An AI-Based Calorie prediction system

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Abstract— The number of diet and nutrition application users has grown to 1.4 billion this year. The vast number of health app users has reached 1.4 billion in 2022 [1]. The three popular applications including MyFitnessPal and moon and Calorie Counter experience growing popularity among users. experiencing significant increases in popularity. However, one All nutrition applications have one main disadvantage [2] which forces users to manually provide information. manually input data. The current food data input process is manual which proves to be time-intensive and unpleasant. Thus, New applications which function autonomously have gained more attention from users. Users need technology to properly detect food types while analysing nutritional values at the same time. Offer can give you up-to-minute advice about nutrition. This paper explores the role of A A. A complex system includes the latest approaches in computer vision. all separate elements brought together under one design. The mobile A number of computer vision methods are integrated within the application. You will also get a nutrition analysis system and a web application. The system consists of three major features. Three main measures are used by the system. a leading-edge series that starts with YOLOv8 model-based food First, detection and second, the EDAMAM API for nutrient values analysis, 3) EDAMAM Meal Planning and 4) Recipe Search should help you choose healthy, delicious meals. Recommendations of meals tailored to each person. The EDAMAM There is a nutrition analysis function built into Nutrition Analysis API is The system has personalization options included. Everyone can request customized help from EDAMAM in finding and meal planning recipes You can find numerous APIs that can help you create meal plans. Search APIs. Widespread early results reflect the system's effectiveness. The app features fast and convenient dietary users get their information as soon as they snap their photos. The Most of the system's success in food recognition came from The ability to correctly recognize things. The system plays the role of Important element that helps users decide what to eat intelligently. The analysis of the research employs these index terms: YOLO and computer vision are enhanced by artificial intelligence as well as using YOLO model for machine learning in food recognition. Scholars examine how humans spot edible substances. Scholars examine how humans spot edible substances. pointing out, Learning Machine, one approach to supplying Artificial Solutions that rely on intelligence and Machine Learning identification.

I.INTRODUCTION

The growth of synthetic intelligence brought on great affects various parts of normal human activities. Artificial intelligence is changing many areas. healthcare is one aspect among the daily things people rely on with entertainment. Among the many new developments in All artificial intelligence technologies The ability The goal of computer vision is to create unique identification. It comes from its ability to recognize what it sees. images. Talking with people and understanding what they mean With this method, you gain experience in development. The computer vision's technology is improving over time Despite just beginning to undertake research, the area of understanding what food is and what nutrients it contains [3]. The research looks into next-generation technologiesfor computer vision. Functional features of a system. This research uses a particular framework. This paper discusses the methods applied. YOLO, short for You Only Look Once preparing meals correctly is the reason for using the system. it is important to deliver those meals on time when the nutritional data is mentioned. A dependable evaluation of food nutrition markers exists through their analysis using the system. nutritional content. The family of YOLO models contains The object detection system uses YOLO as its real-time detection algorithms. The detection system achieves superior operational results. A single YOLO model evaluation system allows simultaneous output of detection boundaries together with predictions about object classes during image processing execution. YOLO generates detection boundary forecasts when it processes images. YOLO performs image processing by producing output boxes together with class probability predictions at the same time. Unlike traditional. The object detection models handle multiple images with a single evaluation method. YOLO A quick detection output results from YOLO since its design operates as one operational stage. functions as a single operational stage. detection times Even so, the games still emphasize accurate results [4]. The overall design can be seen in YOLO To use this technology, developers need to maximize the benefits of YOLO. models are designed as methods for detecting threats. The A fast accurate detection system for objects remains crucial for this application's operations. A prompt detection process is necessary because

the system requires it. Varying implementations of YOLOv5 along with YOLOv8 model The research process will evaluate different YOLOv5 and YOLOv8 versions as part of their evaluation.

II. LITERATURE REVIEW

The key research regarding AI development is presented in Table I. The study focuses its efforts on extracting YOLO models for detecting food items. time nutritional evaluation integrates with nutritional APIs while Ai driven meal recommendations form a part of this system.

