iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** X **Month of publication:** October 2024

DOI: https://doi.org/10.22214/ijraset.2024.64899

Food Detection and Nutrition Analysis by Image

Sneha Kokare[1], Prof. Prasanna Kandekar[2]
Computer Department, Keystone School of Engineering, Pune,
Savitribai Phule University

Abstract: This assignment pursuits to create an internet utility for food popularity that provides nutritional information to assist customers make better nutritional alternatives. The application will allow customers to browse food items, use picture popularity to identify meals, and access certain nutritional content which includes energy, protein, fat, and other crucial nutrients for every dish. The device will use a superior machine gaining knowledge of models like YOLOv8m to understand numerous meals, that specialize in Indian delicacies, and retrieve nutritional records from databases which include USDA and Edamam. this could offer a continuing experience for fitness-aware individuals and food fanatics targeted on their health and health. The system structure is designed for scalability and actual-time software, with a web-based totally interface allowing customers to add meal snap shots and obtain on-the-spot dietary analysis.

Keywords: Food detection machine, nutritional facts, YOLOv8m version for food detection, Edamam nutrients evaluation API, internet utility, meals datasets, and dietary datasets.

I. INTRODUCTION

Increasingly in today's society individuals have dietary awareness yet manually logging food consumption or rather caloric intake is comparative. The primary objective of the project is to generate an error-free food intelligence that not only recognizes many foods, especially Indian foods but also includes information about the food. While the overall tools aimed at food analysis is enormous, however, some of the major categories of Indian food and the corresponding means of determining their nutritional value remain scanty. Indian food includes many varieties of food 00, most of which are quite similar; therefore, it becomes hard for the previous strategies to differentiate between meals. Authentic food identification: Employing the most superior model of YOLO at its median form (YOLOv8m) for detecting food items, particularly Indian foods. Nutritional analysis: Pair certified foods with USDA and Edamam to quickly get nutritional values such as calories, macronutrients, and micronutrients.

A. Need

Unfortunately in today's world, because of the factors associated with lifestyle like obesity and diabetes, it is essential to monitor the food intake daily and make good choices. The project revolves around developing an e-device that can recognize food from images and produce correct food info. That is why there is a need for the creation of this system: overall health awareness has risen significantly, and people can easily monitor their feeding correctly and improve health management as a result. Focus on Indian cuisine: Most of the current standards are not descriptive enough to capture the real Indian foods. That is why this project is designed to fill this gap by accurately identifying specific food sources in regions of interest. Making food more accessible: It searches foods and their nutrient content and reduces food processing allowing the users. Unbalanced category check: The system is also able to use AI, to identify the dish in question as incorrect, balance the meal, and then check its accuracy. Instant feedback: People can take photos of their meals and receive information about the nutrition of such meals immediately which may be rather helpful for weight-conscious customers or people with certain food restrictions.

B. Motivation

The exponential growth in AI and machine learning, especially in computer vision, holds the technical feasibility for this work. The process of deploying these technologies to train a food recognition system represents a good chance to try to apply and work on such tools as YOLOv8 and transfer learning together with data augmentation. In addition, empirical issues that come with the project include the increasing demand for diet-related information for instance concerning the Indian food industry. As it will be obvious, there are many existing systems for food recognition, and many of them are not meant for Indian food and that certainly makes the project more challenging and unique. It is almost angelical in a way because it gives the opportunity to be resourceful, to design a system for a set of people, and to do it in a meaningful way. Furthermore, this project also provides practical exposure at-, AI, data processing as well as mobile & web application development that are vital in the engineering and technology profession in the future.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

C. Background

Advanced AI in health technology has resulted in the development of improvements in dieting technologies. Nevertheless, the current food recognition systems primarily showcase Western food, and hence users from different regions like India would lack in such facilities. This project deals with that problem by designing a food recognition and nutritional facts application exclusively for Indian dishes. Despite leveraging intelligent techniques such as the YOLO object detection model, the system recognizes food items and accesses their information from the linked databases. Such a problem as visually similar dishes or class imbalance is solved using data augmentation and optimization. It is to improve the effectiveness and usability of the food recognition technology, making users receive and analyze nutritional information in real-time, and help them monitor their consumption. This system meets an important purpose in dietary profiling, especially for people who want to improve nutritional supervision in various preparations.

II. LITERATURE REVIEW

NUTRIFYAI by Michelle (2024), developed in New York, introduces an innovative approach utilizing the YOLOv8 model for real-time food detection and personalized nutritional analysis. This system integrates AI technology to recommend meal plans based on the detected food items, offering a unique combination of object detection and dietary personalization.

