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YST018 - ALLERGIFY: MOBILE APPLICATION FOR REAL-TIME ALLERGEN DETECTION IN PACKAGED FOODS

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ABSTRACT

Food allergy is an adverse health reaction that occurs each time an individual is exposed to a specific food. It happens when the immune system mistakenly identifies a harmless food protein as a threat. Even minimal exposure to certain foods can provoke allergic reactions, from mild symptoms such as hives and itching to severe, potentially life-threatening anaphylaxis. The risks are exacerbated, particularly when consumers are unable to accurately identify allergens in packaged foods due to the inefficiency of manually reading ingredient labels and the frequent use of scientific terms or alternative ingredient names. These factors often lead to confusion and misinterpretation, increasing the likelihood of accidental allergen exposure. Based on the motivation, ALLERGIFY, a mobile application, was developed to address these challenges through real-time allergen detection powered by Optical Character Recognition (OCR) and Natural Language Processing (NLP). The application enables users to scan ingredient labels with their smartphone camera, extract text using OCR, and detect allergens by comparing tokenized text against a curated database of alternative names for common allergens. The application also integrated the Gemini AI chatbot to provide personalized guidance on food allergies. The text recognition accuracy evaluation of the system demonstrated its capability for reliable text extraction and effective allergen recognition. ALLERGIFY supports a wide user base, including individuals, parents, schools, and public health agencies, contributing to safer food choices and promoting SDG 3: Good Health and Well-being.

Keywords – allergen detection, food allergies, mobile application, NLP, OCR

INTRODUCTION

Food allergies trigger immune responses when the body misinterprets certain food ingredients as threats, leading to reactions ranging from mild symptoms like rashes to severe anaphylaxis, which can be life-threatening without immediate epinephrine treatment (Yudeepanao et al., 2024). The eight most common allergens, which are milk, eggs, peanuts, tree nuts, soy, wheat, fish, and shellfish, are responsible for most reactions. Manual label reading is prone to misinterpretation due to the presence of technical or alternative ingredient names. This increases the risk of accidental exposure and creates barriers for allergy sufferers in making safe food choices. Mobile technologies offer a promising alternative by leveraging image-based ingredient scanning to automatically

detect allergens without needing to decipher complex terms. Driven by this motivation, this study introduces a mobile application that uses Optical Character Recognition (OCR) and Natural Language Processing (NLP) to detect food allergens in product labels. Users can scan ingredient lists with their smartphone camera, and the app extracts and tokenizes the text to compare it against a curated allergen database. The system identifies potential allergens and presents alerts, while an integrated AI chatbot offers additional allergen-related guidance. This automated approach enhances safety and simplifies allergen identification for users in real-time.

OBJECTIVE

i. To develop a mobile application for allergen detection that employs text recognition technology to address challenges in identifying allergens on packaged food labels.

ii. To promote community wellness through a mobile application that supports individuals with food allergies in making safer dietary choices, in alignment with SDG 3: Good Health and Well-being.

DESCRIPTION OF THE PROJECT

The allergen detection system in the ALLERGIFY application was developed using Optical Character Recognition (OCR) technology to perform text extraction for identifying allergens from scanned food packaging. OCR is a computer vision technique used to extract text from images and convert it into digital formats. This process enables seamless interaction between visual content and digital systems and is widely applied in document scanning, food label reading, and medical text analysis. With the advancement of machine learning, especially Convolutional Neural Networks (CNNs), OCR systems have achieved higher accuracy in recognizing both printed and handwritten text.

The system has been tested, with the evaluation carried out on 40 food label images using text recognition accuracy metrics, specifically the Character Error Rate (CER) and Word Error Rate (WER). CER quantifies character-level errors in OCR output, including extra, missing, or incorrect letters, while WER measures errors at the whole-word level. Figure 1 presents the average of CER and WER of OCR text extraction with varying image sample sizes (10, 20, 30, and 40 images). A noticeable decreasing trend in both CER and WER is seen with an increase in the number of test images. This demonstrates that the accuracy of text recognition improves with more image data being utilized for testing.