III. METHODOLOGY

A. Overview

The study focuses on what is possible with AI technologies. useful for keeping an eye on what you consume during the day based on finding patterns and analysing received information along with making recommendations. The detection and analysis processes complemented by recommendation systems improve daily food tracking procedures. recommendations. The system used a web application which employs artificial intelligence technology. The application demonstrates its usefulness for practical use in everyday life through this design. By Users can benefit from the application because it presents a simple user experience through its interface. The system enables users to add nutritional tracking as a part of their regular activities naturally. The application permits users to acquire images of their food that enable automatic processing. The system undergoes several operational processes to identify all items in the food image. The YOLOv8 computer vision model delivers its power to execute detection tasks within this application. The artificial intelligence system delivers precise identification of different food products present in captured images. The application retrieves complete nutritional information after it detects the food items in its database. Edamam provides nutritional details about every food item which the application detects API. The system The processed data from information collection enables system-generated presentation for users. complete results. The data includes complete nutritional statistics together with essential calculation points. such as The system tracks the complete nutritional data consisting of calories with fat content plus protein and carbohydrate as well as fiber measurements.

It uses this system to compile a food database. Operations in auto mode are monitored by the user. This results from previously collected work help inform what users receive. custom guidance on what to eat. There is a successful application of suggestions for eating a certain way for each person what each user requires in their diet to reach their goals.

B. Data Collection and pre processing

1) The model was taught by working with these datasets. Dataset material collected in the GitHub repository available at [5] Included in the evaluation were five separate pre processed datasets.

a) The Open Images V6 database provided Google with over 20,000 food images that researchers selected 18 specific labels representing American cuisine foods. The database of images contained 20,000 food pictures from which researchers picked 18 specific labels depicting American foods. There are more than 20,000 photographs with 18 distinct food labels are included with foods from the Americas.

b) The School Lunch Dataset covers 3940 photos. The labelled database includes Japanese high school lunches. comprise 21 unique subject areas plus an unspecified number You'll find that list in the 'Other Foods' section. This dataset became a useful tool for the research team for their investigations. The images utilize natural variations in their depiction of foods datasets.

c) Using 10 traditional recipes in addition to the data we have increases the accuracy of the results. Pho and Com Tam are traditional dishes in Vietnam (the letter A rated them) and the rate ranges from 20-30. Every site employed tools to capture its neigh boring images for study. the dishes.

d) The MAFood-121 Dataset includes a total of 21,175 images. Dishes from the 11 most popular cuisines are represented by 121 foods. from different parts of the globe and The Eighty-five percent of all pictures from the food-101 dataset are used in the teaching the model what is required. Its database includes more than 101,000 images that were classified among 101 categories. includes in the dataset are 750 training images and 250 putting images through tests by category. The testing examples along with the dish type examples comprise 750 training examples for building a comprehensive model. training environment. The extended database consisted of 93,748 images for training purposes. A dataset comprised of 26,825 evaluation images together with 93,748 training images constituted the entire collection. total of 180 distinct food items.

TABLE 1

You will find a summary of research in food detection and nutritional analysis below.

