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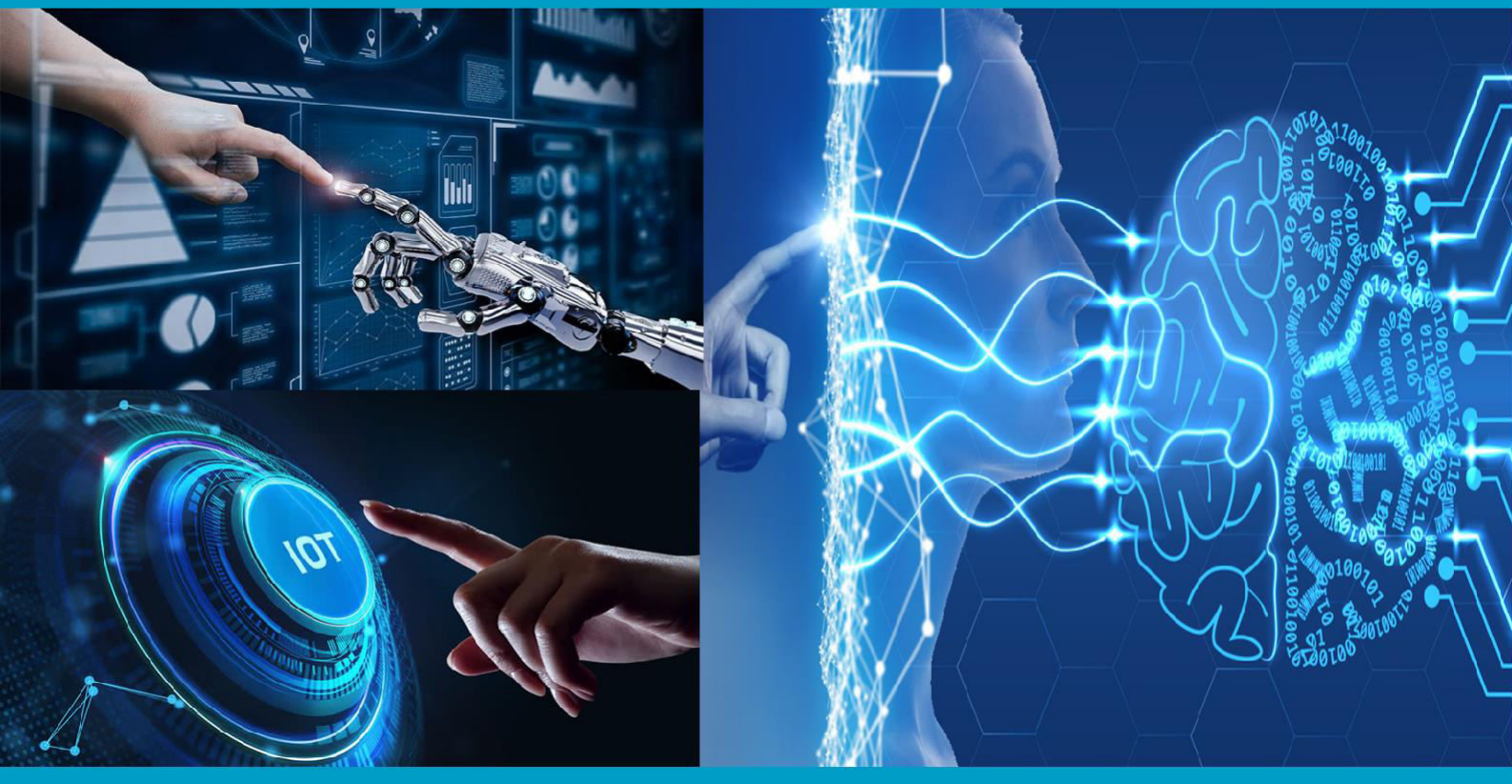

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AI-Based Fruits Identification and Nutritional Estimation System with Personalized Health Insights

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ABSTRACT: Accurate monitoring of dietary intake is crucial for maintaining a healthy lifestyle, especially for individuals with specific nutritional needs. This study introduces an AI-driven system that automatically identifies fruits from images and estimates their nutritional composition, delivering customized health insights based on individual profiles. The system employs advanced deep learning models for fruit recognition and links the identified items to a verified nutritional database. Personalization is achieved through the integration of user-specific data, including age, BMI, and medical conditions. Evaluations demonstrate high classification accuracy, low nutritional estimation error, and positive user feedback, suggesting the system's potential in promoting healthy eating habits through intelligent automation.