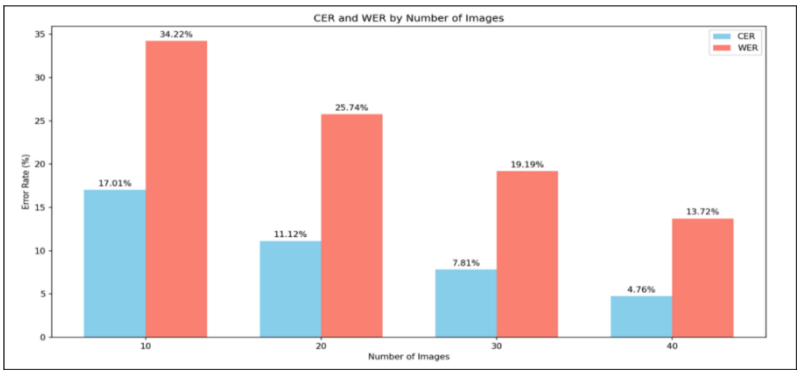

Figure 1: CER and WER by Number of Images

The application's usability was assessed using the System Usability Scale (SUS), a standard method for evaluating systems based on user feedback. The ALLERGIFY app achieved an overall SUS score of 89.79% (Grade A), classified as "Best Imaginable," reflecting an excellent user experience. Referring to Figure 2, the chart shows that most of the 10 SUS questions scored between 8 and 9 out of 10, resulting in a high normalized average score. These findings indicate that the app is highly usable, user-friendly, and effectively meets user expectations.

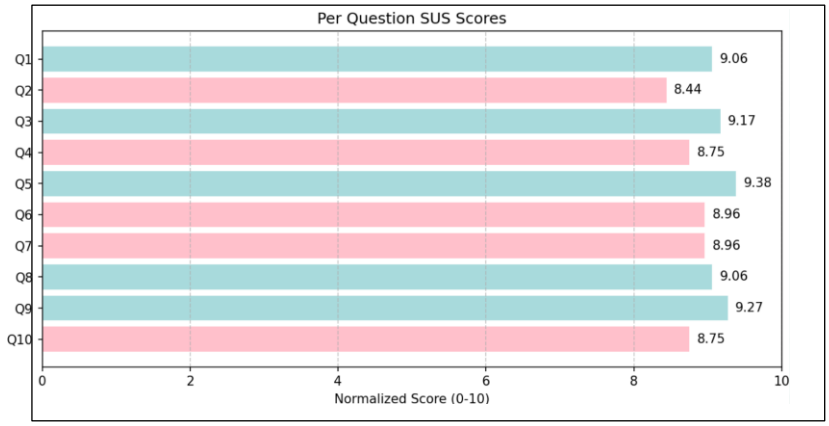

Figure 2: SUS Score Contribution by Each Question (0–10 Scale)

NOVELTY

This project introduces a novel real-time allergen detection mobile application that integrates Optical Character Recognition (OCR) and Natural Language Processing (NLP) to continuously scan packaged food labels and instantly highlight allergen keywords without storing images. By combining lightweight OCR processing with a curated database of alternative allergen names, the system offers higher accuracy and speed compared to existing static-scan or manual search methods. Enhanced with an AI-powered chatbot for personalized guidance, ALLERGIFY app contributes to consumer safety, public health awareness, and technological innovation in mobile health solutions. This unique approach not only addresses a critical gap in accessible allergen detection but also supports the United Nations Sustainable Development Goal (SDG) 3: Good Health and Well-being, fostering safer food choices and reducing accidental allergen exposure.

CONCLUSION

By providing a reliable tool that supports individuals with food allergies in making safer dietary choices, the project has contributed to promoting community wellness and aligns with the United Nations Sustainable Development Goal (SDG) 3: Good Health and Well-being. Altogether, ALLERGIFY has demonstrated strong performance, usability, and practical value in enhancing public health awareness and reducing accidental allergen exposure.

REFERENCES

Yudeepanao, K., Sakkato, K., Tosaman, P., Songmuang, P., & Kongkachandra, R. (2024). Detecting food items with possible allergens using deep neural network. 2024 IEEE International Conference on Cybernetics and Innovations (ICCI), 1–6. https://doi.org/10.1109/icci60780.2024.10532449