TITLE	AUTHORS	DESCRIPTION	BENEFITS	LIMITATIONS
A live food detection mobile app created using Deep Convolutional Neural Networks was developed as Food Tracker [8].	Jianing Sun, Katarzyna Radecka, Zeljko Zilic	A mobile app helps to help users discover what food is there a stream with multiple-object filters images and icons while you offer nutritional values for your meals the pairing of YOLOv2 and deep versions are new and improved. convolutional networks.	A quick mobile food detection system enables on-the-spot nutritional analyses to improve user accessibility and promote regular system usage.	The system depends on a pre-trained DCNN yet shows insufficient ability to perform effectively on food categories which differ from those in its training data consisting mostly of Japanese items. The performance of the system faces restrictions because mobile devices have limited computing capabilities.
Algorithms for object detection in YOLO-based food identification upgrade the identification skills [9].	Sudharson S, Priyanka Kokil, Annamalai R, N V Sai Manoj	In this research, I assess how well would YOUlva5 The YOLOv7 models are used for the task. while classifying foods things you are responsible for while you are there custom-developed datasets.	The data from map, recall, precision and F1 scores demonstrated that YOLOv5 did well on all three metrics for effective performance. Suitable for on-demand food recognition and classification.	This study worked with only 150 pictures for the dataset and it analyzed 5 food items with four Asian foods and one American food.
An Approach to Spot Allergens and Nutrients Present in Fruits and Packaged Foods Using Deep Learning OCR [10]	B Rohini, Divya Pavuluri, LS Kumar, V Soorya, Aravinth Jagatheesan	The system applies OCR technology. included with deep being taught different methods. find out the causes of allergens. nutrients found in what we eat containers.	Thanks to the Labeling system, food security is better supported.	Only findings for processed foods are included and they do not include loose or fresh foods.
Evaluating the How successful is YOLO? Adaptation of Different-Size Object Models and Features: Study [11]	Luyl-Da Quach, Khang Nguyen Quoc, Anh Nguyen Quynh, and Hoang Tran Ngoc	The review tests YOLO models to classify tiny objects and to detect issues caused by background noise and lowering of image features.	During the tough task of inspecting various food, YOLO models are good at finding small objects.	It is not easy for small object tracking to handle the kinds of complex and varied foods encountered in full nutrition monitoring.
Real-Time Flying The Object Detection method YOLOv8 [12]	Reis, D., Hong, J., Kupec , J., Daoudi, A.	A newly improved general detection model for live flying object recognition is presented, along with its use of YOLOv8 for smooth and correct inference.	The results help develop detection systems that work well even with fast-moving and variable targets used in drone defense and at least five related areas.	Since the main purpose of this study is to find flying objects, it limits its capability to detect real-time other types of objects.

C. Model Architecture

Food classification labels and areas of interest boundaries were present in each entry of the YOLOv8 model that was trained on these datasets. Training and validation portions were divided into 80-20 ratios in the dataset. The model received improvements in its generalization capabilities through data augmentation methods that included rotational changes and scaling alterations as well as flipping operations to represent varied viewing situations. SGD with momentum controlled the training procedure The rate that you use for the first few updates At the first step, the learning rate started with 0.01, while the scheduler did not change anything. Allow the model to get better, but don't let it learn every single detail of the data. The training process lasted for 50 epochs following a validation loss criteria which triggered early stopping after the validation loss remained static for ten successive epochs. YOLOv8 received its weights from ImageNet for initial training before EfficientNet-B4 received additional weights to continue the dataset processing. Secure model performance required 30 epochs of Adam optimizer training at 0.001 learning rate together with data augmentation protocols to maintain sturdy recognition of various food elements.

D. Model Evaluation

Food Recognition 2022 dataset [6] served as the basis for model evaluation because it specifically targets semantic segmentation tasks through its extensive labeled Catlog of 95,009 objects from 498 classes scattered across 43,962 images. Five different versions of YOLO models were evaluated in the project. The findings from YOLOv8s are available in the associated GitHub repository. [5] when using an map The model creates a confidence threshold of 0.5 when evaluated by the Intersection over Union score (IOU). 0.5. The accuracy shown in Figure 2 is in terms of map. Displays results obtained by the YOLOv8s version of the YOLO software. Exceptionally high scores in map evaluation are reported. Numbers are provided for measurements at a 0.5 IOU level of overlap. YOLOv8s achieves outstanding performance because of its ability to power .

E. API Integration

The EDAMAM Nutrient Analysis API functions with the Google Sheets API to obtain comprehensive food item nutritional information including calories and protein and fat content from YOLOv8 model detections. Data retrieval The API allows Chart.js (Fig. 4) visualizations to appear on the interface. The system uses Google Sheets to build databases that serve for monitoring needs (Fig. 3, Fig. 6).

