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HEALTHIFY APP (INGREDIENT ANALYZER)

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ABSTRACT:

The Healthify App presents an innovative approach to assist users in making informed dietary choices through advanced machine learning and natural language processing. The app's primary functionality involves capturing images of food product labels, extracting text via Optical Character Recognition (OCR), and generating concise summaries of nutritional content. This streamlined process provides users with quick insights into essential nutritional factors—such as calories, protein, and fat—allowing them to make healthier food choices. Leveraging state-of-the-art summarization models, Healthify delivers a user-friendly experience, presenting nutritional information in an accessible format. Future versions of Healthify aim to expand functionality by incorporating personalized dietary recommendations tailored to individual health goals, along with suggestions for healthier food alternatives. The app's long-term vision is to evolve into a comprehensive health assistant that integrates nutrition tracking, meal planning, and fitness guidance. Through these advancements, Healthify strives to empower users to lead healthier lifestyles by providing a holistic and proactive

Keywords: Healthier Lifestyles, Dietary Choices, Optical Character Recognition (OCR), Nutritional Summarization, Per-sonalized Diet Recommendations.

Introduction

The COVID-19 pandemic has heightened global awareness of health and well-being, leading to a growing demand for tools that empower individuals to make conscious dietary choices. In response to this trend, the Healthify App was developed as an innovative solution that leverages artificial intelligence to provide users with clear insights into the nutritional content of packaged foods.

By using Optical Character Recognition (OCR) technology, the app extracts and processes information from food labels, enabling users to understand complex ingredients and make healthier decisions. Through this transparency, Healthify promotes a greater understanding of hidden and potentially harmful additives in food products, fostering healthier eating habits. In addition to ingredient analysis, the Healthify App enhances user engagement with a nutrition logging feature that allows users to track their food intake and receive feedback on essential nutrients such as protein.

Furthermore, Healthify includes a healthcare assistant chatbot powered by a decision tree classifier. This chatbot assists users in evaluating symptoms and provides probable diagnoses and preventive measures for potential health conditions, supporting proactive health management. The Healthify App is aligned with the objectives of the "Label Padhega India" campaign, which seeks to raise aware ness about the importance of reading food labels in India. This campaign, led by prominent figures such as Revant Himatsingka (FoodPharmer), emphasizes the risks associated with preservatives and unhealthy additives in food products. Inspired by practices in countries like Chile, where pictorial labels alert consumers to potential health risks, the campaign advocates for regulatory reforms, enhanced corporate transparency, and consumer education.

Through this integration of technological innovation and health awareness, the Healthify App aims to empower users with the knowledge needed to make informed dietary choices, ultimately contributing to a shift in consumer habits and promoting healthier lifestyles in India.

LITERATURE SURVEY

The growing demand for health-conscious dietary tools has led to advancements in the use of artificial intelligence (AI) and machine learning (ML) for nutrition tracking and dietary analysis. Modern approaches frequently utilize Op tical Character Recognition (OCR) and Natural Language Processing (NLP) techniques to streamline the extraction and simplification of nutritional information from packaged food labels, aiding users in making informed choices about their food intake. Traditional OCR systems, such as Google Cloud Vision and Tesseract OCR, have been instrumental in the extraction of text from food labels, which are often complex and unstructured. However, these systems typically require additional processing to organize and interpret the raw text data accurately. Building on these OCR technologies, the Healthify App employs advanced text extraction techniques to provide users with clearer insights into the nutritional content of packaged foods. In recent years, NLP models like T5 (Text-To-Text Trans fer Transformer) have demonstrated significant potential in generating concise and readable summaries. T5, a versatile Transformer model developed by Google, is optimized to treat every NLP problem as a text-to-text problem and excels in tasks like summarization, translation, and question answering. It is particularly suited for applications that involve simplifying detailed and technical food ingredient information. Healthify leverages T5 by fine-tuning it on a custom dataset of food ingredients, which enables the app to produce user-friendly summaries of complex or hidden ingredients. This improvement enhances user understanding, enabling them to make well-informed food choices. Furthermore, symptom-based health assessment tools have gained popularity in dietary applications, where decision tree classifiers and neural network models provide preliminary health insights. Healthify incorporates a healthcare assistant chatbot, using a decision tree classifier to assess user-reported symptoms and offer potential diagnoses and preventive recommendations. This feature supports users in proactively managing their health, going beyond dietary tracking to encompass health risk assessment. The development of Healthify aligns with ongoing health awareness campaigns, such as the "Label Padhega India" movement, which advocates for greater transparency in food labeling in India. Inspired by global practices, such as Chile's use of pictorial labels to inform consumers of unhealthy additives, Healthify provides ingredient analysis tools that aim to educate Indian consumers and promote healthier dietary habits. By highlighting potentially harmful additives and other dietary risks, Healthify empowers users to make healthier, more informed decisions. In summary, Healthify combines the strengths of OCR, NLP, and machine learning technologies to bridge the gap between complex nutritional data and consumer health awareness. This integrated approach supports users in understanding their food choices more clearly, enabling them to lead healthier lifestyles.

