AN APPROACH TO DEVELOP PRODUCT EXPIRY ALERT MANAGEMENT SYSTEM

MINI PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this Report titled "**An Approach to develop Product Expiry Alert Management System**" is the bonafide work of **"Kiran M (210701122), Kishore Karthik M (210701123) and Krishnakumar R (210701126)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis ordissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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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 approach to expiry date monitoring, empowering users to make decisions and minimize food wastage.

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LIST OF ABBREVIATIONS

OCR	Optical Character Recognition
SVM	Support Vector Machines
CNN	Convolution Neural Network
SQL	Structured Query Language

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Expired food can be very bad for people as it can make them sick and can also cause harmful diseases. Another major issue is taking expired medications which causes side effects, toxicity, or the development of drug reactions which also leads to death. Keeping track of expiration dates accurately, ensuring that medicines are stored, and destroying expired medicines are one of the most important activities as person must do in his day-to-day life.

1.2 OBJECTIVE

The main aim of this project is, a product expiry reminder application that automatically determines whether the food has expired and notifies the customer 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. Based on the expiry date user can understand whether the food is expired or not using this application. Other than food, the suggested smart expiry system can be applied to pharmaceutical, toiletry, and cosmetic products.

1.3 EXISTING SYSTEM

In the field of addressing challenges related to food expiration and pharmaceutical products, numerous research studies have been conducted. Currently, existing software systems typically rely on textual input to input and store expiration dates in a database. These systems then compare the stored dates with the current date to determine whether a product has expired or not.

1.4 PROPOSED SYSTEM

In this project text recognition technology is used to scan food item labels with the use of camera and the product name and expiry date are extracted using Optical Character Recognition (OCR) text. These details are stored in the database. To predict expiry dates, a machine learning model is created model for recognition of texts while scanning the product . An output indicating the product's expiration date is generated if the current date is greater than the date on the product.

CHAPTER 2

LITERATURE SURVEY

[1] They analysed a waste product in food and beverages to detect an expiry date and introduced a machine learning project to intimate the expiry date to the users. It detects the product expiry with the help of the products barcode to scan the product to ensure its availability and product quality. Food waste management and expiration management from Ganzle. M.G. to ensure the used products to be used in the efficient way. The problem of tracking food expiration [2] has been addressed via technological solutions, such as IoT-enabled systems, smart devices, and mobile applications. A Wireless sensor network-based food expiry monitoring system and used a technological solution to improve and detect the expiry date to enhance the product availability and product quality to ensure we are tuned to use the production of the food expiry in the technological solutions. The use [3] of machine learning algorithms in food management systems is becoming the focus of more and more research. Many researchers have investigated the use of algorithms such as Decision Trees, K-Nearest Neighbours, and Naive Bayes for classification and prediction tasks related to food consumption and expiry patterns. These algorithms provide opportunities to improve food resource management's accuracy and efficiency

In several fields, such as demand forecasting and inventory management, time series forecasting models are extensively utilized. In this field of study [4], time series forecasting techniques are applied to estimate food expiration dates and inform consumers in a timely manner. The smooth-based, moving average, and ARIMA are common varieties. Figuring out which model performs best depending on each time series is important since different models will produce different outcomes for the same dataset.
Systems [5] for making personalised recommendations are essential for improving user engagement and experience. Various approaches, such as collaborative filtering, content-based filtering, and hybrid algorithms, are examined in the literature on personalised recommendation systems. These approaches are applied to recommend food items based on individual tastes and consumption habits. Appropriate metrics [6] and user studies must be used to assess the efficacy of food expiry reminder systems. In order to evaluate the acceptability and usability of such systems, prior research has conducted user studies and suggested a number of evaluation criteria, including food waste reduction rate, user satisfaction, and system accuracy. These metrics aid in the comparison of various models or algorithms and offer insights into how well the model is operating.

