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Detrimental Ingredient Detection System

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ABSTRACT
In today's world, consumers are becoming increasingly conscious about what goes into the products they use, especially in the areas of personal care and cosmetics.However, reading and understanding complex ingredient lists on product labels can be a daunting task for most people. This DIDS – Detrimental Ingredient Detection System, a smart and user-friendly tool designed to help users quickly identify potentially harmful ingredients in products by simply uploading an image of the ingredient list.DIDS uses Optical Character Recognition (OCR) technology, powered by Tesseract, to extract text from the image. It then analyzes the extracted ingredients against a curated database to highlight harmful components. Unlike traditional systems that depend on barcode scanning or manual ingredient searches, DIDS provides a more flexible and efficient approach by working directly with images, even for custom or newly released products.The system is built using Python and integrates image processing and machine learning techniques to enhance the accuracy of detection. It aims to promote transparency in consumer products and empower users to make safer and more informed choices in their daily lives.

1-INTRODUCTION

In recent years, awareness about the safety of personal care and cosmetic products has grown significantly. However, understanding ingredient labels can be difficult for the average consumer. The Detrimental Ingredient Detection System (DIDS) aims to address this issue by providing a simple tool that identifies harmful ingredients from product labels. Using Optical Character Recognition (OCR) technology, DIDS extracts text from uploaded images of ingredient lists and highlights potentially harmful components based on a predefined database. This system promotes consumer safety by offering a quick and accessible way to analyze product content without relying on barcodes or manual searches.

II-LITERATURE SURVEY

Recent advancements in food safety focus on using technology to detect harmful ingredients and contaminants. The paper *"Development of a Toxic Food Ingredients Detector"*, presented at the 2021 IEEE IEMCON conference, introduced a mobile app that uses Optical Character Recognition (OCR) and machine learning to scan food labels and identify toxic ingredients based on a predefined database, offering real-time safety alerts to consumers. Complementing this, the study *"Detection and Prevention of Foreign Material in Food"* highlights methods like X-ray inspection and machine vision to detect physical contaminants such as metal and plastic in food production. While this focuses on non-chemical hazards, it emphasizes the growing role of automation in food safety. On the health impact front, a 2024 PubMed study reports that artificial additives—such as colorants, benzoate preservatives, and non-caloric sweeteners—may increase the risk of mental health disorders, underlining the importance of chemical ingredient monitoring.

Expanding on these ideas, the 2024 study *"Online Analysis of Ingredient Safety"* leverages OCR, machine learning, and toxicological data. Our project aims to address these issues by developing a comprehensive monitoring system that detects and quantifies harmful additives and contaminants in

By leveraging advanced analytical techniques and real-time data analysis, the system will provide consumers and analysis, the system will provide consumers and regulatory bodies witdecisions and promoting food safety.food products.

III-METHODOLOGY

LSTM (Long Short-Term Memory)

LSTM helps predict contamination events **or** detect anomalies in food product data by learning from past occurrences. This enables early warning systems, improved food safety monitoring, and proactive regulatory actions.

ALGORITHM STEPS

STEP 1: Load the image using OpenCV

STEP 2: Preprocessing the Image Make it OCR-ready. Grayscale Conversion removes color, Makes text more detectable. Converts image to pure black and white.

STEP 3: Segmentation & Layout Analysis Understand where text is in the image. Divides the image into: Blocks → Lines → Words → Characters

STEP 4: LSTM-based Character Recognition Each line is passed as a sequence of pixels.

Step 5: Post-Processing the Text After LSTM outputs raw text Language models
correct spellings & combine broken words.
Formula:

$$Gray = 0.2989 \times R + 0.5870 \times G + 0.1140 \times B$$

$$d(i, j) = \min(d(i-1, j) + 1, d(i, j-1) + 1, d(i-1, j-1) + cost$$

Multinomial Naive Bayes

It can be used to analyze and classify text data from food product labels, inspection reports, or online reviews to automatically detect mentions of harmful additives, contaminants, or regulatory violations

ALGORITHM STEPS

STEP 1: Collect and Organize Data

You have a labeled dataset of ingredients. Some ingredients are marked asHarmful, and some are marked as Safe.

STEP 2:Calculate Class Probabilities (Prior Probabilities)Formula:

P(Class)=Number of items in this class/Total number of items.

STEP 3:Count Ingredient Frequencies for Each Class

Count how many times each ingredient appears in each class.

STEP 4:Calculate the Likelihood of Each Ingredient in Each Class For each ingredient, calculate the probability that it belongs to a certain class basedon its frequency.

Formula:

P(Ingredient|Class)=Number of times ingredient appears in this class/Total number ofingredients in this class

STEP 5: Calculate the Probability for a New Ingredient

Formula (using Bayes' Theorem):

$$P(Class|Ingredient) \propto P(Ingredient|Class) \times P(Class)$$

STEP 6:Classify the Ingredient

After calculating the probabilities for each class (Harmful and Safe), the algorithm assigns the ingredient to the class with the highest probability.