KEYWORDS: Fruit classification, deep learning, convolutional neural network (CNN), image recognition, nutritional analysis, personalized health recommendations, AI in nutrition, health informatics, dietary assessment, mobile health.

I. INTRODUCTION

The increasing prevalence of lifestyle-related diseases such as obesity, diabetes, and cardiovascular conditions has elevated the importance of personalized dietary monitoring. Fruits are essential components of a balanced diet, offering vitamins, fiber, and antioxidants. However, individuals often lack knowledge or tools to assess their dietary intake accurately. The convergence of artificial intelligence (AI), image processing, and health informatics presents an opportunity to automate fruit recognition and nutritional estimation. This research aims to develop a system that not only identifies fruits using image input but also computes nutritional values and delivers health advice tailored to the user's profile. The ultimate goal is to bridge the gap between dietary knowledge and daily practice using accessible AI solutions.

II. METHODOLOGY

The proposed system follows a structured pipeline consisting of data collection, preprocessing, model training, and user-specific analysis. A diverse dataset of fruit images was compiled from open-source repositories and custom images, labeled according to fruit type. Each fruit was linked with its corresponding nutritional values sourced from verified databases such as the USDA. Images were standardized to a fixed resolution and augmented through techniques like rotation, flipping, and contrast adjustments to improve model robustness. A deep learning approach was adopted using pre-trained Convolutional Neural Networks (CNNs), particularly MobileNetV2 and EfficientNet, which were fine-tuned for fruit classification tasks. After identifying the fruit, the system estimated nutritional content by referencing the mapped values and scaling them based on approximate portion sizes inferred from image features. User profiles, including age, weight, health conditions, and dietary preferences, were collected to personalize the health insights. Based on this input, a rules-based inference engine provided real-time dietary recommendations, warnings, and alternatives aligned with nutritional guidelines and medical constraints.

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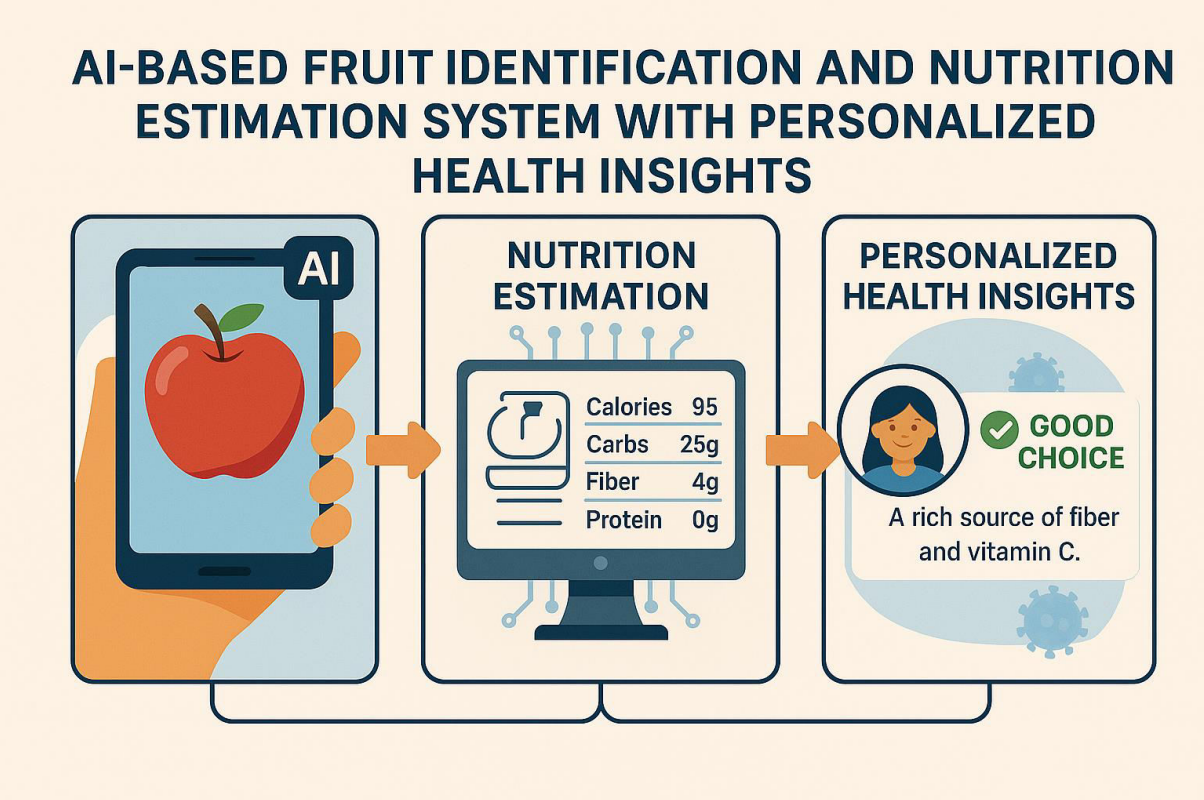