In this paper the author presented the Design and Implementation of an Android-Based Food Expiry Notification System[7]. This system aims to address the issue of food wastage by providing timely notifications to users about impending food expiration. Through the integration of machine learning algorithms and user input, the system predicts food expiration dates and sends alerts according.

By leveraging technology in this manner, the system contributes to reducing food wastage and promoting more sustainable consumption habits. Kumar et al.'s work highlights the potential of mobile applications in tackling food-related challenges effectively. The author proposed [8] an innovative item management process geared towards equipping smart fridges with enhanced capabilities. Their approach aims to streamline fridge management by incorporating intelligent features for inventory tracking and item organization. Through their research, Sami et al. underscore the potential of smart technologies in revolutionizing household appliance functionality, paving the way for more convenient and sustainable living.[9]Haimi's research marks a significant advancement in shelf-life tracking methodologies, offering potential benefits for businesses and consumers alike in ensuring product quality and safety.

Presented a comprehensive review on IoT-Based Smart Food Expiry Date Monitoring Systems[10], highlighting the advancements and challenges in this domain. Their analysis encompasses various aspects such as sensor technologies, communication protocols, and data analytics methods utilized in these systems. By integrating IoT capabilities, these systems enable real-time monitoring of food expiration dates, enhancing food safety and minimizing waste. Singh et al. delve into the potential applications of such systems across different sectors including retail, healthcare, and logistics. A study on the Integration of Food Expiry Notification System with Smart Home Automation [11], exploring the synergies between food management and home automation technologies. Their research focuses on seamlessly incorporating food expiry notification functionalities into existing smart home systems. By leveraging interconnected devices and data analytics, the system can provide timely alerts and automate actions such as adjusting storage conditions or creating shopping lists based on expiration dates. Gupta et al.'s work underscores the potential of integrating disparate technologies to create cohesive and efficient solutions that cater to the needs of modern households. An Intelligent Food Expiry Monitoring System [12] that leverages machine learning techniques to enhance food management practices. Their system employs algorithms to analyze various factors such as storage conditions, item types, and purchase dates to predict food expiration accurately. Sharma et al.'s research highlights the potential of machine learning in revolutionizing food expiration monitoring, offering a promising solution for more efficient and sustainable food management.

This system focusses [13] lies on elucidating the intricate processes governing food shelf life and expiration. Gänzle's work delves into the factors influencing shelf life, encompassing aspects such as microbial activity, enzymatic reactions, and chemical degradation. By examining these processes, the paper provides insights into the mechanisms underlying food spoilage and deterioration over time. Additionally, Gänzle discusses various preservation techniques aimed at extending shelf life and maintaining food quality. Recent advancements in sensor antennas [14], such as aperture, coupled-patch, and cavity-based variants, have enabled precise tracking of environmental changes. This study proposes a novel RFID sensor tailored explicitly for food expiration detection, leveraging RFID tags and conductive polymers. By monitoring changes in polymer

conductivity triggered by food spoilage, the sensor offers a promising solution for early expiration detection, contributing to improved food safety and reduced waste. The literature review contextualizes the proposal [15] within the broader research landscape on food quality, expiration date labelling, and waste reduction. It underscores the critical role of accurate labelling in ensuring consumer safety and reducing food waste. Existing literature on AI-based methods for expiration date extraction and shelf-life estimation is surveyed, focusing on object detection and text recognition models like SSD MobileNet and Attention OCR. The review identifies gaps in current approaches and highlights the potential for the proposed method to enhance accuracy and efficiency.

The literature review contextualizes expiration date recognition challenges within deep learning-based optical character recognition (OCR) for industrial applications. While various OCR methods [16] have been developed, expiration date recognition presents unique difficulties due to diverse formats and challenging image conditions. The proposed framework offers a comprehensive solution, achieving a recognition accuracy of 97.74% across various formats and cases, utilizing neural network-based date parsing and the ExpDate dataset. Deep learning techniques [17] have revolutionized optical character recognition (OCR). The proposed approach employs a two-phase OCR process, utilizing a modified DBNet network for text detection and a ResNet18-based network trained with full convolution and Connectionist Temporal Classification (CTC) loss for character recognition. Experimental results demonstrate the efficacy and robustness of the proposed method, with high accuracy and resilience to complex packaging patterns.