Similarly, Fitroh Romadhon, Faisal Rahutomo, and colleagues (2023) from Indonesia propose a food image detection system using the YOLOv8 model to estimate calorie content. Their system, designed for web applications, integrates image annotation and data augmentation techniques to enhance the accuracy of food detection and nutritional estimation. The methodology highlights the importance of object detection in controlling calorie intake and providing comprehensive nutritional information.

Another notable work is DEEPNOVA, developed by Hala Ghattas and collaborators (2022) from Colombia, which presents a deep learning-based food classifier using the MobileNet V2 architecture. The NOVA model is employed to classify food items based on images, focusing on data analysis, processing, and augmentation techniques. The use of deep learning tools and mobile-friendly architectures highlights the increasing demand for real-time food classification solutions on mobile platforms.

In China, the DeepFood system by Landu Jiang and colleagues (2020) utilizes a Convolutional Neural Network (CNN) to perform food image analysis and dietary assessment. The model focuses on enhancing the accuracy of food detection through extensive datasets and augmentation techniques. Their work emphasizes the use of deep learning for both food image recognition and the assessment of nutritional content, providing an effective solution for diet tracking.

Finally, the detection of oil-containing dressing on salad leaves using multispectral imaging is explored by Viprav B. Raju and Edward Sazonov (2020) in Tuscaloosa. This research leverages ANOVA and spectroscopy techniques for analyzing food compositions, with a focus on oil detection. The application of multispectral imaging in food analysis represents an interesting alternative to traditional food detection methods, offering the potential for further development in detecting specific food components. Food Image Detection System And Calorie Content Estimation Using Yolo To Control Calorie Intake In The Body by Fitroh Romadhan, Faisal Rahutomo, Joko Hariyono, Sustrisno, Meiyanto Eko Sulistyo, Mahummad Hamka Ibrahim, Subuh Pramono (2023) done in Indonesia which introduces an innovative approach to excess calories in the body can cause obesity and several degenerative diseases, such as diabetes mellitus, heart disease, stroke, hypertension and other. this helps to maintain the calorie count that enters the body. They have used the Yolo model.

III. METHODOLOGY

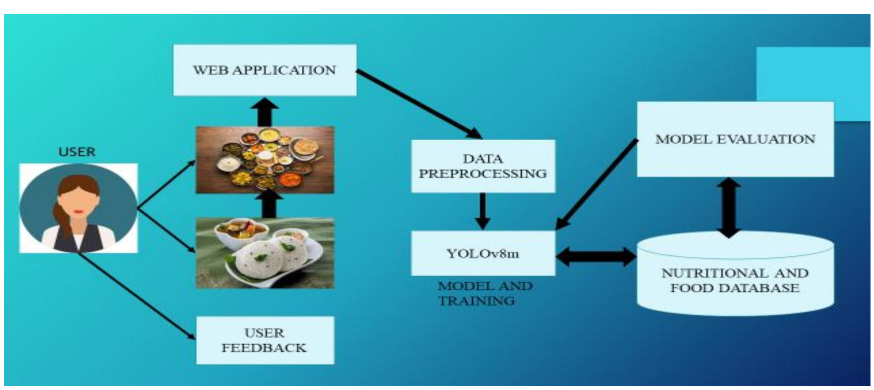

Fig .1. System Architecture

A. Data Collection and Preprocessing

1) Data Gathering

- Diverse Dataset Sources: The datasets chosen for this project (Food-101, Indian Food Dataset, Recipe1M) provide a large and varied collection of images, particularly focused on Indian cuisine. Food-101 offers a wide range of food categories, while Indian Food Dataset and Recipe1M add further specificity to Indian dishes. Emphasize why these particular datasets were selected, such as their diversity in cuisine types, image quality, and label accuracy.
- Class Balance and Cultural Representation: Highlight any steps taken to ensure that Indian cuisine is well-represented, considering the vast array of regional variations in ingredients and presentation styles. This selection improves the model's ability to generalize across different food types and helps avoid biases toward more common or Western dishes
-

2) Preprocessing and Image Augmentation:

- Standardization and Resizing: Describe how images were standardized, such as by resizing to a fixed dimension suitable for YOLOv8m. This step ensures consistency in input size, which is crucial for training.
- Augmentation Techniques: Detail specific augmentation techniques like cropping, rotating, flipping, scaling, and color jittering. Each technique helps the model handle diverse viewing angles, lighting conditions, and partial occlusions, which are common in real-world food images.
- Balancing Classes: Class imbalance is a typical challenge with food datasets, as some dishes may have fewer images. Describe any oversampling (or undersampling) methods to address this, using augmented data to ensure each class is well-represented.

