facilitates transforming image-based text into an editable and searchable file format. OCR software identifies shapes, patterns, and their spatial arrangement in the image to extract the text ultimately delivering it to a machine-readable state. In other words, OCR tools allow a user to convert a printed document – be it a scanned article or a photograph of a piece of paper – into a digital file that can be edited and copied and offer a search function. OCR is employed in document-related tasks, data-related duties, primary document digitization, and securing text-access for blind individuals, to name a few applications. With the advances of artificial intelligence and computer vision, OCR technologies have become increasingly accurate and efficient.

The interconnected nodes organization in layered architecture involves the network and being inspired by the structure and function of a human brain. In this project the Deep learning concept has been implemented and that uses a neural network with multiple layers to extract information in the higher-level feature from raw data. Deep learning concepts consist of speech recognition, natural language processing and image recognition. It uses complex patterns that need to be learned from large amounts of data. The training process involves feeding labelled data into the network, adjusting the network's parameters through backpropagation to minimize errors, and optimizing performance through techniques like regularization and dropout. Deep learning has revolutionized various fields, including healthcare, finance, and autonomous vehicles, by enabling unprecedented levels of accuracy and automation in tasks that were previously challenging for traditional machine learning methods.

Date detection refers to the process of identifying and extracting date information from various sources, including text documents, images, and digital records. This task is commonly performed using a combination of techniques such as pattern recognition,(NLP), and ML algorithms. In text documents, date detection algorithms parse through the text to locate patterns resembling date formats, such as "mm/dd/yyyy" or "mm/dd/yyyy." These algorithms often employ regular expressions to match date patterns accurately. For images and scanned documents, Optical Character Recognition (OCR) technology is used to convert text contained within the image into machine-readable format. Once the text is extracted, date detection algorithms can identify and extract date information from the OCR output. In more advanced systems, machine learning models are trained on large datasets containing various date formats and contexts to improve accuracy in date detection tasks. These models can learn to recognize dates in different languages, formats, and contexts, enhancing their versatility and performance in real-world applications. Overall, date detection plays a crucial role in numerous applications, including document processing, information retrieval, event scheduling, and data analysis.

In this project, a dataset comprising 1000 images capturing an array of expiry date digits has been meticulously crafted. The dataset encompasses 10 distinct classes of digits ranging from 0 to 9, with each class brimming with a bountiful 100 samples. The images encapsulate a rich diversity, having been sourced from numerous grocery stores through an extensive photo documentation endeavour. To refine the dataset, the digit images underwent a meticulous process of cropping and resizing, ensuring each digit is elegantly presented in a compact 32×32-pixel frame. Noteworthy is the color richness of the images, featuring a vibrant palette of red, green, and blue through the 3 color channels. Delving deeper, the images boast unique font styles rarely encountered in conventional text documents, adding an element of distinctiveness to the dataset. Moreover, some images deviate from the conventional norms of being fully vertical or horizontal, introducing a challenge that propels the dataset's complexity. Background colors further add to the dataset's diversity, underscoring the need for tailored recognition approaches as conventional OCR libraries may falter in deciphering these intricacies.

The data are stored in an excel sheet by extracting the date from the product. These dates are obtained using text recognition algorithms. When the user buys a new product he/she scans the expiry date using the camera. The date is extracted from the photos and stored in a database. These databases are either stored in excel or SQL. For example, A user decided to buy a biscuit packet in the month of January and he opened the packet and ate 3 biscuits and kept it open. He then decides to go for a vacation for 6 months. The expiry date of the biscuit packet is 4 months. If he was unaware of that, he would consume that and get sick.

In summary, product expiration date alerts represent a crucial aspect of modern family life, offering a range of benefits that contribute to convenience, safety, and security. By harnessing advanced technologies like OCR, machine learning, and intuitive interfaces, these alerts empower consumers to efficiently manage their products, minimize food wastage, mitigate health risks, and save money effectively. This proactive approach to product monitoring not only addresses the challenges faced by individuals and households but also ensures that items are either utilized or disposed of prior to expiry.