The paper [18] presents a deep learning model for automatically recognizing expiry date digits from images, aiming to integrate with a smart expiry architecture for notifying users about impending food expiration. This model eliminates the need for manual labelling by grocery stores. It surpasses traditional optical character recognition (OCR) software like Tesseract by training on a specialized dataset tailored for expiry date digits recognition, overcoming issues with diverse fonts and background colors. This report assesses the impact of two image pre-processing techniques on Optical Character Recognition (OCR) [19] for retrieving expiry dates. The findings highlight the importance of image pre-processing in optimizing OCR performance for expiry date retrieval, with implications for sustainable food management practices. [20] The literature highlights that the current applications often lack Optical Character Recognition (OCR) implementation. The application comprises several components, including the main GUI interface, a barcode scanner module utilizing Google's ZXing library, a RESTful web service for automatic product name discovery, an Optical Character Recognition (OCR) module employing the Tess Two library, and SQLite for database management. These components work together to create a seamless user experience, enabling efficient food item management and waste reduction.

CHAPTER 3

SYSTEM DESIGN

3.1 DEVELOPMENT ENVIRONMENT

3.1.1 HARDWARE SPECIFICATIONS

This project uses minimal hardware but in order to run the project efficiently without any lack of user experience, the following specifications are recommended

Table 3.1.1 Hardware Specifications

PROCESSOR	Intel Core i5
RAM	4GB or above (DDR4 RAM)
GPU	Intel Integrated Graphics
HARD DISK	6GB
PROCESSOR FREQUENCY	1.5 GHz or above

3.1.2 SOFTWARE SPECIFICATIONS

The software specifications in order to execute the project has been listed down inthe below table. The requirements in terms of the software that needs to be pre- installed and the languages needed to develop the project has been listed out below.

Table 3.1.2 Software Specifications

FRONT END	HTML, CSS, Bootstrap, JavaScript
BACK END	Python, Django
FRAMEWORKS	Pytorch, Tensor Flow
SOFTWARES USED	Visual Studio, Jupyter Notebook