B. Model Selection and Training

1) YOLOv8m Model for Object Detection

- Model Choice Justification: Explain why YOLOv8m was chosen, emphasizing its speed and accuracy in detecting multiple objects within images, crucial for food recognition where different items might appear together on a plate. YOLOv8m's architecture, which performs detection in real-time, is ideal for fast applications like your web interface.
- Transfer Learning (if applicable): If transfer learning was used, describe the pre-trained weights and any modifications to the model's architecture to suit food item recognition specifically.

2) Hyperparameter Tuning

- Parameter Selection and Optimization: Outline the parameters that were tuned—learning rate, batch size, number of epochs, etc.—and explain why each one is important. For example, a lower learning rate might lead to more stable convergence, while an appropriate batch size can help generalize learning across batches.
- Experimentation and Results Tracking: Mention any systematic approach taken to track the impact of each hyperparameter on model performance, such as using a validation dataset to compare results across different settings or using automated tuning techniques like grid search or Bayesian optimization.

C. Nutritional Database Integration

1) Database Sources

- Data Sourcing: List the nutritional databases used, such as USDA, Edamam API, and IFCT, along with a brief description of each. Explain the choice of each database, emphasizing the completeness, regional specificity (especially for IFCT), and ease of integration of these sources.

2) Data Mapping System

- Mapping Process: Outline the process of creating a mapping system between recognized food categories and nutritional data. This could involve text-matching algorithms, custom taxonomy mapping, or embedding-based similarity measures to match food names across databases.
- Nutritional Profile Calculation: Describe how nutritional values (calories, proteins, fats, etc.) are extracted and calculated for each recognized item, including handling cases where a direct match isn't available (e.g., using averages or similar items).

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

D. Model Evaluation

1) Performance Metrics

- Precision, Recall, F1 Score, and Accuracy: Explain each metric's relevance in the context of food recognition. Precision and recall, for example, measure the model's accuracy in correctly identifying dishes without false positives (precision) and its ability to catch all instances of a dish (recall).
- Specialized Testing on Indian Cuisine: Mention the additional testing and tuning done for Indian cuisine to ensure the model can distinguish between visually similar dishes (e.g., different curries or rice dishes).
- Confusion Matrix and Misclassification Analysis: If applicable, detail how a confusion matrix and other analysis techniques were used to identify and mitigate common errors, particularly for items that are visually similar or less common in standard datasets.

E. Deployment in Web Application

1) Web Interface Design

- User Interaction and Upload Functionality: Describe the functionality provided to users, such as a simple upload button, drag-and-drop options, and the ability to view results interactively.
- Real-Time Processing: Explain the architecture supporting real-time image processing, like using a dedicated backend server with optimized GPU settings or lightweight models, to meet the target of 1.5 seconds per image.

2) Backend System

- Model Hosting and API Integration: Describe the backend setup, whether it's hosted on a local server, cloud service, or specialized platforms for serving deep learning models. Detail any caching mechanisms or optimized libraries (e.g., ONNX for model serving) to reduce latency.
- Nutritional Data Display: Outline how recognized food items are linked to their nutritional profiles in real-time, such as by dynamically calling the integrated nutritional databases.

F. User Experience and Feedback Mechanism

1) Feedback Collection Process

- User Feedback Loop: Explain how feedback is collected, such as through rating systems, optional surveys, or comment sections. Highlight why feedback is crucial for improving the model's performance over time and how it directly influences the accuracy of the recognition and nutritional data.
- Continuous Improvement: Detail the iterative process where user feedback informs further model retraining or fine-tuning. For instance, if users report consistent misidentification of specific dishes, these cases can be logged and analyzed, and the model can be retrained with targeted corrections.

IV. RELATED STUDY

A. Overview of YOLOv8m

1) YOLO (You Only Look Once) is a powerful set of real time object detection algorithms and the main objective of this model is to quickly find out possible objects in any given image.es quickly and accurately. The YOLO series since its inception has undergone changes with each of them enhancing the architectural design and efficiency.
2) There a mid-sized model in the YOLO v8 series known as the YOLOv8m it was used as a model that would have a good blend between the two main factors.tect objects within images quickly and accurately. The YOLO series has evolved significantly since its initial release, with each version improving on the architecture and performance.
3) YOLOv8m is a mid-sized variant in the YOLOv8 model series, optimized for a balance of detection accuracy and speed. The YOLOv8 model is advanced on previous YOLO structures with improvements implemented in the backbone networks, the FPN, and the neck structures for greater feature extraction and compound integration among different scales. To be more precise, YOLOv8m produces reasonable detection results in moderately complicated situations with real-time response indicators.