PROJECT UNDERTAKEN

Problem Definition

The Healthify App addresses the challenge of making informed dietary choices and promoting health awareness through a user-friendly, AI-driven solution. Consumers often face difficulty understanding complex ingredient information on food labels, which can contain obscure terms and hidden additives. Additionally, managing health based on diet and symptom monitoring is challenging without accessible, non-invasive tools.

Objective of Project

Develop an Efficient OCR System: The primary objective of the project is to develop a robust Optical Character Recognition (OCR) system using Flask that can accurately extract text from images. The OCR model should be trained to detect and process text in various conditions, such as varying font styles, sizes, and image qualities. The extracted text should be accurate enough to identify food ingredients from images, making it useful for the intended purpose.
Seamless Integration with Flutter App: A key goal of this project is to create a seamless connection between the Flutter frontend and the Flask backend. The application must allow users to easily upload images through a simple interface, and upon submission, the image will be sent to the Flask server for processing. Once the OCR analysis is complete, the extracted text should be displayed clearly on the Flutter app's UI, ensuring an efficient and intuitive user experience. User-Friendly Interface for Image Upload: The project aims to design a simple and user-friendly interface in the Flutter app for image uploads. The upload mechanism should be smooth, with clear instructions and the ability for users to quickly submit images. The interface should be minimalistic, ensuring ease of use, with feedback messages indicating the progress or outcome of the OCR processing, such as successful text extraction or errors. Optimize Performance for Speed and Responsiveness: The application should be optimized for both speed and performance.

The backend must process image uploads and OCR extraction efficiently, ensuring that users can receive results in a reasonable amount of time. The Flutter frontend should be responsive, with smooth transitions between screens, quick loading times, and minimal latency during image upload and result display. Security and Data Privacy: Ensuring the security of user uploaded data is a crucial aspect of the project. The backend must handle image uploads securely, protecting user privacy and preventing unauthorized access. All data transmitted between the Flutter app and Flask server should be encrypted, and any sensitive information processed by the OCR system should be stored or discarded following data privacy best practices.

PROJECT PLANNING AND MANAGEMENT

System Requirement Specification (SRS)
System Overview:
The following are the main features of the project: The proposed system is a web-based application designed to extract and summarize ingredients from packaged food la bels. It utilizes Optical Character Recognition (OCR) through downloaded Tesseract to scan food labels and extract ingredients. The extracted ingredients are then processed by the t5 model (a transformer-based language model) to generate concise summaries, highlighting nutritional facts about the food product. Additionally, the system includes a chatbot for disease assistance, which takes user-inputted symptoms to suggest possible diseases. Users can manually enter their food intake, which is then processed to provide nutritional information and visualized in a nutrition intake graph.