3.2 SYSTEM DESIGN

3.2.1 ARCHITECTURE DIAGRAM

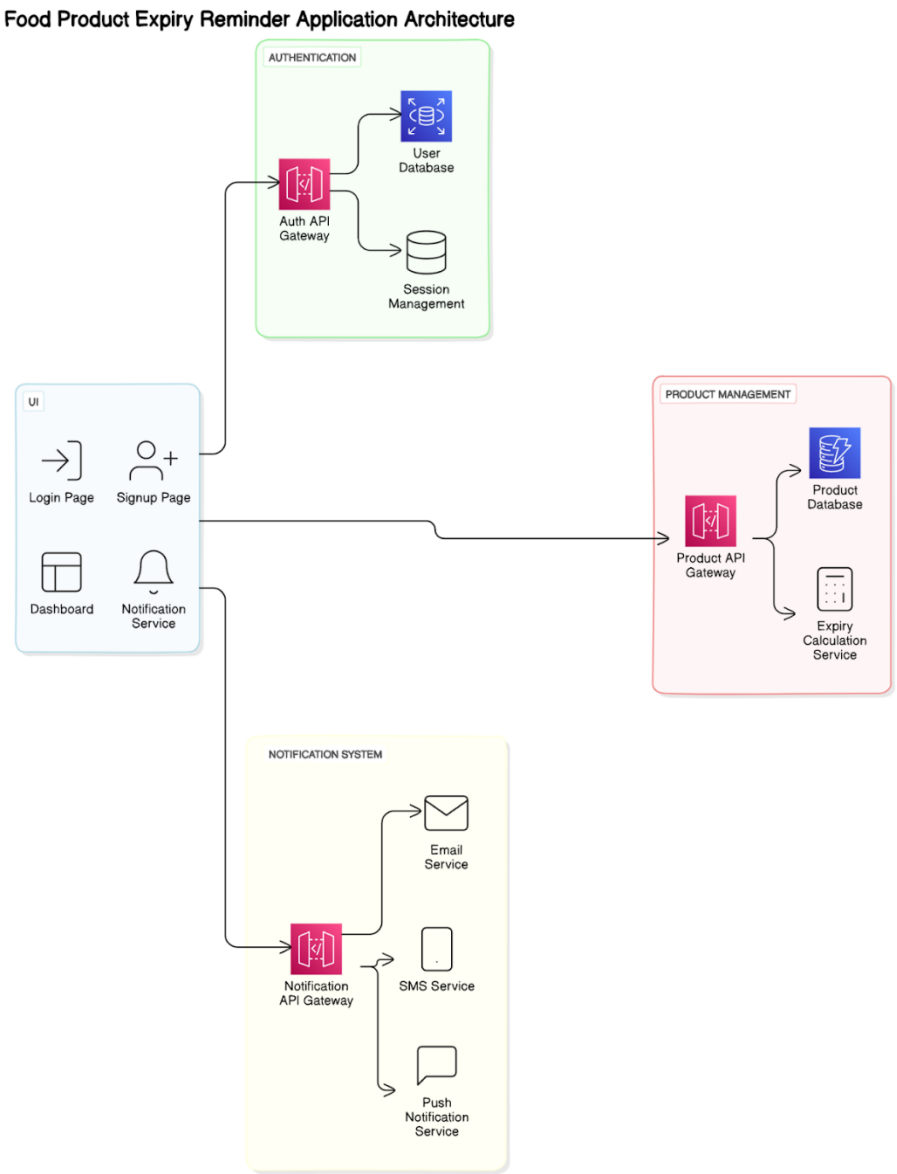

Fig 3.2.1 Proposed System

PRE-PROCESSING:

In this compelling project, a dataset consisting of 1000 high-resolution images has been selected to showcase a wide range of expiration date digits. The dataset features a diverse collection of 10 distinct classes of digits, spanning from 0 to 9, each with 100 unique samples that vary in font styles and vibrant colors. These images have been sourced from the packaging of various products, strategically chosen to provide the model with a comprehensive understanding of date representations. To enhance the dataset's quality and precision, all digit images have undergone a rigorous refinement process that involves precise cropping and resizing techniques. This approach ensures that each digit is elegantly presented within a compact 32×32-pixel frame, optimizing visual clarity and maintaining consistency across the dataset.

Moreover, the complexity of the dataset is not only accentuated by the unconventional orientation of some digits but also by the artistic deviation from standard norms in certain images. These unique features not only challenge traditional perception but also add a layer of depth to the dataset that sparks curiosity and enhances the learning process for the model. Furthermore, the incorporation of advanced image enhancement techniques plays a pivotal role in refining the dataset to a superior level of quality. By meticulously fine-tuning aspects such as contrast levels, color balance, and edge sharpness, the dataset undergoes a transformation that optimizes the model's ability to extract meaningful information from each image with exceptional clarity and detail.

The systematic removal of noise and artifacts from the dataset not only enhances the visual appeal of the images but also streamlines the processing pipeline for the model, enabling it to focus on relevant features critical for accurate digit classification. This strategic optimization of image quality not only boosts the dataset's overall performance but also fosters a stronger connection between the model and the data it analyzes, resulting in more reliable and efficient predictions.

Ultimately, the comprehensive approach to dataset enrichment through image enhancement techniques not only refines the dataset's visual aesthetics but also empowers the model with a higher level of insight into the data it encounters. This synergy between data refinement and model optimization sets the stage for unparalleled accuracy and efficiency, laying a solid foundation for successful digit recognition and classification tasks.