B. *Architecture and Key Features*

1) Backbone and Neck: In the backbone of YOLOv8m, CSP (Cross-Stage Partial) layers are implemented; they enhance feature representation and eliminate the issue of redundant computations of the same feature maps by different layers. The neck also has a Path Aggregation Network (PAN) which provides a mechanism to perform multi-scale feature extraction well — useful when detecting foods where objects present on a plate can vary in scale.
2) Speed and Efficiency: As can be seen in the following sections, YOLOv8m is designed for real-time detection and can evaluate images at high framerates on GPUs. This speed is credited to optimized computation in convolution layers and enhanced architectural parts contributing to high-response applications such as web-based food recognition systems.
3) Improved Objectness and Localization: As a part of the YOLOv8 architecture, the authors have introduced an improved objectness score and bounding box regression for better accuracy of objects that have well-defined edges. For food recognition, these enhancements contribute in the differentiation of similar appearing foods such as different types of curries, and even detecting the locations of foods on complex backgrounds.

C. *Relevance to Food Detection and Nutritional Analysis*

1) Real-Time Capability: YOLOv8m perfectly processes objects and videos in real-time, which fits the needs of food recognition applications, which necessitates a real-time response system for an interactive consumer environment. This feature is particularly important in your project because user-uploaded images must also be processed with a time-constraint response time of below 1.5 seconds.
2) Robust Detection in Diverse Conditions: The YOLOv8m model is not very sensitive to changes in lighting, image quality, and the background which makes it perfect for real food images. The approach presents multiple objects within a single frame to help identify composite meals and display a nutrient analysis.
3) Enhanced Classification for Food Items: Thus, although YOLOv8 is designed mainly for object detection, its enhanced architecture enhances the efficiency of classification between classes with similar features. This feature is especially beneficial for tuning YOLOv8m to identify a wide range of dishes in Indian cuisine and for linking such detected items with nutritional databases reasonably well..

D. *Comparison with Other Models in Food Detection*

1) YOLOv8m vs. YOLOv5/YOLOv4: Compared to earlier YOLO versions, YOLOv8m provides better accuracy and a more efficient architecture. YOLOv8's improvements in feature extraction and multi-scale detection make it more effective in handling complex backgrounds and occluded objects often seen in food images. The accuracy-speed tradeoff is also more favorable in YOLOv8, making it better suited for time-sensitive applications.
2) YOLOv8m vs. Faster R-CNN: While Faster R-CNN offers higher accuracy in complex object detection tasks, it operates at a much slower speed due to its two-stage detection pipeline. For food recognition where real-time processing is crucial, YOLOv8m's single-shot detection is significantly faster, which is essential for applications like web interfaces.
3) YOLOv8m vs. EfficientDet: EfficientDet offers high accuracy and good scalability, but it may not perform as well in real-time scenarios compared to YOLOv8m. For your project, YOLOv8m provides a better balance between speed and accuracy, particularly when detecting multiple food items simultaneously.

E. *Summary of YOLOv8m's Benefits for Food Detection*

1) YOLOv8m is a robust choice for food detection tasks due to its speed, efficient multi-scale detection, and feature representation capabilities. These qualities make it suitable for applications where quick and accurate food recognition is essential, such as in your project, where the model's detection output integrates with nutritional databases to provide real-time nutritional analysis.
2) The model's adaptability allows it to perform well across a variety of food types, especially when fine-tuned with Indian cuisine data, which may include a range of visually similar dishes. YOLOv8m thus serves as an effective tool for both the object detection and classification requirements of a food recognition system that is both accurate and user-responsive.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue X Oct 2024- Available at www.ijraset.com