Functional Requirements:

- OCR-Based Ingredient Extraction
- Ingredient Summarization
- Manual Dietary Input and Nutrition Tracking
- Chatbot for Disease Assistance

3) Non-Functional Requirements:

- Response Time
- System Availability
- User-Friendly Interface
- Open to All Users

4) Deployment Requirements:

- Client-Server System
- Operating System: Windows, macOS, or Linux
- IDE/Code Editor: Visual Studio Code/IntelliJ IDEA
- Tools: Python3
- Frontend: Flutter (for creating a mobile and web app interface)
- Backend: Flask or FastAPI
- Database management using Firebase, MongoDB, or Google Firestore
- Recommendation System: Content-based filtering algorithm

Project Process Modeling

The development of the Healthify App (Ingredient Analyzer) is implemented using the Agile Development Model, which is well-suited for projects requiring flexibility, rapid iteration, and frequent user feedback. This approach ensures that the development process is dynamic and adaptable to evolving requirements, making it particularly effective for the project's goal of delivering an interactive and data-driven food intake analysis platform. The project is structured into small, manageable increments, each focusing on specific functionalities such as OCR-based ingredient extraction, ingredient summarization with the t5 model, manual dietary input and tracking, and user authentication. Each increment delivers a fully functional feature, which is then reviewed and tested, allowing the team to focus on one feature at a time while maintaining overall project coherence. The Agile methodology emphasizes collaboration among self-organizing, cross-functional teams, ensuring that both developers and stakeholders can actively contribute to the refinement of features and functionalities throughout the project's lifecycle. Regular sprint reviews and retrospectives are con ducted to assess the success of the sprint, discuss any feedback, and determine improvements for the next sprint cycle.

Methodology

1) Data Collection and Preprocessing:

Gather food label images uploaded by users. Collect manual dietary input from users, where they enter the food items consumed. Clean and remove noise from food label images to ensure quality input for OCR. Apply OCR technology (Tesseract) to extract text (ingredients) from the food label images. Correct OCR errors by filtering common misreads (e.g., recognizing "o" as "0"). Normalize extracted ingredients to a standardized format (e.g., "sugar" → "sucrose").

2) Feature Engineering:

Feature engineering plays a crucial role in improving the performance of machine learning models by transforming raw data into meaningful inputs. For the Healthify App (Ingredient Analyzer), feature engineering focuses on extracting and creating informative features from food label images, manually entered dietary inputs, and associated nutritional data. This ensures that the system is able to process data efficiently and provide accurate summaries and recommendations. The first step involves extracting textual data from food labels using Optical Character Recognition (OCR) technology, specifically Tesseract OCR. The raw text extracted may contain various irregularities, such as spelling mistakes, misplaced characters, or incomplete ingredient names. Cleaning and Normalization: These errors are addressed by applying text-cleaning techniques such as removing special characters, correcting common OCR misreadings (e.g., "0" interpreted as "o"), and ensuring consistency in ingredient names. For instance, "high-fructose corn syrup" is standardized as "fructose". Users also provide their daily food intake manually. This data is often entered in free-text form, so feature engineering is applied to convert this into structured information. Text Parsing and Normalization: Free-text food entries are parsed and mapped to recognized food items in a predefined food database. For instance, if the user enters "two slices of bread," the system maps this to a specific food item and quantity, and retrieves the corresponding nutritional data.