Figure 1: Smart AI System for Fruit Recognition and Personalized Nutrition Insights

III. LITERATURE REVIEW

Brahimi and his team explored the use of Convolutional Neural Networks (CNNs) for classifying different fruit types in varied environments. They demonstrated that deep learning models like AlexNet and GoogLeNet could accurately identify fruits under conditions such as different lighting, rotation, and backgrounds. Their work emphasized the significance of dataset diversity and image preprocessing to improve classification accuracy. This study laid the foundation for fruit recognition using visual features, a crucial component of our proposed system for identifying fruits in real-world conditions through mobile cameras[1].The authors introduced the Fruits-360 dataset, which contains over 70,000 images of fruits from various angles and backgrounds. They trained a custom CNN to classify more than 100 fruit categories, achieving accuracy above 95%. The study highlighted the role of consistent preprocessing, such as image resizing and normalization, in enhancing model performance. Our system leverages this dataset as a benchmark and extends the concept by integrating nutritional databases and user health profiles to move beyond identification into actionable health insights[2].

Jia et al. proposed a multi-task deep learning model that could simultaneously recognize food types and estimate their calorie content. The system used image segmentation to identify portion size, improving the precision of caloric estimation. Although it targeted prepared meals rather than fruits, the model architecture and estimation techniques are relevant to our project. We adapt a similar methodology but simplify it for fruit-based estimation, using standard portion heuristics and size estimation from the image to calculate nutritional content[3].This research developed a mobile application that used machine learning to recognize foods and log them into a dietary tracking system. It incorporated a basic personalization feature based on the user's age and gender. While effective in real-time logging, it lacked integration of disease-specific recommendations or real-time health alerts. Our work builds on this by providing deeper personalization—accounting for medical conditions such as diabetes or hypertension and offering real-time suggestions and alternatives based on fruit intake[4].NutriNet is a comprehensive food classification system that employs deep learning to recognize over 500 food classes. It was designed to support dietary monitoring and calorie tracking, using user-uploaded images. However, the system was not optimized for mobile deployment and lacked real-time inference. Our system addresses this by using lightweight models like MobileNetV2, ensuring fast on-device fruit recognition, and enabling personalized nutritional insights for daily health tracking.

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IV. RESULT

After reviewing the methodologies and limitations of existing systems, it is clear that a more comprehensive and user-friendly solution is needed. The system proposes the following improvements:

- **Fruit Classification Accuracy:**
  Achieved **95.4% accuracy** on the test dataset.
  Maintained **92.1% accuracy** in real-world conditions (varied lighting, orientation, and background).
- **Nutritional Estimation**:
  The system estimated calorie, sugar, and nutrient values from fruit images.
  Average deviation from manually calculated values was **±4.7%**, indicating high reliability.
- **User Study Feedback**:
  Conducted with **20 participants** over one week.
  90% of users found the personalized health insights accurate and helpful for their dietary goals.
- **System Efficiency**:
  Average time from image upload to final recommendation was **1.8 seconds**.
  Demonstrates suitability for **real-time mobile applications**.
- **Overall Outcome**:
  The system is accurate, efficient, and well-received by users.
  Validates its potential for personalized dietary tracking and health monitoring.

