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AI System for Detecting Nutritional Deficiencies from Food Image

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Abstract: *Keeping track of daily food intake is useful for understanding eating habits, but writing down every meal can take time and may become difficult to maintain. This paper presents NutriFood-Health, a proposed web application that uses AI to help users identify food from an image and view an estimated nutrition profile. Along with food recognition, the proposed platform includes nutrition information, packaged-food label reading, ingredient review, product comparison, meal suggestions, an AI nutrition chatbot, reminders, allergy alerts, and basic fitness tracking. The presentation describes HTML and CSS for the frontend, Node.js for backend services, Python for AI and image processing, and SQL for data storage. The main aim is to make everyday nutrition information easier to access. The application is not intended to diagnose medical conditions. A food photograph alone cannot show whether a person has a vitamin or mineral deficiency. As no completed benchmark results or user-study findings were provided, this paper describes the design and a plan for evaluating it rather than claiming proven performance.*

Keywords: Artificial Intelligence, Computer Vision, Food Image Recognition, Nutrition Estimation, OCR, Personalized Diet, Wellness Monitoring.

I. INTRODUCTION

Food choices play an important role in a person's energy, growth, and general health. Many people track meals from memory, write them down, or enter them manually into calorie-counting apps. These methods can take effort, and the information provided may not always help users understand a meal's nutrients or compare packaged products. Image-recognition technology offers one way to make this process easier: it can suggest what food appears in a photograph and link that suggestion to nutrition information.

NutriFood-Health is planned as a website that brings food-image analysis and everyday wellness tools together. A user could upload a photo, take a picture with a camera, or enter a meal manually. The website would then show an estimated nutrition report and provide features such as product comparison, meal history, and selected fitness records. The idea is to keep these tools in one place and help users make more informed food choices.

Although the project title refers to detecting nutritional deficiency, a food image cannot establish that a person has a deficiency. It can only help estimate the nutrients that may be present in the food shown. Assessing a person's nutritional status may require information about their usual diet and symptoms, professional assessment, and sometimes laboratory tests. For this reason, NutriFood-

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Health should provide general nutrition information and awareness-based suggestions, not medical diagnoses.

II. PROBLEM STATEMENT AND MOTIVATION

Recording meals often means entering the same kind of information again and again. Some food apps focus mainly on calories and offer less support for reading ingredient labels, comparing products, saving allergy details, or following personal goals. Nutrition labels can also be difficult to understand at a glance. This project aims to bring these tasks into one platform, reduce some of the effort involved in meal tracking, and present food and wellness information in a clearer way.

The supplied presentation shows example figures of 40% for challenges with manual calorie counting, 35% for limitations in nutrition apps, and 25% for poor food awareness. However, it does not give the source of these figures or explain how they were collected. They are therefore treated as presentation examples only, not as verified statistics. A survey method and reliable source would be needed before using them as research evidence.

III. OBJECTIVES

1. Recognize food items from uploaded or camera-captured images using an AI-based pipeline.
2. Estimate calories and nutrients such as protein, carbohydrates, fats, vitamins, and minerals when a reliable food-data match is available.
3. Provide meal suggestions based on user-entered preferences and goals.
4. Extract packaged-food label text using optical character recognition (OCR).
5. Compare two to four packaged products using available ingredient and nutrition information.
6. Offer chatbot-based nutrition guidance and meal reminders.
7. Record weight, height, BMI estimates, step count, distance, and other selected wellness information.
8. Maintain user profiles, meal history, diary entries, and saved allergy information with appropriate access protection.
9. Present results in an accessible dashboard while clearly communicating estimates and uncertainty.

IV. LITERATURE REVIEW

Recognizing food from photographs is not always straightforward. The same dish can look different depending on lighting, camera angle, serving style, and background, and one image may contain several foods. Dishes that look alike can also contain different ingredients. Mohanty et al. present the Food Recognition Benchmark and discuss the use of deep learning for food recognition, highlighting the need for representative images and careful evaluation [1].

Konstantakopoulos et al. review image-based food recognition and portion-volume estimation [2]. Their work highlights that identifying a food and estimating how much of it is on the plate are separate tasks. This difference matters because even if the system identifies a dish correctly, its calorie estimate may still be inaccurate when the portion size or weight is unknown.