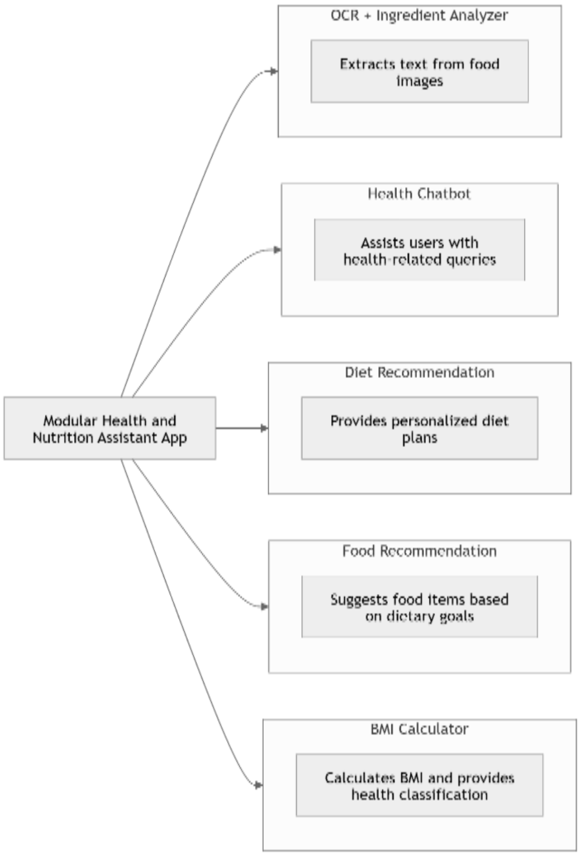

Fig. 1. Architecture Diagram

3) Model Evaluation:

Model evaluation is a critical part of ensuring that the Healthify App (Ingredient Analyzer) provides accurate and reliable results to users. The evaluation of the system's performance involves assessing the effectiveness of different components of the system, including OCR for ingredient extraction, the summarization model, and the disease prediction chatbot.

4) System Integration and Deployment:

The Healthify App (Ingredient Analyzer) relies on the integration of multiple components to provide a seamless and efficient user experience. System integration ensures that all parts of the ap plication—OCR for ingredient extraction, the summarization model, the disease prediction chatbot, and the user management system—work cohesively to deliver accurate and timely results. The deployment process involves setting up the infrastructure and making the system available to users in a scalable, reliable, and secure manner.

The integration process begins by combining the various modules developed for the application. The core modules include the OCR engine, which extracts ingredients from food label images, the T5-based summarization model, which generates concise nutritional summaries, the chatbot for disease prediction, and the user authentication system for managing user profiles.

The first integration step involves the OCR module. The Tesseract OCR engine is used to process food label images and extract ingredients. This output is then passed to the summarization module, which utilizes the T5 transformer model to generate a detailed yet concise summary of the nutritional content and health implications.

Analysis and Design

Introduction

This chapter covers the analysis and design of the considered system.

UML Diagrams

Sequence Diagram:

A Sequence Diagram visually rep- resents the functional requirements of a system from the user's perspective, showing the system's interactions with external actors (users, other systems, etc.). In the context of the Healthify App (Ingredient Analyzer), a use case diagram can help illustrate how various stakeholders interact with the system to achieve their goals. The primary goal of the app is to allow users to upload food label images, get nutritional summaries, input their food intake manually, and interact with a chatbot for disease predictions.

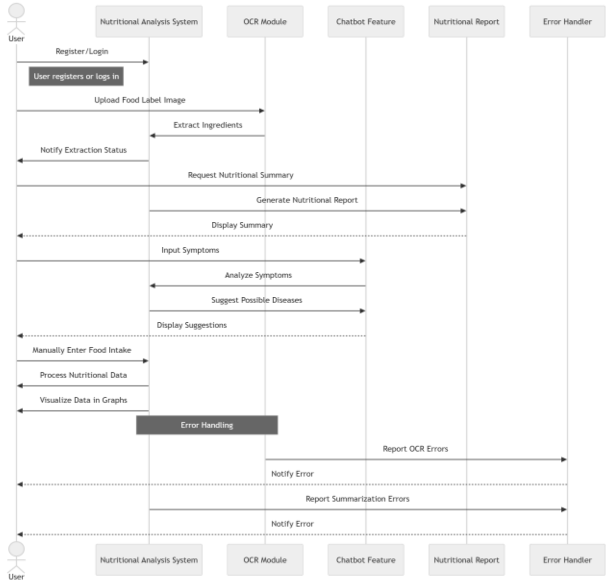

Fig. 2. Sequence Diagram

- **Class Diagram:**
  A Class Diagram is a high-level representation of the architecture of the system, showing the main components and how they interact with each other. For the Healthify App (Ingredient Analyzer), the system diagram will illustrate the different components of the application, including the frontend, backend, external services, and the database. He user interacts with the system through the frontend. It provides features such as uploading food label images, inputting food intake manually, viewing nutritional summaries.

