International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

FoodSynthNet: Generative AI Framework for Creating Class Balanced Food Image Datasets and Intelligent Classification for Nutrition Monitoring and Food Recognition Applications

[1]Mr. T. Sesha Sai,[2]Shaik Afrin,[3]Reddy Tejaswi,[4]Tatikonda Sathvik

[1]Assistant Professor, Dept of Computer Science and Engineering, St. Ann's College of Engineering and Technology, Chirala-523187, India.

[2,3,4]B. Tech Student, Dept of Computer Science and Engineering, St. Ann's College of Engineering and Technology, Chirala-523187, India.

ABSTRACT

FoodSynthNet is a Generative AI–based framework developed for intelligent food recognition and nutrition monitoring. The system employs Conditional Generative Adversarial Networks (cGANs) to generate class-balanced food image datasets, effectively addressing class imbalance and improving classification accuracy. Users can securely upload food images through a web-based interface, where the system identifies the food item and analyzes its nutritional content. Detailed information such as calories, nutrients, health benefits, disadvantages, and dietary recommendations is provided. By integrating food recognition with nutrition analysis, FoodSynthNet supports nutrition awareness, healthy eating habits, and preventive healthcare applications.

KEYWORDS: ***Food Synth Net, Generative AI, Conditional GAN (CGAN), Class-Balanced-Food Image Dataset, Food Image Recognition, Nutrition Analysis, Flask web application.***

INTRODUCTION

Accurate food recognition and nutrition analysis are increasingly important for dietary assessment and preventive healthcare applications. Image-based food

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

recognition systems enable automated analysis of food intake, reducing manual effort and user dependency. However, many existing systems face challenges such as class imbalance in food image datasets, limited food diversity, and poor integration of nutritional information. Recent advances in Generative Artificial Intelligence provide effective solutions to these issues. Conditional Generative Adversarial Networks (cGANs) allow the generation of realistic, class-balanced food images conditioned on class labels. This paper introduces FoodSynthNet, a Generative AI–based framework for intelligent food recognition and nutrition monitoring. The system identifies food items from uploaded images and provides detailed nutritional insights, including calories, nutrients, health benefits, disadvantages, optimal consumption time, and avoidance recommendations. Implemented as a secure web-based application, FoodSynthNet supports nutrition awareness and preventive healthcare.

LITERATURE REVIEW

In recent years, several studies have explored food recognition using deep learning techniques. Kagaya et al. proposed a CNN-based food recognition system but did not address dataset imbalance. Zhang et al. used traditional classification methods, which showed limited accuracy for large datasets. Recent GAN-based approaches improved classification performance but lacked nutritional and health integration. These limitations are addressed in the proposed FoodSynthNet framework using Conditional GANs for class-balanced data generation and intelligent nutrition monitoring.

RELATED WORK

FoodSynthNet enhances existing food recognition systems that rely on deep learning but face challenges like dataset imbalance and limited nutrition analysis. The system leverages Conditional GANs (cGANs) to generate balanced food image datasets, improving classification performance. A Flask-based web interface allows users to upload images for real-time

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

food identification. Preprocessing is handled using PIL and TorchVision, while detailed nutritional information including calories, nutrients, health benefits, and dietary guidance is provided to support informed dietary choices.

EXISTING METHOD

Existing food recognition systems primarily rely on Convolutional Neural Networks (CNNs) and traditional Neural Network (NN) models for identifying food items from images. These models are usually trained on imbalanced and limited food image datasets, which leads to biased learning and reduced classification accuracy, especially for less-represented food categories. As a result, the systems often fail to correctly recognize diverse food items in real-world scenarios. Moreover, most existing systems focus only on food identification and provide inaccurate or incomplete nutritional values, lacking detailed information such as vitamins, minerals, and health benefits. They also do not incorporate personalized health analysis or dietary recommendations, limiting their usefulness in nutrition monitoring and preventive healthcare applications.

PROPOSED SYSTEM

FoodSynthNet is a Generative AI–based framework developed to enhance food recognition and nutrition monitoring. The system uses Conditional Generative Adversarial Networks (cGANs) to generate class-balanced food image datasets, reducing bias caused by imbalanced data. A secure web-based application allows users to upload food images for analysis. The system identifies the food item from the uploaded image and retrieves relevant nutritional details. It provides information such as calories, macronutrients, vitamins, and minerals. In addition, health benefits and possible disadvantages of the food are presented. The system also recommends the best time to consume specific foods and highlights who should avoid them. By integrating food identification with nutrition analysis, FoodSynthNet supports informed dietary decisions. The user-friendly interface ensures easy interaction

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

and accessibility. Overall, the system promotes nutrition awareness, diet management, and preventive healthcare.