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Tan et al. compare deep-learning methods for food detection and recognition [3], while He et al. describe an end-to-end system for food-image analysis [4]. Together, these studies support using several connected steps, including image processing, model prediction, nutrition lookup, and a clear user interface. Since an image model can make mistakes, the application should also let users review and correct the predicted food label.

NutriFood-Health brings several related functions into a single proposed platform: food recognition, label scanning, product comparison, allergy profiles, meal history, reminders, and fitness tools. The combination is the main focus of this project. However, each feature still needs to be implemented and tested before its accuracy or usefulness can be confirmed.

V. PROPOSED SYSTEM AND ARCHITECTURE

The system is planned around four main parts: a user interface for signing in and entering information, backend services for handling requests and user records, AI tools for food recognition and label reading, and a database for profiles, meals, nutrition details, preferences, and activity logs. As stated in the presentation, the proposed technologies are HTML and CSS for the frontend, Node.js for the backend, Python for AI processing, and SQL for storing structured data.

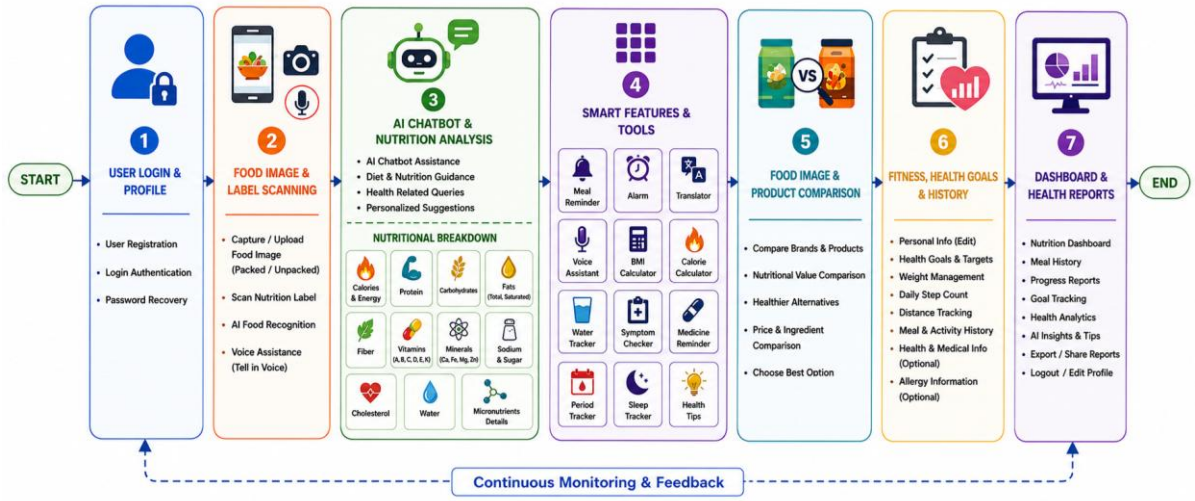

Figure 1: Project System/Module Overview from the Supplied Presentation

A. Input Layer: Users can provide a meal photo by uploading an image or taking a picture, or they can type the food name themselves. For packaged products, they can submit a photo of the ingredients or nutrition label. Before processing an image, the application should check that the file type is supported, the image is readable, and the upload is not empty or too large.

B. AI and Image-Processing Layer: The image-processing component would identify one or more likely food categories. A convolutional neural network (CNN) or another suitable vision model could be used, depending on the implementation. The system should keep the model's confidence information and allow users to correct an incorrect prediction. The presentation

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mentions a Kaggle dataset with more than 10,000 food items, but the exact dataset, its licence, included classes, and training/test split need to be confirmed and documented.

C. **Nutrition Mapping Layer:** Once a food category has been suggested, the application can look up its nutrition information in a trusted database. The final estimate will depend on the food type, how it was prepared, and how much was eaten. If the portion size is not known, the report should clearly say that the values are estimates and explain any serving-size assumption.

D. **Backend and Data Layer:** Node.js can handle requests between the website and its services, while Python can run the image-recognition and OCR tasks. A SQL database can store information such as user profiles, meal records, saved allergies, and nutrition results. Since some of this information is personal, passwords should be stored securely and records should only be available to authorized users.