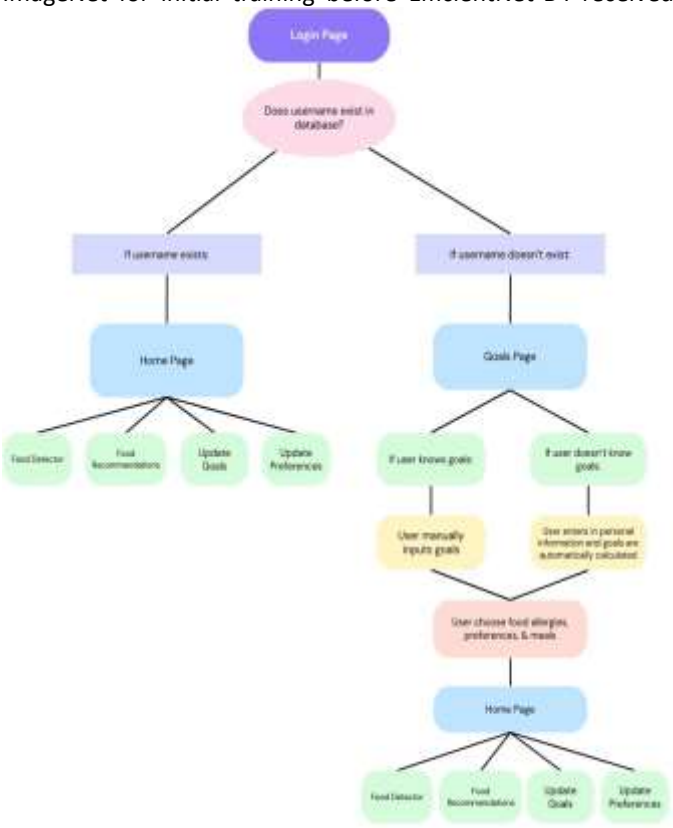

Fig. 1. The System Forms an End-to-End Flow for AI Based

Username	Date	Time	x	y	w	h	labels	scores	names	calories	protein	fat	carbs	fiber
MichelleHan	2024-08-08	15:18:36	877	579	933	836	43	0.4823947647	Egg	155	12.56	10.61	1.12	0
MichelleHan	2024-08-08	15:18:36	872	211	1175	543	43	0.1318445417	Egg	155	12.56	10.61	1.12	0

Fig. 3. Food tracking example in Google Sheets

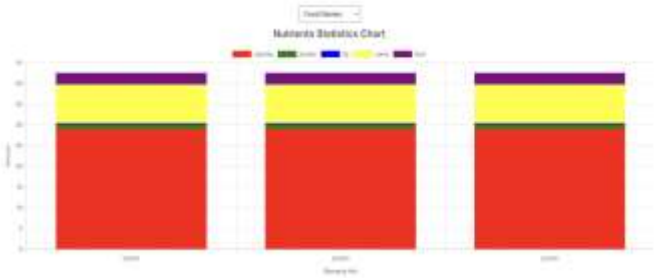

Fig. 4. You can check nutrient analysis by using the web-app.

Models	Image Size	Epochs	mAP@0.5
YOLOv5s	640x640	172	0.907
YOLOv5m	640x640	112	0.897
YOLOv5l	640x640	118	0.94
YOLOv5x	640x640	62	0.779
YOLOv8s	640x640	70	0.963

Fig. 2. Comparison of map results across YOLO model variations at 0.5 IOU [5]

The evaluation process of the model needed an analysis of chosen datasets from Food Recognition 2022. a chosen part of the Food Recognition 2022 dataset those classes were the first ones to be trained in the model. This resulted in a Fig. 5.

The meal recommendation prompting system included a test with 55 categories from the User dataset. The assessment demanded a necessary operation to map labels due to its complex nature. The Food Recognition 2022 dataset was part of the project. We have seen 498 different classes that were not included in the original data set. The system detected more than 498 possible classes which exceeded its training capacity. The labelling process utilized Food Recognition 2022 labels in order to match with the data annotations within the system. training phase labels. The Food Recognition 2022 dataset Various specific categories were added to the dataset through "rose-wine" and "red-wine" among others. The modified training sample set included new classifications such as “red-wine” and “rose-wine.” “wine” class label. The analysis used the specific training classes to map them to the general category of ”wine” in Fig. 6. Users stored their information inside Google Sheets for maintaining consistent evaluation procedures

b) EDAMAM Recipe and Meal Planning API: The API delivers customized nutritional meal suggestions that match user dietary goals and targets along with recipes that fit their dietary preferences along with specific dietary restrictions and nutritional requirements. The application generates recommendations by analyzing user-provided or calculated nutritional aims (Fig. 5) before offering individualized meal recommendations toward health objectives.