Moreover, the presence of expiration alerts establishes a significant linkage between fostering health-conscious behaviours and promoting environmental sustainability. As society becomes increasingly cognizant of the implications of food wastage on the environment, the value of these alerts escalates. Through integrating these notifications into their daily routines, consumers can play a tangible role in curbing waste, optimizing their purchases, and supporting sustainable practices Ultimately, the concept of expiration date warnings embodies pertinent solutions to the multifaceted issues prevalent in contemporary society. By acknowledging the significance of these alerts, individuals are better equipped to make informed decisions regarding product usage and disposal, thereby contributing to a more conscientious and sustainable lifestyle that benefits both personal well-being and environmental conservation.

II. LITERATURE SURVEY

ln[1] This study demonstrates the utilization of waste products in food and beverages to detect expiry dates, introducing a machine learning project aimed at

notifying users about product expiration. Emphasizes the significance of food waste management in detecting product availability and quality through barcode scanning for efficient delivery.

ln[2] Research in this field explores technological solutions such as IoT-enabled systems, smart devices, and mobile applications to address the challenge of tracking food expiration. Highlights the utilization of wireless sensor networks for real-time expiry monitoring, enhancing consumer experience and reducing food waste.

ln[3] This research investigates the increasing focus on machine learning algorithms in food management systems, including Decision Trees, K-Nearest Neighbours, and Naive Bayes for classification and prediction tasks related to food consumption and expiry patterns. These algorithms offer opportunities for improving accuracy and efficiency in food resource management.

ln[4] This study applies time series forecasting models, such as smooth-based, moving average, and ARIMA, to estimate food expiration dates. It emphasizes the importance of selecting the most suitable model for accurate predictions based on historical data.

ln[5] This research examines various approaches like collaborative filtering, content-based filtering, and hybrid algorithms in personalized recommendation systems for food items based on individual tastes and consumption habits. It emphasizes the importance of tailored recommendations to enhance user engagement and experience.

ln[6] This study highlights the use of relevant indicators, such as food waste reduction rate, user satisfaction, and system correctness, together with user studies to evaluate the effectiveness of food expiry reminder systems. Evaluation metrics offer insights into the performance of several models or algorithms and facilitate cross-model comparisons.

ln[7] This research presents the design and implementation of an Android-based system for addressing food wastage by providing timely notifications to users about impending food expiration. Integrates machine learning algorithms and user input for accurate prediction and emphasizes user-friendly interfaces for enhanced user experience.

ln[8] This study proposes an item management process for smart fridges with enhanced capabilities, integrating sensor technology and machine learning algorithms for efficient inventory tracking and item organization. Highlights the potential of smart technologies in revolutionizing household appliance functionality and promoting sustainable food management practices.

ln[9] This study presents a system and technique for monitoring shelf life that uses sensors and data analytics to evaluate the quality of the item in real-time and provide precise estimates of how long it will last. highlights how adaptable the approach is for different sectors in order to save waste and manage inventories effectively.

ln[10] This comprehensive review explores advancements and challenges in IoT-based systems for real-time monitoring of food expiration dates. It discusses potential applications across different sectors for smarter and more efficient food management practices.

ln[11] This research explores synergies between food management and home automation technologies, focusing on seamlessly incorporating food expiry notification functionalities into existing smart home systems.

ln[12] This study leverages machine learning techniques to develop an intelligent system for enhancing food management practices by accurately predicting food expiration. Emphasizes real-time monitoring capabilities and adaptive learning for proactive measures to prevent food waste.

ln[13] This research delves into factors influencing shelf life and food spoilage mechanisms, providing insights into preservation techniques for extending shelf life and maintaining food quality.

ln[14] This study proposes a novel RFID sensor tailored for food expiration detection by monitoring changes in polymer conductivity triggered by food spoilage. Offers a promising solution for early expiration detection, contributing to improved food safety and waste reduction.

ln[15] This review surveys existing literature on AI-based methods for expiration date extraction, focusing on object detection and text recognition models. Identifies gaps in current approaches and highlights potential enhancements for accuracy and efficiency.

ln[16] This research proposes a framework for reliably detecting expiration dates across diverse formats, achieving high recognition accuracy. It fills a critical gap in publicly available datasets, promising improvements in food safety and waste reduction.

ln[17] This study addresses challenges in optical character recognition for food packaging, proposing a two-phase OCR process for accurate character recognition amidst complex packaging patterns.

ln[18] This research presents a deep learning model for automatically recognizing expiry date digits from

images, offering a potential solution to reduce food waste.

ln[19] This study assesses the impact of image pre-processing techniques on optical character recognition for retrieving expiry dates from product images, highlighting the importance of image pre-processing for sustainable food management practices.

ln[20] This thesis proposes an application featuring a graphical user interface for efficient food item management and waste reduction, integrating components like barcode scanning and optical character recognition. Aimed at combating food waste at the household level.