VI. METHODOLOGY

A. **Food Image Acquisition:** After signing in, the user can upload a food image or take a picture using the camera option. The application should check that the image format is supported and that the picture is clear enough to process. If the image is blurry or difficult to recognize, the user should be asked to try again or enter the food manually.

B. **Preprocessing and Recognition:** Before the image is analysed, it may need to be resized, normalized, or converted into a format accepted by the chosen model. The model then returns one or more possible food labels. Mixed meals may require detection of several items or a step where the user selects the correct foods. Testing should use images that were not included in the model's training data, so performance can be assessed more fairly.

C. **Nutritional Analysis:** After the food is identified, the application can retrieve nutrient values from a reference database and adjust them to the serving size if the weight is known or entered by the user. The report may include energy, protein, carbohydrates, fat, and available vitamins or minerals. If a nutrient value is missing from the source database, the application should say so instead of guessing.

D. **Label Scanning and Product Comparison:** For packaged foods, optical character recognition (OCR) can be used to read the printed label. The extracted text may need cleaning because OCR can confuse letters, numbers, or spacing. The application can then display ingredient names and nutrition facts in a readable format. When comparing products, it is important to use equivalent serving sizes and to distinguish information copied from the label from any general interpretation.

E. **Personalization, Reminders, and Alerts:** Meal suggestions and reminders can be based on preferences and goals entered by the user. The allergy feature can compare ingredients found on a label with allergies saved in the user's profile. However, OCR and ingredient matching are not perfect and may miss important details. An alert should therefore be treated as a warning to check the label carefully, not as proof that a product is safe.

F. **Dashboard and Record Keeping:** The dashboard can bring together meal history, estimated nutrient values, reminders, weight entries, and selected activity information. Users should also

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have a way to correct or delete their records and to see how their personal information is stored and used.

VII. FUNCTIONAL MODULES

1. ***User Authentication Portal***: Account registration, login, recovery, and access control for personal information.
2. ***Meal Scan:*** Lets users upload a food image, take a picture, or enter food manually, then view the recognition result and nutrition report. The presentation mentions a 16-point report and a dataset of more than 10,000 items; these details should be checked against the final working application before being reported as completed features.
3. ***Packed Food Checker:*** Ingredient-label input and a readable summary of potentially concerning ingredients.
4. ***Compare Products:*** Side-by-side comparison of two to four products using available nutrition and ingredient data.
5. ***Fitness & Scale:*** User-entered height and weight, BMI calculation, and estimated calorie, hydration, and step goals.
6. ***Diary:*** Personal notes, daily activity logs, mood selection, and saved entries.
7. ***Allergy Alert:*** Comparison of ingredient information with allergies saved in the user profile, with clear uncertainty warnings.

VIII. INTERFACE SCREENSHOTS

The screenshots below were taken from the supplied project presentation. They show the intended interface and examples of the planned modules. A screenshot by itself does not confirm that a feature is fully implemented or that the AI model produces accurate results.