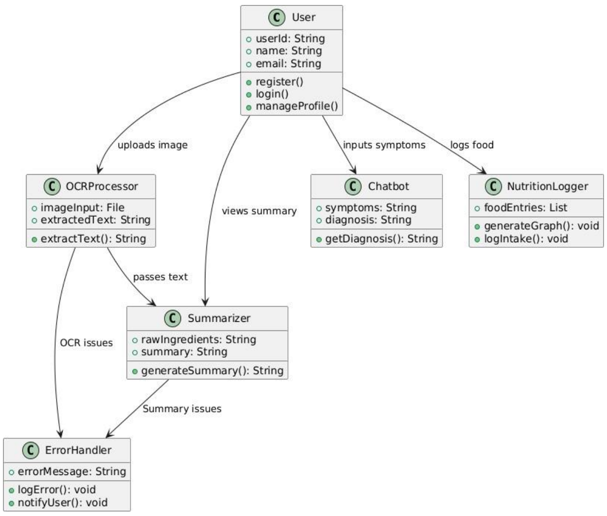

Fig. 3. Class Diagram

- **Activity Diagram:**
  The Activity Diagram provides a dynamic view of the system's workflow, illustrating how different components and users interact during the operation of the Healthify App. It captures the sequential flow of activities starting from image selection, ingredient extraction via OCR, summarization using the language model, and finally, displaying nutritional insights to the user. The diagram also highlights alternative paths such as manual entry of food intake and accessing the chatbot for disease-related queries. This visualization helps in understanding the logical progression of processes, system behavior, and user interaction in various scenarios.

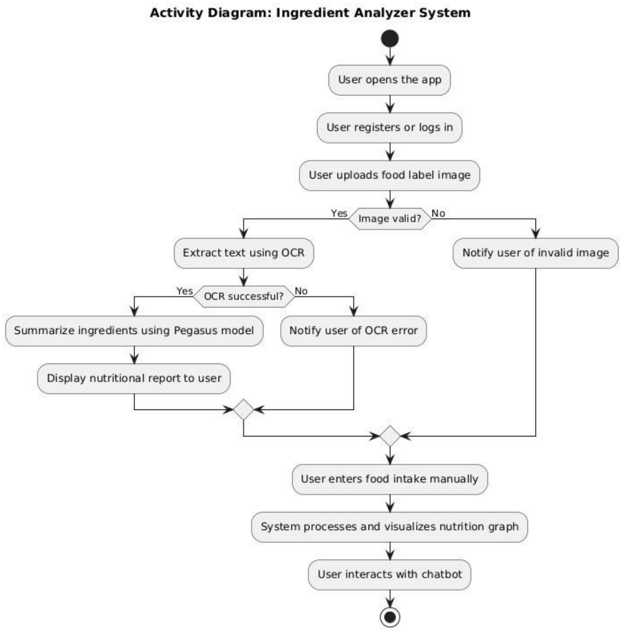

Fig. 4. Activity Diagram

MATHEMATICAL MODEL

- Model 1: Ingredient-Based Health Fact Extraction
- Let the system be:
- S1 = {Ip1, Op1, Ac1, Su1, Ex1, Fa1}
- Ip1: Inputs = {I1, I2}
- I1 = Image of food ingredient list
- I2 = User-provided context (optional)
- Op1: Outputs = {O1, O2}
- O1 = Text list of extracted ingredients O2 = Generated health-related facts Ac1: Actions = {A1, A2, A3}
- A1 = Perform OCR on the image A2 = Preprocess text
- A3 = Generate facts using T5 model
- Su1: Success = {S1}
- S1 = Facts successfully generated and shown
- Ex1: Exceptions = {Ex1, Ex2} Ex1 = Blurred image
- Ex2 = Incomplete extraction
- Fa1: Failures = {F1, F2} F1 = OCR engine crash
- F2 = Model returns null output

SIMULATION RESULT

The below graph illustrates the nutritional intake visualized based on the food items entered by the user. It demonstrates how the system parses and processes food data, converting it into meaningful nutritional components such as carbohydrates, proteins, fats, vitamins, and minerals. This helps users monitor their daily dietary patterns and assess their nutrient consumption effectively. The visualization is dynamically generated based on user input and showcases the system’s ability to provide intuitive feedback in an accessible graphical format.