c) Server-Side Implementation: A Flask server controls the operation by receiving requests and processing data along with generating results. The server establishes connection with the YOLOv8 model hosted on Google Colab through ngrok to process images in real-time securely.

d) Client-Server Implementation:

Users transmit images videos or URLs to the server through its web client for processing. through the web client for food detection processing. The The YLOLOv8 model processes input data prior to its transfer to the server. The server platform receives identified items that undergo nutritional analysis through the Edamam APIs. recommendations. After processing

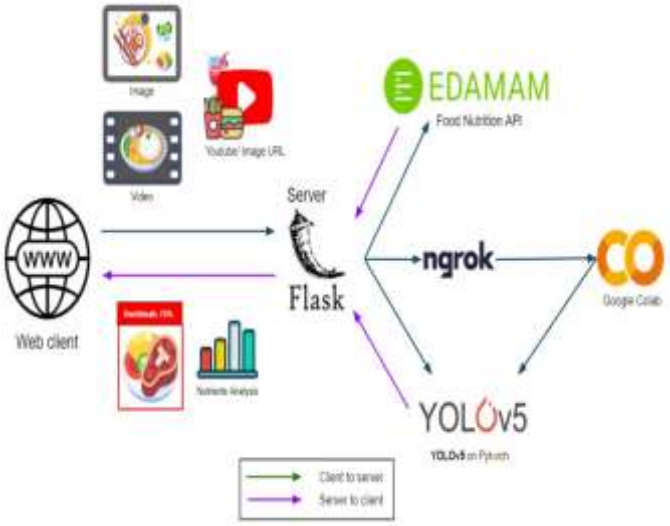

Fig. 7. AI based Client-Server and Server-Side Interaction represent [5] [5]

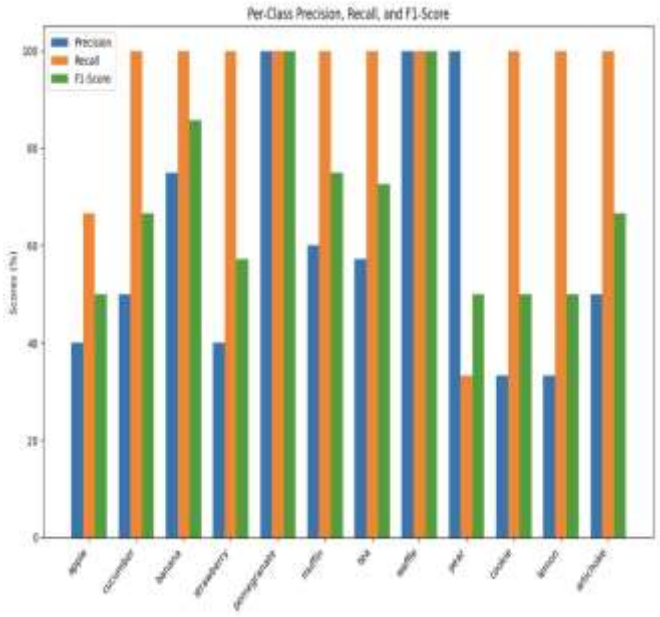

Fig. 8. Precision, Recall and F1 Scores Grouped by Food Classes

Although it has improved, we will need to keep improving further. The data obtained so far is encouraging. We should focus on actions that will more clearly represent the diversity of inventors. the data used for learning to recognize foods Improve how you measure certainty for data analysis. Incorporating collected feedback from users will improve the system. use the meal plan in your everyday meals, adjusted to meet your needs recommendation. The artificial intelligence related to nutrition is an area that has great prospects for use in many fields, for instance, healthcare and tailored diets. That's why the improvements we suggest are truly valuable.