III. PROPOSED SYSTEM

- This system is divided into three major sections: user authentication, product management, and notification system.
- The User Authentication component is responsible for logins, signups, and session management. Users can set up accounts and log in via a dedicated login page. The Auth API Gateway authenticates user credentials and interacts with the user database. Once logged in, session management ensures a safe and personalised experience.

- The Product Management module helps users to keep track of their food inventories. The Product API Gateway allows users to add, delete, and alter information about their food items in the product database. This information includes expiration dates, which are critical to the Notification System.

- The Notification System is based on the expiry dates stored in the product database. The Notification Service calculates imminent expirations and sends notifications to users via their preferred channels. This can be done through email, SMS, or even push notifications to their devices. This ensures that people are informed of expired food before it goes to waste.

- When a user makes the decision to purchase a product, they utilize the camera to scan the expiry date, which causes the dates to be highlighted for easy viewing. Subsequently, within the database, these identified dates are stored with the corresponding product name, forming a record. The model then takes charge of the task of regularly updating the user with relevant information, regarding whether the product has reached its expiration based on a direct comparison between the stored expiry date and the present date. This process ultimately aids the user in making informed decisions about the products they have acquired.

ARCHITECTURE DIAGRAM

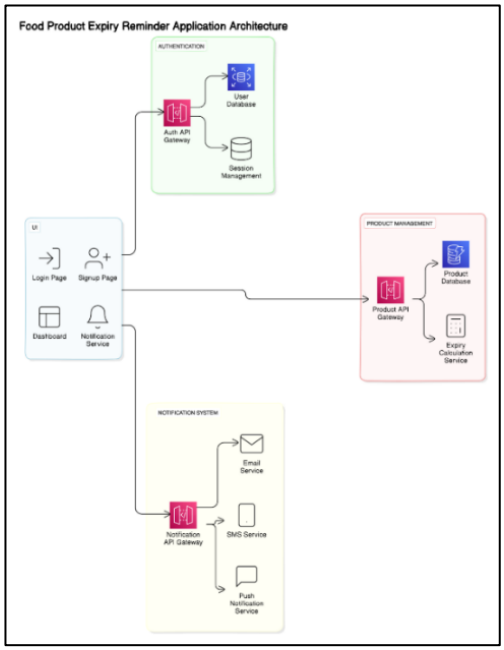

Fig 1

- Component: Login Page
    - Function: Allows user account creation and input of product information (name, expiry date).
    - Input: User account details, product information.
    - Output: User authentication, stored product data.
    - Interfaces: User interface for account creation and product input.

- Component: Product Information Server
    - Function: Stores product data (name, expiry) and potentially user information (preferences, restrictions).
    - Input: Product information, user data.
    - Output: Stored product data, potentially user preferences.
    - Interfaces: Database interface for storing and retrieving product and user information.

- Component: Product Management Server
    - Function: Analyzes product data to predict expiry dates, likely using time series forecasting or machine learning. May integrate

with sensor technology for storage condition monitoring (not shown). Generates and sends alerts to users via Login Page.

- Input: Product data, historical data, potentially sensor data.
- Output: Predicted expiry dates, alerts to users.
- Interfaces: Machine learning algorithms, sensor data integration (if applicable), interface for sending alerts to Login Page.

SVM:- Support Vector Machines (SVM) are employed as the core classification algorithm for predicting food expiry dates. SVM excels at handling high-dimensional data and nonlinear relationships, making it suitable for complex prediction tasks. By learning from historical data and relevant features, SVM classifiers can accurately classify food items into different expiry date categories.

Regular Expression:- Regular expressions are utilized to extract relevant information from textual data sources such as product names and descriptions. By defining patterns and rules for text parsing, regular expressions enable efficient feature extraction from unstructured text data. This extracted information, such as product names and ingredients, serves as input features for SVM classifiers, enhancing prediction accuracy.

Overall, this architecture outlines a system that allows users to track expiry dates for food products and receive notifications before they expire. This can help reduce food waste and save users money.