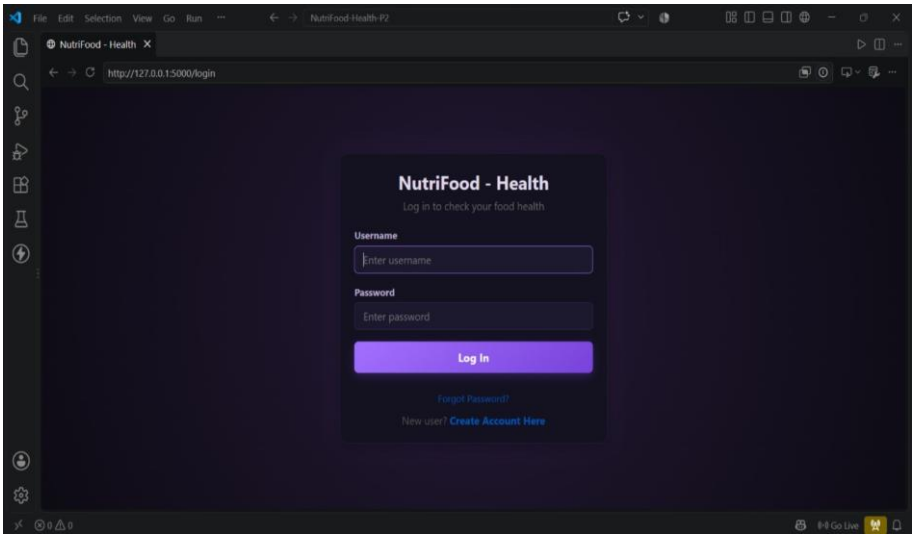

Figure 2: User Login Interface

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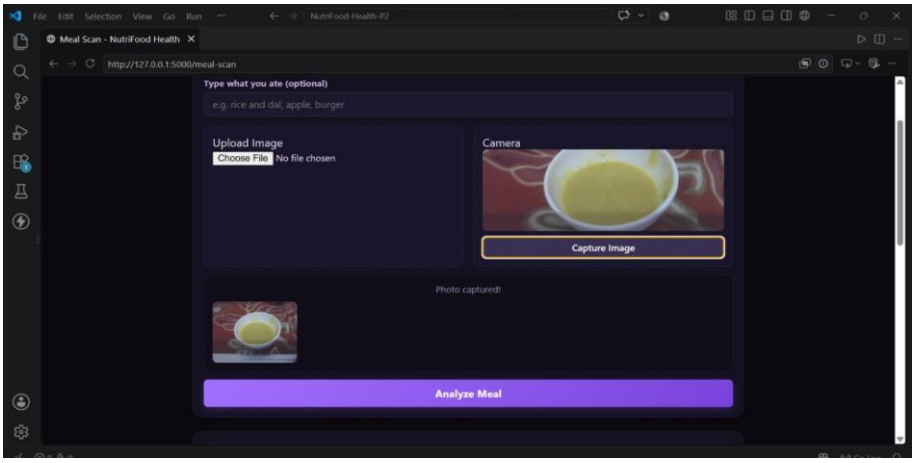