RESULTS

Four metrics were covered by the evaluation: precision. along with recall and F1 score and overall accuracy. The team checked how accurately the model can recognize different kinds of food on Food Recognition 2022. You should calculate precision, recall, F1 score, as well as overall. our research tested our model on the Food Recognition 2022 dataset how YOLOv8s ran when its IOU was set to 0.5. The assessment The process examined the model predictions using a variety of techniques. The results obtained from labeling images directly. It monitored images through its system Using labels in addition to all positive cases from the data set there are times when results from the algorithm are known as false positives and false negatives. tiny variances in all the images. The model It was evident through the demonstration that the design was correct. Accuracy stands at 75.4%. Nearly three out of four of the samples under analysis were successfully organized into the machine learning model was able to separate data into the right categories. Good control of false discovers is shown by the 78.5% precision value. Positives. 72.8% is the recall and the F1 score is a balance in recognition is shown by the 75.5% F1 score evaluating how much the model "understood."

The model was found to identify a wide range of foods from several different groups. In testing, the model scored a perfect match for pomegranate and waffles, but it had a hard time with apples and pears. Almost everything was detected correctly by the model, except for waffles which were identified with near perfection. Examples of apple and pear types were chosen to demonstrate similar kinds of food tested in the study. This model is strongly affected and likely because of class imbalance. In order to validate the model, performance metrics were used on a wide range of food types, displaying the data in Figure 8.

A speed test was carried out with the model as well. Testing of models shows that they require a range of between 0.5 seconds to 3.8 seconds per image. Results show that the model needed anywhere from 0.5 to 3.8 seconds to work with an image, with the average time being 1 The model is able to perform a fast version in only 1.5 seconds. Processing which does not slow down so simulation is possible now.

V. CONCLUSION

According to the research, using computer vision models together with nutritional APIs results in a reliable method for identifying types of food.

REFERENCES

[1] A. Sharma, "Diet and Nutrition Apps Statistics: Exploring the Impact on Health," Market.us Media, 28 Aug. 2023. https://media.market.us/ diet-and-nutrition-apps-statistics/.

[2] L. Young, "Featured Blogs," ACSM CMS, 2024.http//www.acsm.org/blog-detail/fitness-index-blog/2024/06/12/ eating-healthy-nutrition-apps.

[3] A Based et al., "Computer Vision Based Food Recognition with Nutrition. Analysis, 2023. https://www.ijcrt.org/papers/IJCRT2301042.pdf.

[4] "You Only Look Once (YOLO): The Best Model for AIIntegrated Video Analytics" discusses this topic as the ideal framework within a 2016 article obtained from https://i3international.com/resources/media/yolo-the-best-model-for-ai-integrated-video-analytics.

[5] H.-L. Nguyen, "Meal Analysis with Theseus," GitHub, 21 Sept. 2022. https://github.com/lannguyen0910/food-recognition. "Food Recognition 2022 - Dataset Ninja," Dataset Ninja, 2022. https: //datasetninja.com/food-recognition.

[6] J. Redmon et al., A research published on 9 May 2016 under the title " You Only Look Once Paper: Fast, Efficient Detection of Different Objects livelihoods are held on the land" https://arxiv.org/pdf/1506.02640v5.pdf.

[7] B. Rohini et al., "A Framework to Identify Allergen and Nutrient Content in Fruits and Packaged Food Using Deep Learning and OCR, 3 June 2021. https://ieeexplore.ieee.org/document/9441800.

[8] L.-D. Quach *et al.*, "Evaluating the Effectiveness of YOLO Models in Different Sized Object Detection and Feature-Based Classification of Small Objects, https://doi.org/10.12720/jait.14.5.907-917.

[9] D. Reis *et al.*, "Real-Time Flying Object Detection with YOLOv8. 17 May 2023. https://arxiv.org/pdf/2305.09972.

[10] S. Sudharson *et al.*, "Enhanced Food Classification System Using YOLO Models for Object Detection Algorithm, 6 July 2023. https://doi.org/10.1109/icccnt56998.2023.10307943.

[11] J. Sun *et al.*, "FoodTracker: A Real-Time Food Detection Mobile Application by Deep Convolutional Neural Networks, 13 Sept. 2019. https://arxiv.org/pdf/1909.05994.