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IV.RESULTS

Fig-1 Upon running the application, The web application will open. Go to the choose file

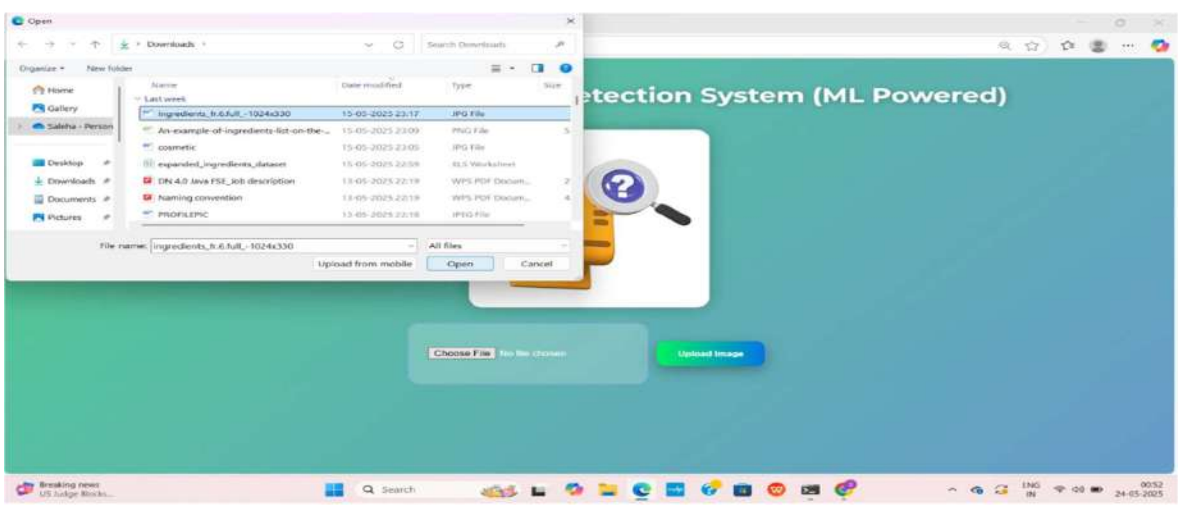

Fig-2 Select the jpg /png image option from your computer

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Fig-3 After choosing, click on the upload image button