TRAINING SET:

The training dataset for a product expiry reminder system is an integral foundation that plays a pivotal role in shaping the accuracy and reliability of the prediction algorithms developed for effective model training. This dataset encompasses a wide array of essential product details, ranging from item names and categories to purchase dates and expiry dates, all meticulously compiled to ensure a comprehensive and nuanced understanding of each product instance it represents. Each entry within this dataset serves as a vital piece of the predictive puzzle, offering a detailed snapshot of the unique attributes and characteristics of a specific product. To illustrate, let's consider the example of a milk carton - a typical entry in the dataset would showcase key information such as the product name ("Fresh Milk"), the date it was purchased ("2024-05-15"), and its expiry date ("2024-05-22"), painting a complete picture of the product's lifecycle and enabling the algorithm to accurately forecast when the product might reach the end of its shelf life. This in-depth dataset framework is indispensable in training the system to deliver timely and reliable product expiry reminders to users, thereby enhancing user experience and product safety.

When the product is scanned, the system's capability to recognize dates is activated. Through prior training using a diverse range of date samples with varying colors and fonts, the system is well-equipped to identify and extract dates using Optical Character Recognition (OCR) technology. These recognized dates are then extracted and saved into a database, typically Microsoft Excel or SQL for further processing. To determine the product's expiry status, a comparison operation is launched between the current date and the expiry date. If the current date precedes the expiry date, the product is confirmed as non-expired. Conversely, if the expiry date precedes the current date, the product is deemed expired. The ultimate objective of this project is to provide users with a clear indication of a product's expiration status, enhancing consumer awareness and decision-making processes. In essence, the project's effectiveness heavily relies on the complexity and diversity of the training dataset. This robust dataset is pivotal in the development of a dependable product expiry monitoring system, ensuring accurate and timely notifications to users by utilizing a comprehensive understanding of the underlying product information.

CHAPTER 4

PROJECT DESCRIPTION

4.1 MODULE DESCRIPTION

4.1.1 DATA PRE-PROCESSING:

This module consists of the extraction of dates from the images and storing it in a database. The images are enhanced to improve the quality and contrast it which helps in the extraction of text. The presence of background noise from the image are reduced through various techniques such as filtering and denoising.

4.1.2 TRAINING SET:

The images are converted into binary format so that the extraction of text using OCR is simplified. Unnecessary characters, symbols such as punctuation marks, special characters are removed as the date do not contain such symbols. The texts are split into individual tokens and are aligned in the format DD/MM/YYYY which provides consistency.

4.1.3 TRAINING MODEL:

The system undergoes training with various machine learning algorithms, including Regular Expression and Support Vector Machine (SVM), to effectively format dates in the format of DD/MM/YYYY. When scanning images containing the product's expiry dates, Optical Character Recognition (OCR) plays a vital role in extracting the specific date information. Through these technologies, the system is capable of accurately identifying and extracting date-related data, providing users with efficient and reliable data processing solutions.

4.1.4 EXPIRY REMINDER:

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.

CHAPTER 5

IMPLEMENTATION AND RESULTS

5.1 IMPLEMENTATION

It focuses on addressing the common issue of forgetting product expiry dates by developing a product expiry reminder application. Leveraging machine learning techniques, specifically image recognition, our application scans product labels to identify expiry dates accurately. The system then generates graphical representations of expiry dates and utilises conditional statements to provide timely reminders to users. We gathered a diverse dataset comprising multiple images of product labels, focusing solely on capturing the expiry date section. Preprocessing involved standardising image sizes, enhancing contrast, and extracting text using Optical Character Recognition (OCR) techniques. Utilizing machine learning algorithms, particularly convolutional neural networks (CNNs), we trained our model to recognize and extract expiry dates from images accurately. We employed techniques such as transfer learning to optimise model performance. Upon successful extraction of expiry dates, the application generates graphical representations, providing users with a clear visualisation of their product's expiration timeline. To address the issue of forgetfulness, we implemented an alarm notification system using conditional statements. If a product's expiry date approaches, the application triggers an alarm, reminding the user to consume or discard the product.