SYSTEM ARCHITECTURE

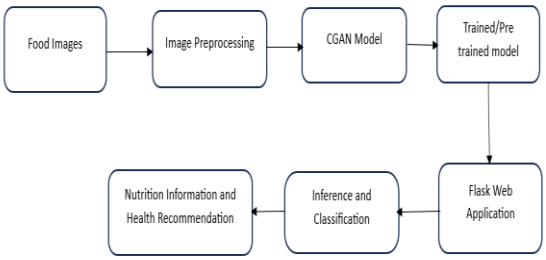

Fig 1: System Architecture

METHODOLOGY DESCRIPTION

Food Images: This block represents the input dataset consisting of food images collected from various sources. These images belong to multiple food categories and are used as input for dataset preparation and food recognition.

Image Preprocessing: In this stage, raw food images are standardized through operations such as resizing, normalization, color conversion, and tensor transformation. Preprocessing improves image quality, reduces noise, and ensures compatibility with the learning model.

CGAN Model: The Conditional Generative Adversarial Network (cGAN) is employed to generate high-quality synthetic food images by conditioning the generation process on specific food class labels. Unlike traditional GANs, cGANs allow controlled image generation, ensuring that each synthetic image belongs to a desired food category. This capability is particularly useful for addressing class imbalance, where certain food classes have fewer training samples than others.

Trained/Pre-trained model: After training, the cGAN and classification components are saved as pretrained models. These stored models capture learned food features and can be efficiently reused during inference without retraining.

Inference and Classification: Uploaded food images are passed through the pretrained model to predict the food category. This stage performs real-time classification based on learned visual patterns.

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

Nutrition and Health recommendation:

Once the food item is identified, the system maps the predicted class to a nutrition dataset. It displays calories, nutrients, vitamins, minerals, health benefits, disadvantages, best time to eat, and foods to avoid, supporting nutrition awareness and healthy decision-making.

RESULTS & DISCUSSION

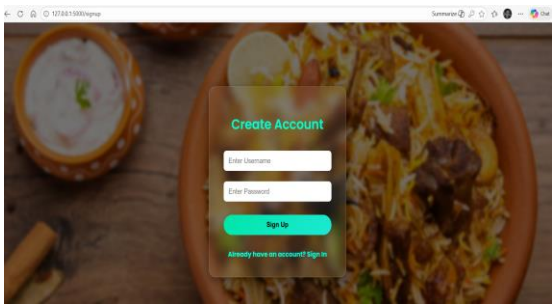

Fig 2: Sign up page

The image shows the user registration (Sign Up) interface of the FoodSynthNet web application. This page allows new users to create an account before accessing the system's features.

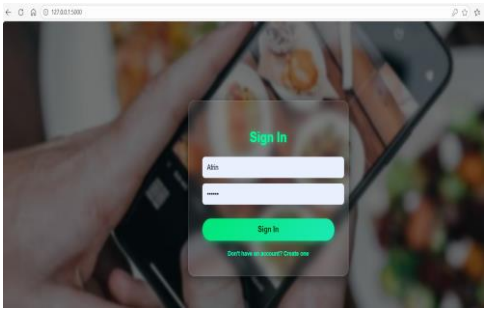

Fig 3: Sign in Page

The image displays the Sign In interface of the FoodSynthNet web application. This page enables registered users to securely access the system using their username and password. The form includes input fields for entering login credentials, with the password field masked to ensure privacy and security.

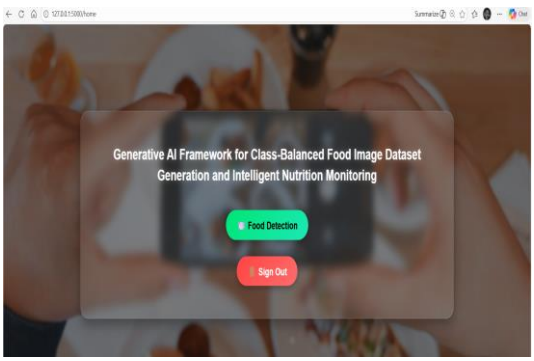

Fig 4: Home Page

The image represents the home page (dashboard) of the FoodSynthNet web application, displayed after successful user

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
ISSN: 3068-272X
www.ijdim.com
Original Research Paper

authentication. The dashboard offers two main actions: Food Detection and Sign Out. The Food Detection option enables users to upload food images for recognition and nutritional analysis, while the Sign Out option ensures secure logout.

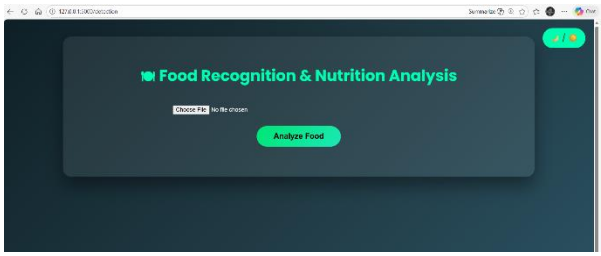

Fig 5: Upload Image

This interface allows users to upload a food image and initiate analysis through the Analyze Food button.