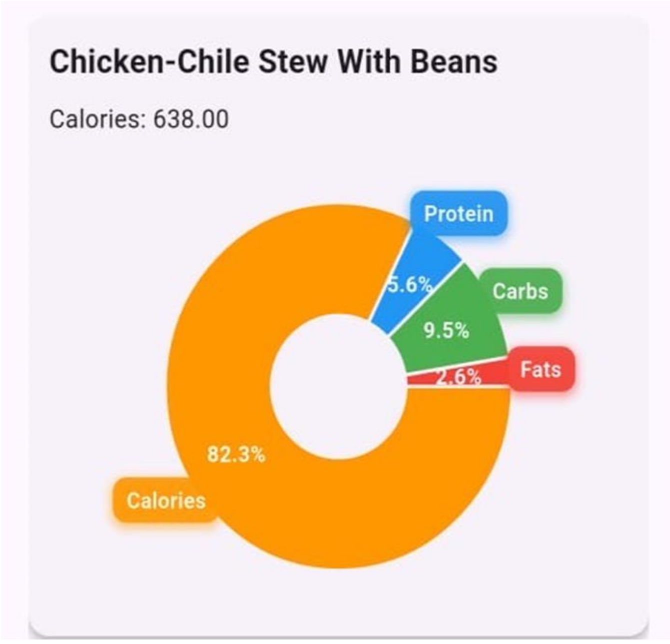

Fig. 5. Prediction Result Visualization

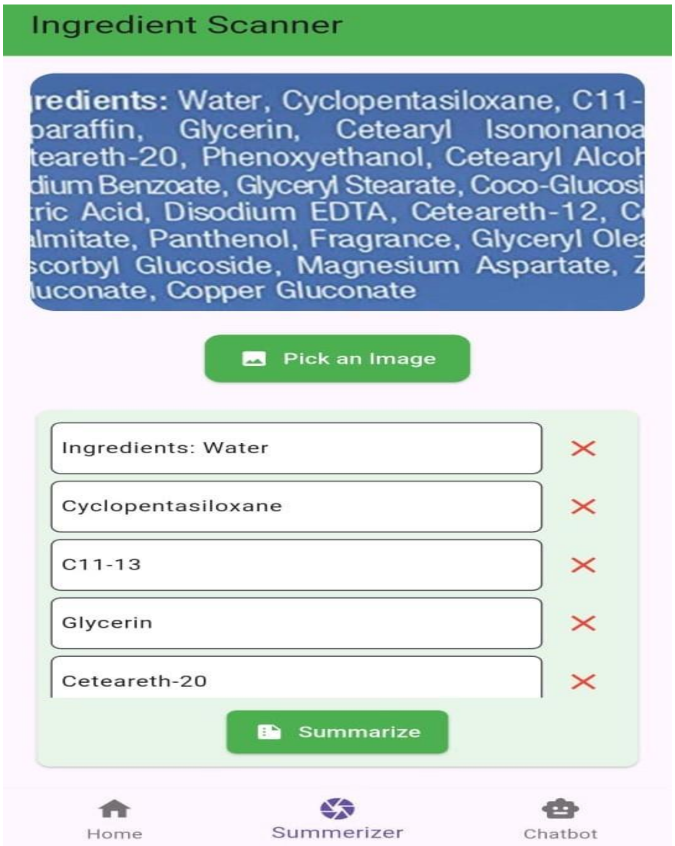

Fig. 6. Text Extraction

RESULT AND DISSCUSION

This interface allows users to upload images of packaged food labels. Once an image is selected, the system uses Optical Character Recognition (OCR) to extract the text content from the label. The extracted ingredients are then displayed on the screen and passed through a summarization model (T5), which generates a brief and informative summary highlighting key nutritional components. This helps users quickly understand the essence of the ingredients present in the scanned food item.