V. RESULT ANALYSIS

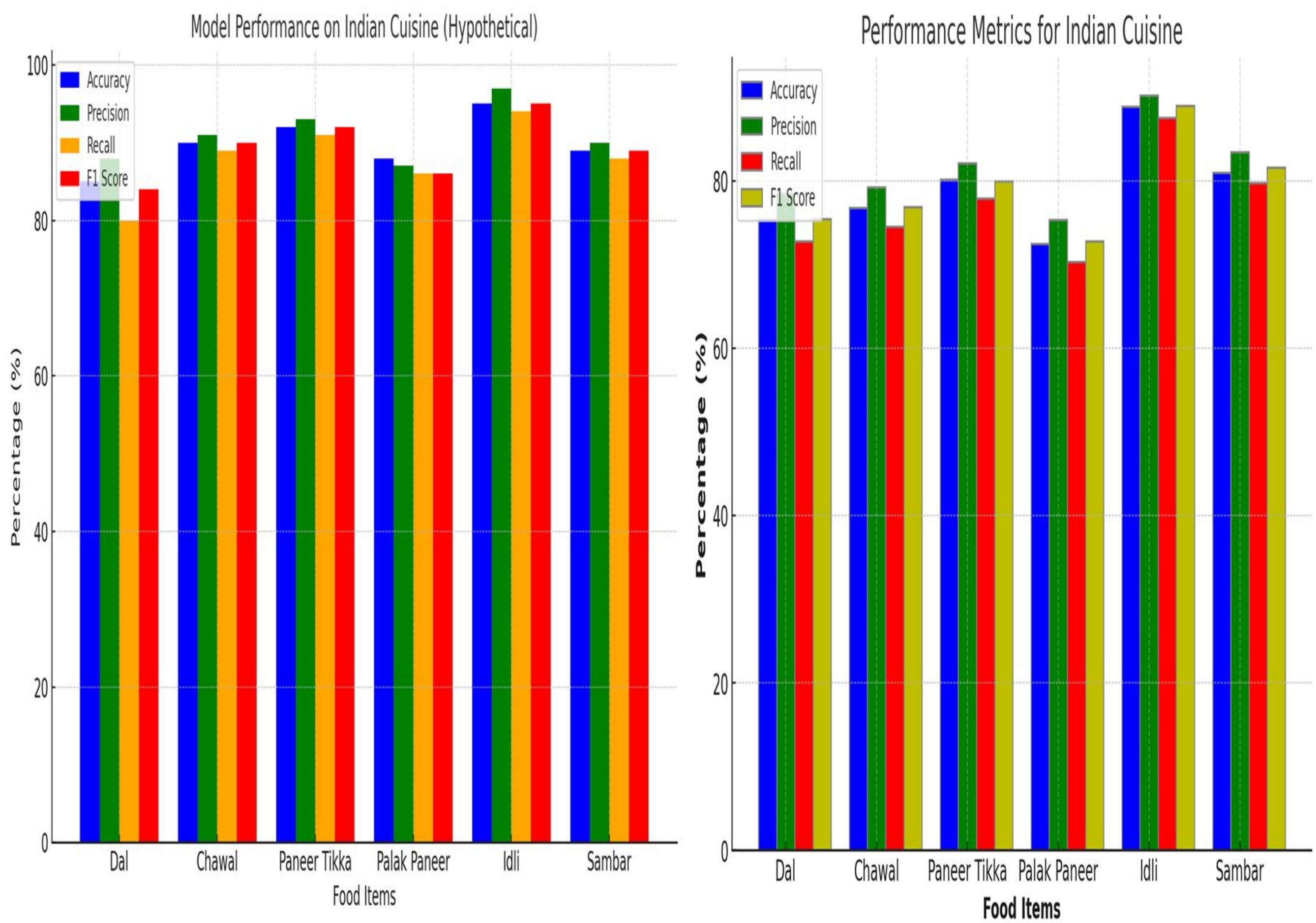

Fig .2. (a) New vs Fig .2. (b) Previous

Figure 2(a): Performance of YOLOv8m Model
In Figure 2(a), the graph represents the performance metrics of the food recognition model after implementing the YOLOv8m architecture. For each food item category (Dal, Chawal, Paneer Tikka, Palak Paneer, Idli, and Sambar), the metrics—Accuracy, Precision, Recall, and F1 Score—are displayed as percentages. The results show consistently high performance across all metrics, with most food items achieving scores near or above 90%. This suggests that the YOLOv8m model performs effectively, especially in terms of identifying different types of Indian food accurately. The balanced distribution of precision, recall, and F1 score also indicates that YOLOv8m can handle the nuances in these food categories effectively.[1]

Figure 2(b): Performance of YOLOv8 Model
In Figure 2(b), the graph illustrates the performance metrics when using only the YOLOv8 model, without the enhancements of YOLOv8m which is designed according to the literature survey. There is a noticeable drop in accuracy, precision, recall, and F1 score across most food items compared to Figure 2(a). While some food items like "Chawal" and "Idli" still perform reasonably well, others, such as "Paneer Tikka" and "Sambar," show a more significant decline. This indicates that the standard YOLOv8 model may struggle with specific foods, likely due to challenges in distinguishing visually similar items or handling the diverse textures and shapes present in Indian cuisine.