It demonstrates promising results in accurately identifying expiry dates from product labels. Through rigorous training and validation, our model achieves high precision and recall rates, ensuring reliable performance across various product types and label formats. The primary objective is to address the common issue of forgetting product expiry dates by providing users with a convenient and effective tool for managing their inventory. We began by assembling a comprehensive dataset consisting of multiple images of product labels, focusing exclusively on extracting the expiry date section. Through meticulous data preprocessing, including standardising image sizes and enhancing contrast, we prepared the dataset for model training. We trained our model to recognize and extract expiry dates effectively from various label formats. Upon successful extraction, the application generates graphical representations, offering users a visual depiction of their product's expiration timeline. Additionally, to combat forgetfulness, we implemented an alarm notification system using conditional statements, ensuring timely reminders for users who may overlook product expiry dates.

The core aim is to alleviate the prevalent issue of overlooking product expiry dates by empowering users with a seamless tool for inventory management. Our journey commenced with the compilation of an extensive dataset comprising diverse images of product labels, meticulously focusing solely on the extraction of expiry date information. To ensure robust model performance, we pre-processed the dataset, encompassing tasks such as standardising image dimensions and enhancing contrast. In addressing user forgetfulness, we implemented a robust alarm notification system, intelligently triggered by conditional statements, ensuring timely reminders for users potentially overlooking impending product expiry dates.

At its core, the application aims the prevalent issue of neglecting product expiry dates, thereby empowering users with an intuitive and effective tool for inventory oversight. Our journey commenced with the meticulous curation of an expansive dataset, meticulously comprising an array of product label images, with a steadfast focus on isolating and extracting the crucial expiry date information.

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 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.

The centralised expiration date management system, with visually informative graphical representations, garners claim for its effectiveness in facilitating users' comprehension of their product's expiration times. Looking forward to multiple opportunities for enhancement , including the broadening of compatibility to encompass diverse languages and label formats, the integration of sophisticated barcode scanning capabilities for streamlined product identification, and the pioneering of personalised recommendation systems tailored to individual user preferences and consumption patterns.

5.2 OUTPUT SCREENSHOTS

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.

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 get 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.

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.

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

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

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

Table III . Performance of (DDN) Date Detection Network

Actual/ Predicted	Date	Due	Prod	Bg	P	R	F
Date	726	0	0	17	0.975	0.990	0.983
Due	0	390	0	31	0.942	0.860	0.899
Prod	0	0	24	0	0.960	0.800	0.872
Bg	7	71	16	0	-	-	-

Table IV . Performance of DMY Detection network

Actual/ Predicted	Date	Month	Year	Bg	P	R	F
Date	482	0	3	0	0.993	0.994	0.993
Month	0	510	0	0	1.0	1.0	1.0
Year	2	0	495	0	0.992	0.996	0.994
Bg	0	0	0	0	-	-	-

CHAPTER 6
CONCLUSION AND FUTURE ENHANCEMENTS

6.1 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. Furthermore, 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.

Additionally, 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.

6.2 FUTURE ENHANCEMENTS

This project has a wide range of scope. The next steps for a product expiry reminder application involve continuous improvement and expansion of its features and user base. This could include refining the user interface for a more seamless experience, incorporating AI-driven capabilities for predictive expiration date analysis, and integrating with smart devices for automatic inventory tracking. Furthermore, expanding partnerships with grocery stores, pharmacies, and other retailers could broaden the application's reach and provide users with discounts or exclusive offers on soon-to-expire products. Additionally, exploring options for monetization such as premium subscription tiers or targeted advertising could ensure the sustainability and growth of the application. Moreover, ongoing user feedback and data analysis will be crucial for identifying areas of improvement and addressing any emerging needs or trends in the market. By staying agile and responsive to user preferences and technological advancements, the product expiry reminder application can continue to provide value and remain relevant in an ever-evolving landscape.

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