Figure 3: Meal-Scan / Food Input Interface

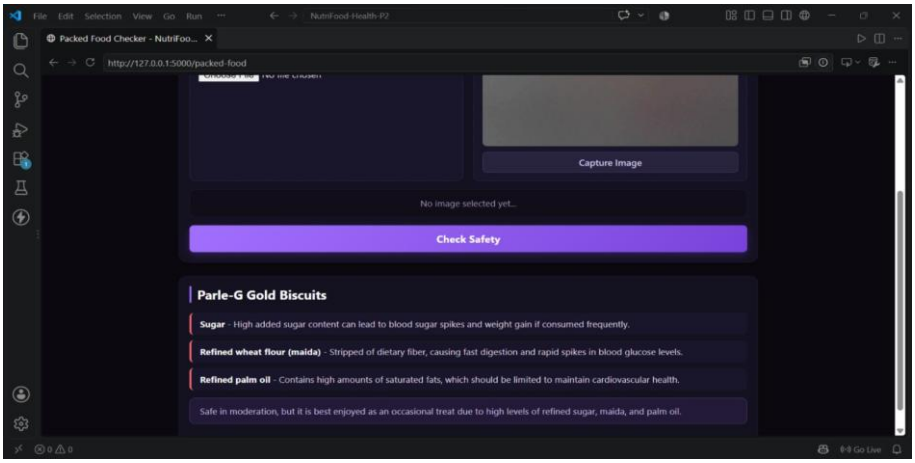

Figure 4: Food and Nutrition Result Interface

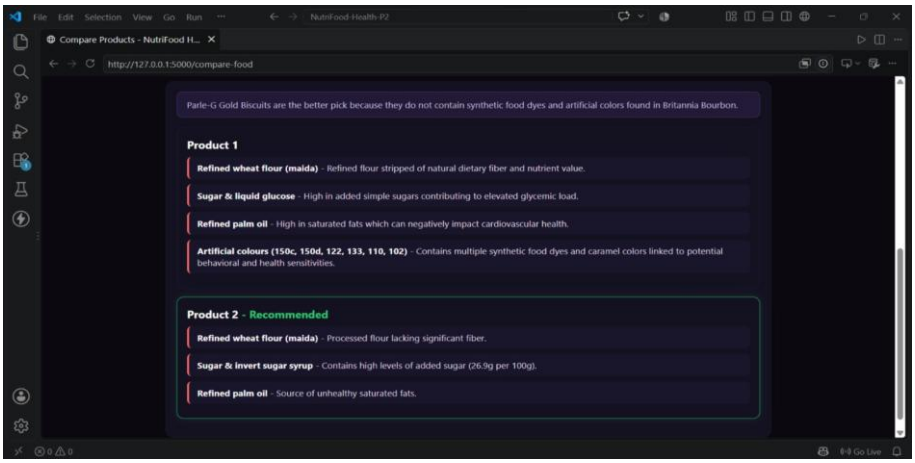

Figure 5: Nutrition Guidance or Result Interface

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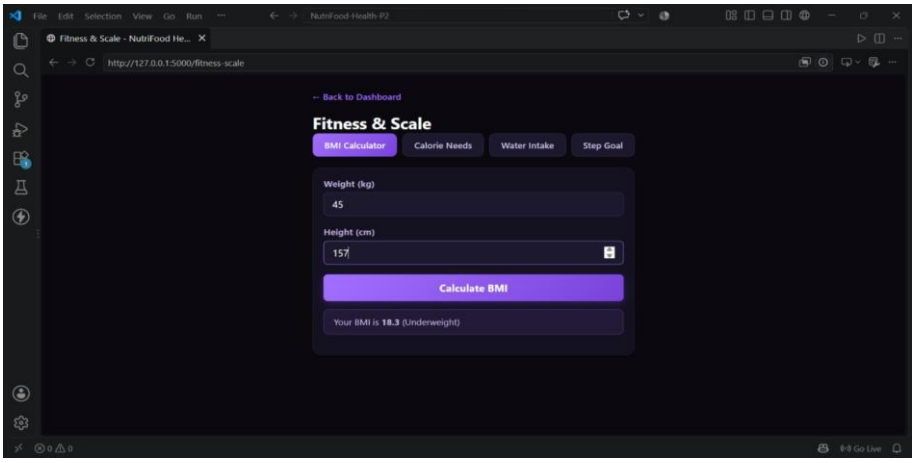