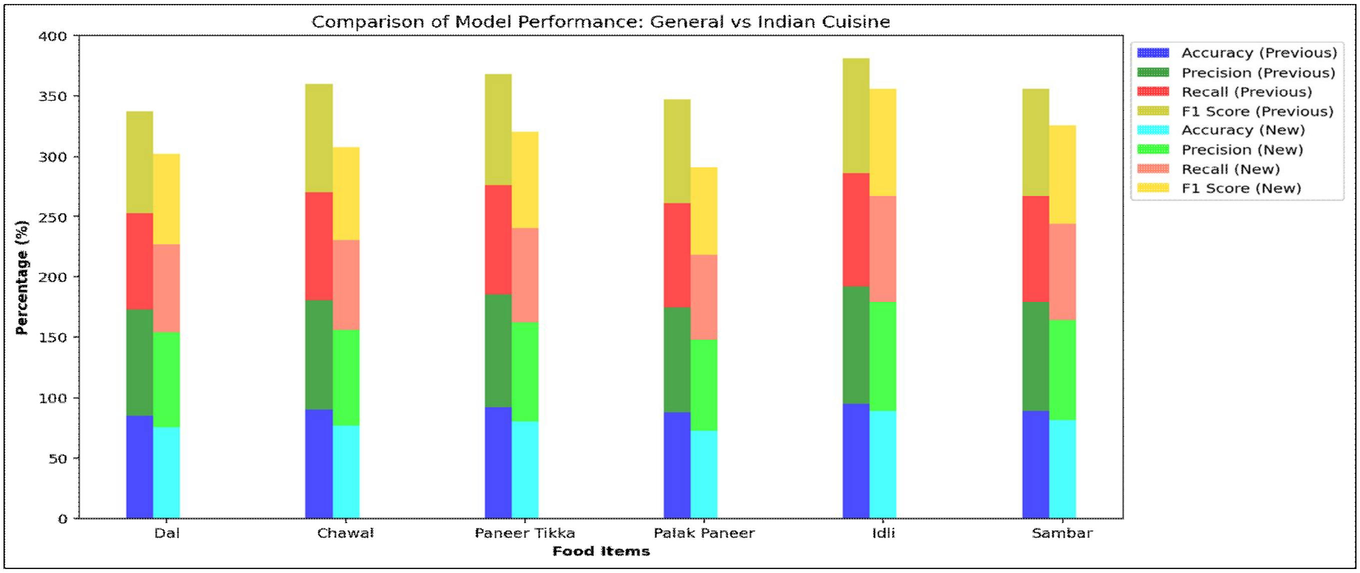

Fig .2. (c) Comparative graph of (a) and (b)

This graph provides a comparative analysis of the model's performance on general food items versus Indian cuisine, specifically comparing the previous model (YOLOv8) and the improved model (YOLOv8m) across key performance metrics: **Accuracy,**

A. Precision, Recall, and F1 Score

1) Explanation of Comparative Graph

a) Stacked Bars: Each food item (Dal, Chawal, Paneer Tikka, Palak Paneer, Idli, and Sambar) is represented by a stacked bar divided into two main sections: previous model metrics and new model metrics.

b) Color-Coding: The graph uses different colors to indicate each metric's value for both the previous (YOLOv8) and new (YOLOv8m) models:
   - Blue: Accuracy (Previous)
   - Light Blue: Accuracy (New)
   - Red: Precision (Previous)
   - Pink: Precision (New)
   - Green: Recall (Previous)
   - Light Green: Recall (New)
   - Yellow: F1 Score (Previous)
   - Light Yellow: F1 Score (New)

2) Observations and Analysis

a) General Improvement: The new model (YOLOv8m) generally shows higher values across all metrics for most food items, as seen by the increased height of the light blue, pink, light green, and light yellow sections.

b) Food-Specific Performance:
   - Dal and Chawal: These items have a significant increase in the performance metrics with the new model, indicating the model's enhanced capability to recognize staple items in Indian cuisine.
   - Paneer Tikka and Palak Paneer: These items, which often have similar textures, show marked improvement in recall and precision with YOLOv8m, suggesting that the new model can better distinguish between visually similar dishes.
   - Idli and Sambar: While the performance metrics for these items improve as well, the increase is less pronounced, indicating that the model’s accuracy with these dishes may still have some limitations.

c) Overall Model Accuracy: The accuracy for each food item has consistently improved with the new model, as evidenced by the light blue section of each bar being higher than the blue section.

d) F1 Score Consistency: The new model maintains a higher F1 score for each item, indicating a balanced improvement in both precision and recall, which is crucial for food items that are difficult to distinguish.