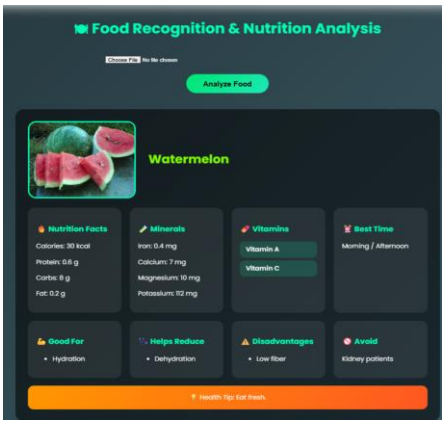

Fig 6: Nutrition Analysis

The image displays the Food Recognition and Nutrition Analysis result screen, where the system identifies the uploaded image as Watermelon. It presents key nutritional details, vitamins, minerals, health benefits, disadvantages, best time to eat, and avoidance advice in a clean, user-friendly layout.

CONCLUSION

FoodSynthNet demonstrates an effective food recognition and nutrition monitoring system by using Generative AI to create class-balanced food image datasets. The system accurately identifies food items and provides detailed nutritional information and dietary guidance through a user-friendly web interface. This approach enhances nutrition awareness and supports healthier food choices for preventive healthcare.

FUTURE SCOPE

The project can be extended by incorporating a larger and more diverse food dataset to improve recognition accuracy. Real-time food detection using

mobile cameras and integration with wearable health devices can enhance usability. Personalized diet recommendations based on user health profiles can further support smart nutrition monitoring.

REFERENCES

[1] Harini, D. P. (2024). Electronic Health Record Stage Identification using Principal Component Analysis. *Machine Intelligence Research*, 864-873.

[2] Y. Zhang and Y. Li, "Food image recognition using traditional machine learning techniques," Journal of Visual Communication, vol. 45, pp. 1–8, 2016.

[3] I. Goodfellow et al., "Generative adversarial networks," Advances in Neural Information Processing Systems, pp. 2672–2680, 2014.

[4] M. Mirza and S. Osindero, "Conditional generative adversarial nets," arXiv preprint arXiv:1411.1784, 2014.

[5] L. Bossard, M. Guillaumin, and L. Van Gool, "Food-101: Mining discriminative components with random forests," European Conference on Computer Vision, pp. 446–461, 2014.

[6] H. Hassannejad et al., "Food image recognition using deep learning," ACM Multimedia, pp. 651–659, 2016.

[7] S. Yang, M. Chen, and D. Pomerleau, "Food recognition using deep feature learning," IEEE Transactions on Image Processing, vol. 26, no. 3, pp. 1346–1358, 2017.

[8] G. Pandey et al., "Food image recognition with deep learning and nutritional analysis," IEEE Access, vol. 7, pp. 100098–100110, 2019.

[9] C. Shorten and T. M. Khoshgoftaar, "A survey on image data augmentation for deep learning," Journal of Big Data, vol. 6, no. 60, 2019.

[10] C. Zhang et al., "Addressing class imbalance in image classification using GANs," Pattern Recognition Letters, vol. 125, pp. 351–357, 2020.

[11] X. Wang et al., "Synthetic data generation for improving food image

classification," IEEE International Conference on Artificial Intelligence, pp. 420–426, 2021.

[12] M. Islam et al., "Vision-based dietary assessment using machine learning techniques," Sensors, vol. 20, no. 18, pp. 1–17, 2020.

[13] P. Pouladzadeh et al., "Food calorie measurement using image processing," IEEE International Conference on Multimedia and Expo, pp. 1–6, 2014.

[14] S. Mezgec and B. K. Seljak, "NutriNet: A deep learning food image recognition system," Food Chemistry, vol. 216, pp. 65–75, 2017.

[15] K. He et al., "Deep residual learning for image recognition," IEEE Conference on Computer Vision and Pattern Recognition, pp. 770–778, 2016.

[16] J. Zhao et al., "GAN-based data augmentation for image classification," Artificial Intelligence in Medicine, vol. 118, 2021.

[17] J. Li et al., "Web-based food recognition systems for nutrition monitoring," International Journal of Computer Applications, vol. 176, no. 12, pp. 9–14, 2020.

[18] M. Chen et al., "Mobile-based food recognition for dietary assessment," IEEE Pervasive Computing, vol. 17, no. 2, pp. 76–84, 2018.

[19] M. Tan and Q. Le, "EfficientNets: Rethinking model scaling for convolutional neural networks," International Conference on Machine Learning, pp. 6105–6114, 2019.

International Journal of

DATA SCIENCE AND IOT MANAGEMENT SYSTEM

ISSN: 3068-272X

www.ijdim.com

Original Research Paper