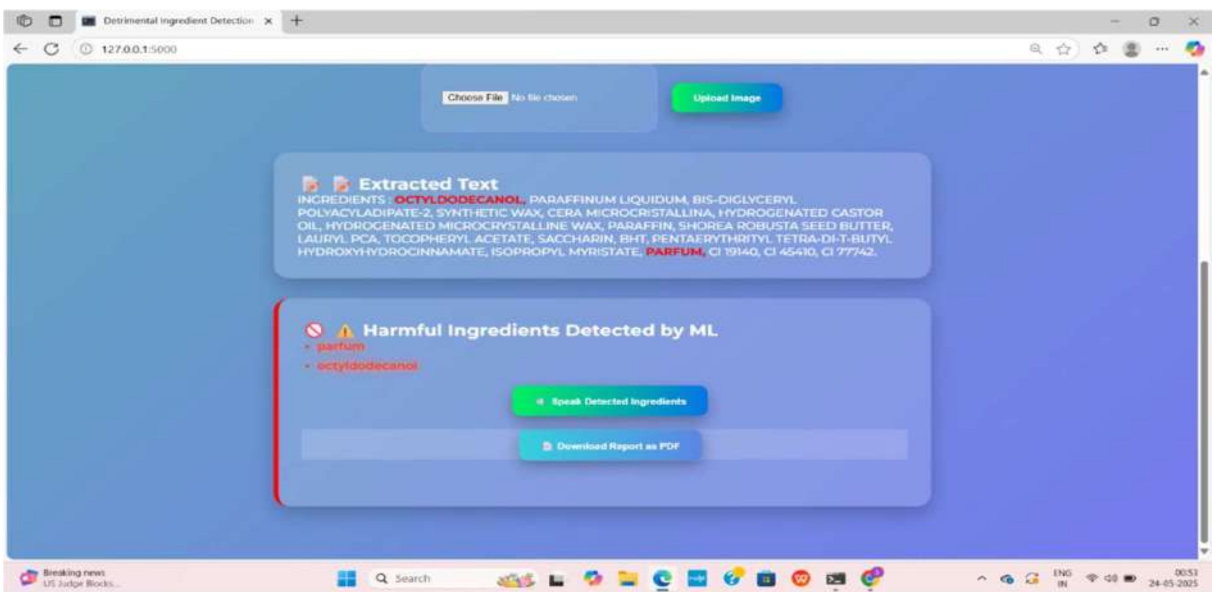

Fig -4 The list of harmful ingredients will be detected from the extracted text

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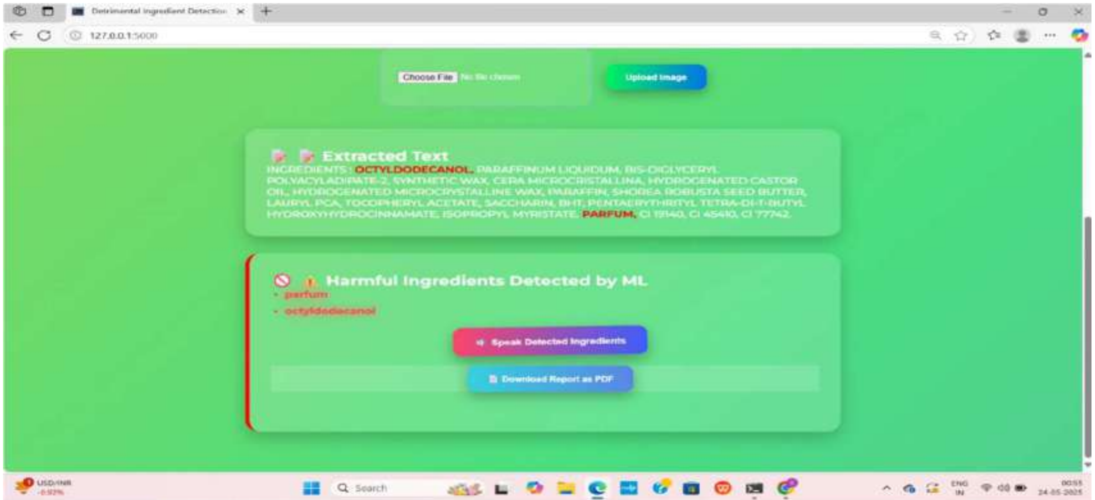

Fig-5 Click on the speaker to listen to the harmful ingredients

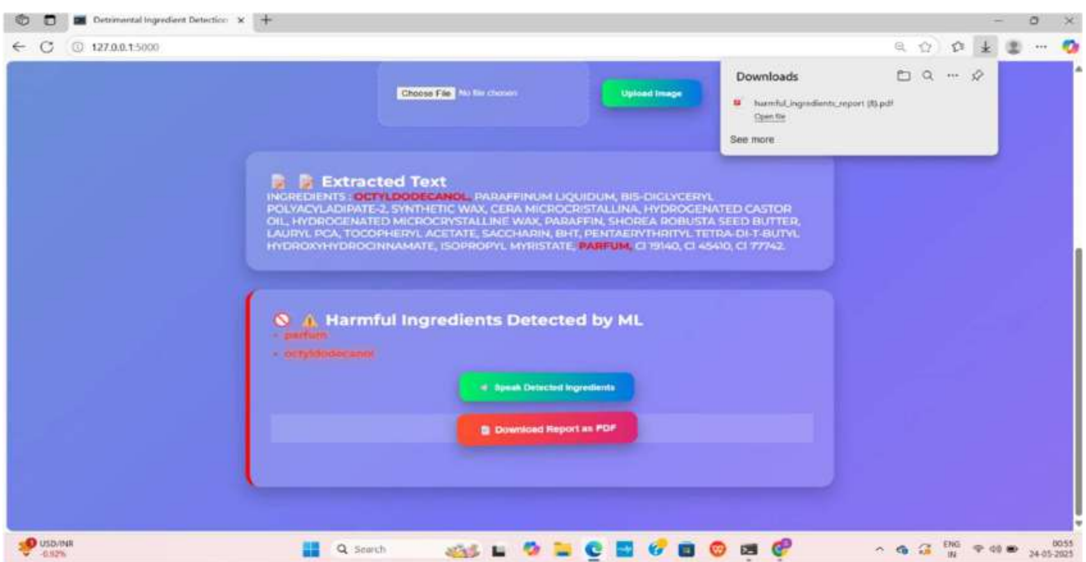

Fig-6 To download the list of harmful ingredients,click on downlaod report

V-CONCLUSION

The Detrimental Ingredient Detection System (DIDS) helps users easily identify harmful ingredients in personal care and cosmetic products using image-based analysis. By combining OCR, image processing, and machine learning, the system offers a fast and user-friendly way to analyze ingredient lists without relying on barcodes or manual searches. It promotes transparency and allows consumers to make safer, more informed choices.

In the future, the system can be improved by expanding the harmful ingredient database and supporting multilingual labels. Voice-based input and mobile app integration can make it even more accessible. Real-time feedback, user reviews, and recommendations for safer alternatives can also be added to enhance the overall user experience and impact.

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