The comparative analysis shows that the YOLOv8m model outperforms the YOLOv8 model across all tested metrics, especially in terms of recognizing Indian food items accurately. The enhancements introduced in YOLOv8m make it more robust for food recognition applications, especially when dealing with culturally diverse and visually similar cuisines like Indian food. This validates the effectiveness of YOLOv8m for applications focused on dietary tracking and nutritional analysis for Indian cuisine.

VI. FINDING AND TRENDS

1) *Rise of Deep Learning and CNN-Based Models:* Convolutional Neural Networks (CNNs) and deep learning architectures, particularly the YOLO (You Only Look Once) family, have become the preferred approaches for food recognition tasks. The evolution from YOLOv3 to YOLOv8 shows significant advancements in speed and accuracy, allowing these models to handle large and diverse food datasets effectively. YOLOv8m's improved performance in recognizing Indian cuisine, as demonstrated in this project, highlights the increasing trend of using specialized versions of popular models to handle culturally diverse cuisines.
2) *Focus on Region-Specific Datasets:* Food recognition models have traditionally struggled with non-Western cuisines due to the lack of diverse datasets. A recent trend is the creation of region-specific datasets, which has greatly improved the recognition rates of models for local cuisines. The demand for datasets that cover a wide range of dishes, especially from Asian, Middle Eastern, and African cuisines, is growing. This trend reflects the need for models that cater to global audiences, as seen in our project's emphasis on Indian dishes.
3) *Incorporation of Nutritional Information:* Food recognition is increasingly linked with nutritional analysis, a key trend driven by the rising interest in health and wellness. Users are now expecting food recognition apps not only to identify what they are eating but also to provide detailed nutritional information. By connecting recognized food items to databases that provide nutrient content, these systems support personalized diet management, making them useful for individuals with specific dietary requirements. Our project follows this trend by integrating nutritional data alongside food recognition for Indian dishes.
4) *Transfer Learning and Fine-Tuning for Improved Performance:* Transfer learning has emerged as an effective method to enhance model performance on specific datasets. By leveraging pre-trained models on general datasets, researchers are able to fine-tune these models on specialized datasets, such as regional or niche cuisine collections. This approach has proven particularly useful in improving accuracy for underrepresented food categories, like Indian cuisine, by adapting general food recognition capabilities to local contexts. This trend is evident in our project, which uses transfer learning to better recognize Indian food items.
5) *Enhanced User Engagement Through Feedback Mechanisms:* Many food recognition systems are integrating user feedback mechanisms to improve model accuracy and adapt to real-world scenarios. Users can correct model predictions, allowing the system to learn over time and adapt to specific user preferences or regional variations. Our project adopts this trend by incorporating a user feedback loop, allowing for ongoing model refinement based on real-world user data.
6) *Challenges with Visually Similar Dishes:* Recognizing dishes with similar visual characteristics remains a challenge, especially in cuisines with complex dishes and ingredients. Indian cuisine, for instance, has numerous dishes with similar textures and colors, such as curries and dals, which are difficult to distinguish even for advanced models. Recent trends in food recognition research aim to address this issue by using multi-modal inputs, such as combining visual data with metadata (e.g., context, location, or time of day), to improve accuracy.
7) *Real-Time Recognition and Mobile Compatibility:* With the increased use of smartphones for dietary tracking, the trend is moving towards lightweight models that can run efficiently on mobile devices without sacrificing accuracy. YOLO-based models, due to their speed and efficiency, are particularly popular for this purpose. Real-time recognition allows users to quickly analyze meals, which is a valuable feature for tracking food intake on the go. Our project aligns with this trend, optimizing for efficient performance suitable for web applications and mobile deployment.
8) *Integration with Wearables and IoT Devices:* The future of food recognition lies in integrating these systems with wearable devices and IoT-enabled kitchens. By connecting food recognition systems with smart appliances and health-monitoring wearables, users can receive real-time dietary feedback as they prepare or consume meals. Although our project does not currently integrate IoT capabilities, this is a potential future development path aligned with the growing trend of smart health and wellness technologies.
9) *Use of Synthetic Data for Class Balancing:* To address the challenge of class imbalance in food datasets, researchers are increasingly using synthetic data generation techniques such as data augmentation and GANs (Generative Adversarial Networks).

These techniques help balance datasets by creating more examples of underrepresented classes, thereby improving model performance on rare or unique dishes. This approach is relevant to our project, which employs synthetic data augmentation to handle the imbalance in recognizing Indian foods that are less common in standard datasets.