Figure 6: Fitness and Scale Interface

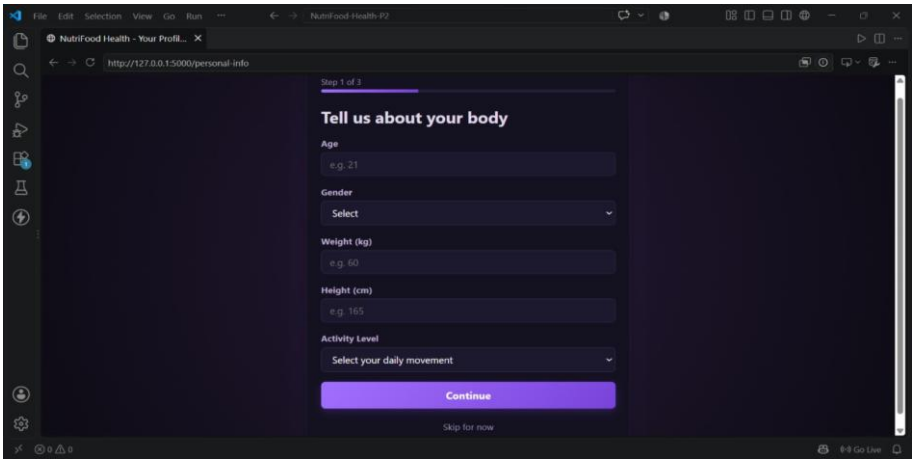

Figure 7: User Health-Profile Interface

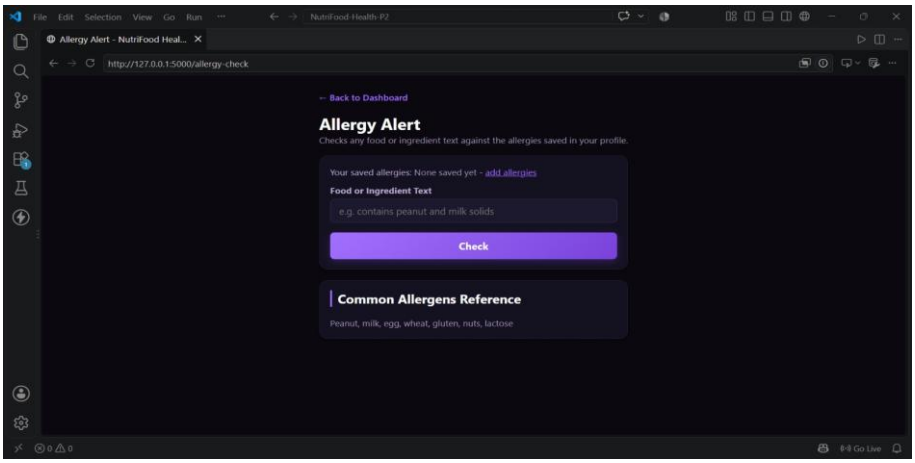

Figure 8: Allergy Alert Interface

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IX. EVALUATION PLAN AND EXPECTED OUTCOMES

The project is intended to produce a web application for image-assisted meal logging, estimated nutrition information, packaged-food label review, product comparison, general meal suggestions, and basic activity records. The supplied presentation does not report test-set results, model accuracy, response times, or feedback from users. For that reason, this paper does not claim that the system's performance has already been validated.

To evaluate the system, testing should use a separate dataset with known food labels. Useful measures include accuracy, precision, recall, and F1-score; mean average precision may be suitable if the model detects several food items in one image. OCR can be assessed using character or word error rate. Nutrition estimates should be compared with reference values for foods whose portions are known. A small usability study could also record how long tasks take, whether users complete them successfully, and what feedback they provide.

Testing should include a range of real-world situations, such as different lighting, camera angles, mixed dishes, regional foods, unfamiliar items, and unclear photographs. Incorrect predictions and allergy-related cases should also be checked. Showing confidence information and allowing users to correct a result would make the system more transparent and help limit the effect of mistakes.

X. ADVANTAGES AND APPLICATIONS

1. Reduces the amount of manual meal information users need to enter.
2. Combines meal tracking, label reading, product comparison, and wellness records in one platform.
3. Can make nutrition information easier to understand through organized reports.
4. May support awareness activities in homes, colleges, fitness centres, and nutrition counselling settings.
5. Offers a modular design that can be expanded with improved models and external data sources.

Possible uses include personal meal tracking, student wellness activities, support for fitness centres, and helping nutrition professionals keep routine food records. The application should be used as a support tool and should not replace advice from a qualified health professional.

XI. LIMITATIONS, SAFETY AND PRIVACY

1. A photograph does not reliably show every ingredient, the amount of oil used, the full recipe, or the exact portion weight. As a result, nutrition values generated from an image should be treated as estimates.
2. The recognition model may struggle with mixed meals, regional dishes, poor lighting, or foods that were not represented in its training data.
3. OCR may make mistakes when reading small text, curved packaging, or low-resolution label images.
4. The allergy feature may miss alternative ingredient names, hidden ingredients, or cross-contamination warnings. It cannot guarantee that a food product is safe for a person with an allergy.

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5. BMI and calorie or hydration targets are general estimates. They may not be appropriate for every person's age, health, activity level, or circumstances.
6. The application cannot diagnose a vitamin or mineral deficiency from a food photograph. Anyone concerned about a possible deficiency should seek advice from a qualified healthcare professional.
7. Because the platform may store health-related and personal information, it should use clear consent, secure storage, limited access, and understandable rules for data retention and deletion.

XII. FUTURE SCOPE

Future versions could compare models such as CNNs, EfficientNet, and Vision Transformers using the same documented dataset and evaluation measures. Portion estimates could be improved by using reference objects, depth information, or serving sizes confirmed by users. Other possible additions include barcode scanning, OCR for more languages, better coverage of regional foods, wearable-device connections, and nutrition guidance reviewed by qualified professionals. Before real-world use, the system should also be checked for explainability, confidence calibration, bias, and privacy risks.

XIII. CONCLUSION

NutriFood-Health is a proposed platform that brings food-image recognition together with nutrition estimates, packaged-food label reading, product comparison, meal suggestions, allergy alerts, and fitness tracking. Its goal is to make everyday food information easier to access and reduce the work involved in recording meals. The interface screenshots and project features described here come from the supplied presentation; the evaluation approach and implementation considerations have been added to make the paper more complete. The system still needs documented testing before its effectiveness can be established. It should be presented as a tool for nutrition awareness, not as a way to diagnose nutritional deficiencies.

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