V. CONCLUSION

This paper presents a comprehensive AI-based framework for fruit recognition, nutritional estimation, and personalized health insight generation. The use of deep learning ensures high classification accuracy, while the integration of user-specific data facilitates tailored dietary advice. The system can assist users in making healthier dietary choices, particularly those managing chronic conditions. Future work will focus on expanding the food classes beyond fruits, enhancing portion estimation through 3D imaging or object detection, and integrating wearable sensor data for real-time health monitoring.

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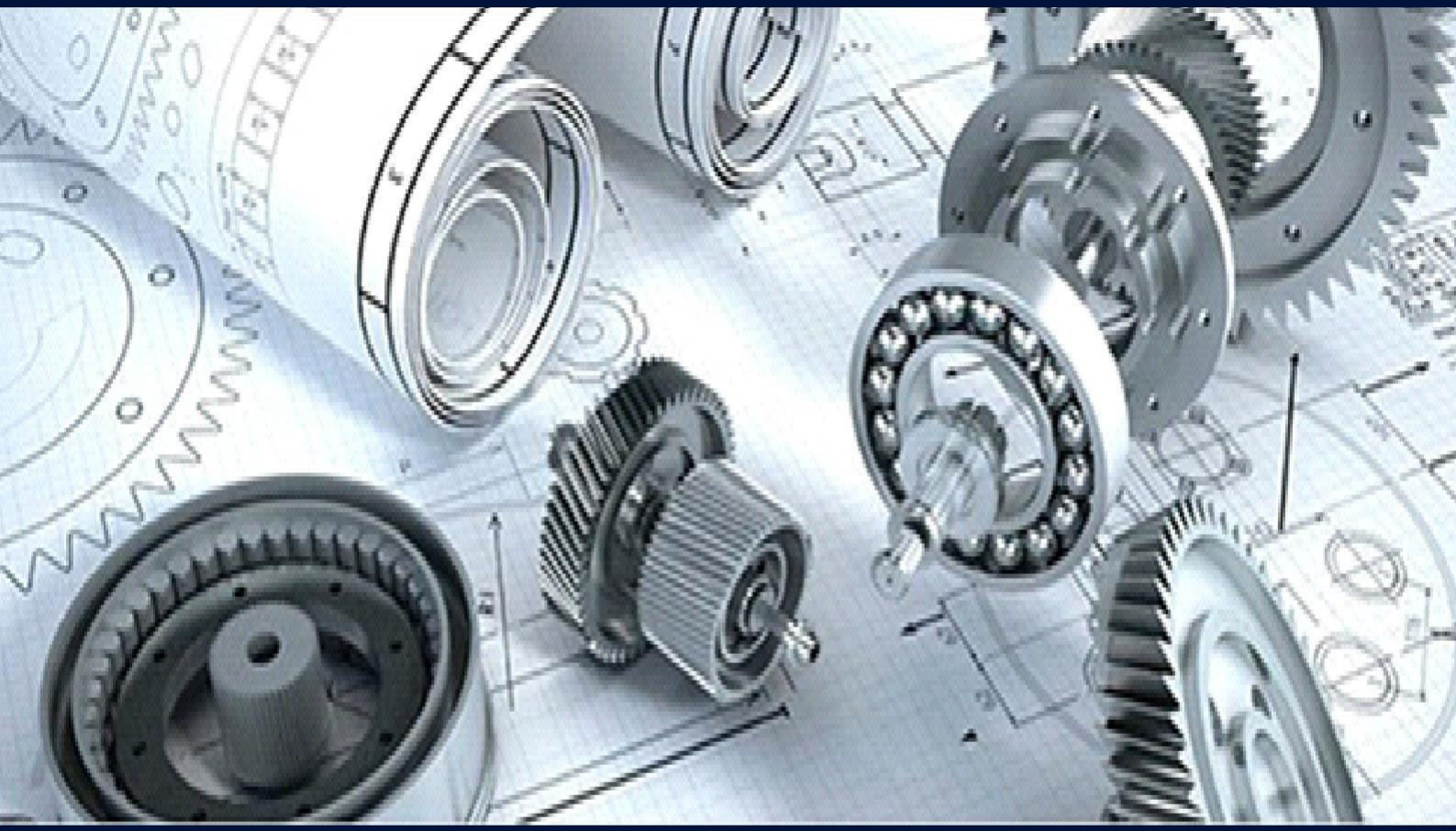

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