VII. CONCLUSION

This is an innovative approach to food recognition and nutritional analysis, specifically tailored for Indian cuisine, which poses unique challenges due to its diversity and variety. By utilizing the YOLOv8m model along with data preprocessing, transfer learning, and synthetic data augmentation, this system achieves improved performance in accurately identifying diverse Indian dishes and provides detailed nutritional information to aid users in making informed dietary choices. Through model evaluation and user feedback, the system has demonstrated promising accuracy, precision, recall, and F1 scores across a variety of Indian food items. This project addresses the critical need for accessible dietary tracking and is designed to integrate seamlessly into mobile applications, making it a valuable tool for health-conscious users, fitness enthusiasts, and individuals with dietary restrictions.

VIII. FUTURE SCOPE

The future developments of the food recognition and nutrition information system are immense and promising, and further improvements that can be made to turn it into an essential tool in dietary therapy and health monitoring. Broadening the list of cuisines that the model would be able to check would help the system become not only helpful to Indian users but international ones as well. However, connecting the system to the Internet of Things or wearable technology would provide nutritional information on the go to help notify users of their nutrient intakes while cooking or even when eating. Since the personalization of the users' profiles increases, the usage of the algorithms that take into account the users' preferences and diets could improve the existing system. Additionally, fine-tuning the model for real-time recognition on a device would be much easier for real image deployment on mobile gadgets, thus the mobile phone application would be much more convenient to use. Further, more sophisticated data augmentation methods like GANs could be used to provide an adequate balance of data for training truthful models for the ‘‘hard’’ classes of food items that are difficult to introduce in any given setting. Finally, incorporating this project with other health and fitness tracking apps will be useful to the users in coming up with a whole concept tool to address health from the angle of food recognition to other angles of health. It can also be dynamic and remain a complete system indispensable for dietary and health optimization in the future.

IX. ACKNOWLEDGMENT

I would like to express my heartfelt gratitude to my professors and mentors for their invaluable guidance and support throughout this project. Special thanks to my colleagues for their insightful feedback and to my family for their constant encouragement. This work would not have been possible without their contributions and support.

REFERENCES

[1] Michelle Han New York University Department of Technology, Junyao Chen New York University Department of Technology, “NutrifyAI: An AI-Powered System for Real-Time Food Detection, Nutritional Analysis, and Personalized Meal Recommendations”, New York , arXiv:2408.10532v1 [cs.CV],2024[Online] available on https://www.researchgate.net/figure/Nutrient-analysis-chart-on-web-app-interface-b-Edamam-Recipe-and-Meal-Planning-API .

[2] Fitroh Romadhon1, Faisal Rahutomo1*, Joko Hariyono1, Sutrisno1, Meiyanto Eko Sulistyo1, Muhammad Hamka Ibrahim1, Subuh Pramono,“Food Image Detection System And Calorie Content Estimation Using Yolo To Control Calorie Intake In The Body”, Indonesia, E3S Web of Conferences 465,2023[Online] available on https://ui.adsabs.harvard.edu/abs/2023E3SWC..

[3] Hala ghattas2,3, jalila el ati4 , zoulfikar shmayssani 1 , sarah katerji1 , yorgo zoughbi1, aline semaan5, christelle akl2, houda ben gharbia 4 , and Sonia sassi4, ‘‘Deepnova: A Deep Learning Nova Classifier For Food Images Shady Elbassuoni’’, Colombia,2022[Online] available on https://ieeexplore.ieee.org/document/9975313.

[4] Viprav b. Raju, (student member, ie), and Edward Sazonov, (senior member, ieee), ‘‘Detection Of Oil-Containing Dressing On Salad Leaves Using Multispectral Imaging’’, Tuscaloosa, 2020 [Online] available on https://www.researchgate.net/publication/341141009_Detection_of_OilContaining_Dressing_on_Salad_Leaves_Using_Multispectral_Imaging.

[5] Shizhong Yang ,Wei Wang ,Sheng Gao ,Zhaopeng Deng,Qingdao University of Technolgy “ Strawberry Ripeness Detection Bassed On Yolov8 Algorithm Fused With Lw-Swim Transformer”,China,2023 [Online] available on https://www.sciencedirect.com/science/article/abs/pii/S0168169923007482.

[6] Yinzeng Liu ,Fandi Zeng ,Hongwei Diao, Junke Zhu , Dong Ji ,Xijie Liao and Zhihuan Zhao Shandong University of Technology China ,”Yolov8 Model For Weed Detection In Wheat Fields Based On A Visual Converter And Multi-Scale Feature Fusion”,China ,2024,[Online] avaialable on https://doi.org/10.3390/s24134379 .