IV. RESULT

The Table 1 and 2 provides expiry date of each product, specifically highlighting the various date formats found on the backside of the cover. These formats encompass some formats such as Date Month Year and Month Date Year configurations, providing a rich dataset for the identification of multiple date. The date stored in the database serves as a training set for recognizing and handling the diverse date structures present, ensuring accurate and efficient date processing.

a. Table I . Date Formats

S.No	Date Format	Sample
1	DDMMYY	02 05 24
2	DDMMYYYY	02 05 2024
3	DDMMMYY	02 MAY 24
4	MMMDDYYYY	MAY 24 2024
5	MMMDDYY	MAY 02 24
6	DDMMMYYYY	02 MAY 2024
7	YYMMDD	24 05 02

Table 2 contains the information about the product name and the date in which the products gets expired. These dates include multiple formats mentioned in Table 1. All these details are securely stored within a robust database platform, which can either be in the form of SQL or Microsoft Excel for a user-friendly interface, ensuring easy access and efficient management of the information.

b. Table II . Sample Expiry Data

S.No	Product Name	Expiry Date
1	Milk Packet	02 05 24
2	Biscuit Packet	AUG 07 24
3	Perfume	25 12 24
4	Crocin 500mg	25 01 25

The performance of a date recognition network is usually evaluated by measuring precision, recall and F1 score. Precision measures the proportion of correctly identified dates out of all dates predicted by the network, which reflects its ability to minimize false positives. Recall estimates the proportion of correctly detected dates out of all true dates in the dataset, which indicates the ability of the network to minimize false negatives. The F1 score, as a harmonic mean of precision and recall, provides a balanced measure of the overall performance of the network, taking into account both false positives and false negatives.

$$\text{Precision} = \frac{\text{True positives}}{(\text{True positives} + \text{False positives})}$$

$$\text{Recall} = \frac{\text{True Positives}}{(\text{True Positives} + \text{False Negatives})}$$

$$F1 = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}}$$

c. Table III . Performance of DDN (Date Detection Network)

Actual/ Predicted	Date	Due	Prod	Bg	P	R	F
Date	726	0	0	17	0.9758	0.9905	0.9831
Due	0	390	0	31	0.9420	0.8600	0.8995
Prod	0	0	24	0	0.9600	0.8000	0.8727
Bg	7	71	16	0	-	-	-

d. Table IV . Performance of DMY Detection network

Actual/ Predicted	Date	Month	Year	Bg	P	R	F
Date	482	0	3	0	0.9938	0.9941	0.9939
Month	0	510	0	0	1.0	1.0	1.0

Year	2	0	495	0	0.9920	0.9960	0.9940
Bg	0	0	0	0	-	-	-

V. CONCLUSION

In conclusion, the implementation of this food expiry reminder system offers numerous benefits by helping consumers to track and manage their food inventory effectively. This promotes the reduction of food waste by minimizing the risk of consuming expired or spoiled items. Such practices not only contribute to environmental sustainability but also aid in leading a healthy lifestyle by preventing unnecessary diseases caused by ingesting expired food.

Moreover, the significance of this system extends beyond food safety. While expired food can lead to health issues, consuming expired medicines or syrups poses even greater risks, potentially resulting in fatal consequences. By addressing these concerns, this project plays a crucial role in safeguarding public health.

Additionally, the product expiry reminder empowers users to streamline their shopping habits. By alerting them to impending expirations, it helps prevent duplicate purchases and ensures the optimal utilization of existing inventory. This not only saves money but also reduces unnecessary consumption and waste, contributing to a more sustainable future.

Furthermore, the proposed system successfully addresses the challenge of product expiry management by providing a practical and user-friendly solution. Through its intuitive interface and timely notifications, it encourages responsible consumption habits and promotes both healthcare and environmental consciousness.

In essence, by adopting this approach, consumers can make meaningful contributions to building a more sustainable future while safeguarding their health and well-being. The proactive nature of the system also instils a sense of mindfulness in users, encouraging them to be more aware of their consumption patterns and make informed choices for a healthier and more sustainable lifestyle. Additionally, the system's reminders can serve as educational tools, raising awareness about the importance of food safety and proper storage practices, thus fostering a culture of responsibility and care towards not just personal health but also the wider impact on the environment.

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