The summary feature of the application effectively condenses the extracted ingredient text into a concise and meaningful overview. Once an image of a food label is uploaded, the OCR module captures the raw ingredients data.This data is then passed to transformer-based language model (T5), which processes and refines the information into a user-friendly summary. The generated summary highlights key nutritional aspects of the food item, such as the presence of additives, allergens, and core nutritional components. This enables users to quickly understand the health implications of the food product without manually analyzing lengthy ingredient lists. The summarized output enhances the overall usability of the app by making nutritional evaluation faster and more accessible.

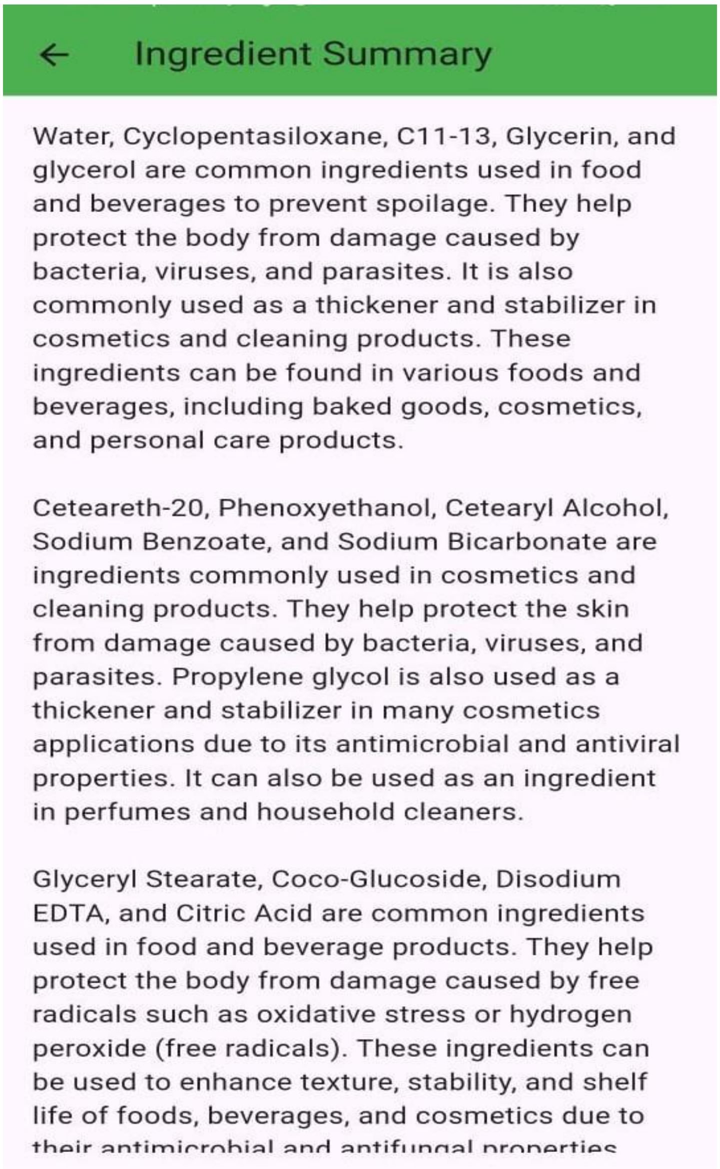

Fig. 7. Summary Generation

CONCLUSION

The Healthify App is designed to promote health-conscious decision-making, particularly in the post-COVID era. It uses advanced technologies like OCR and the T5 transformer model to simplify food ingredient lists, helping users understand the components of packaged foods. The app also features a nutritional logging system for tracking food intake and a chatbot that assesses health risks based on symptoms. The Label Padhega India campaign within the app advocates for clearer food labeling, highlighting the risks of preservatives and unhealthy additives. By combining AI, machine learning, and health education, Healthify aims to empower users to make informed, healthier choices, promoting better nutrition and well-being.

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