RISHI M.S INSTITUTE OF ENGINEERING AND TECHNOLOGY FOR WOMEN

(Accredited by NAAC with 'A' Grade)

Department of Computer Science & Engineering

B. Tech III Year II Sem CSE-A section

INDUSTRIAL MINI PROJECT

FOOD DETECTION & CALORIE ESTIMATOR

Under the guidance of :

Dr. K. RAMA KRISHNA, Ph.D

Assistant Professor, Dept of CSE

Presented By Team no : 03

D.SRUTHI (226P1A0544)

G.SNIGDHA (226P1A0555)

D.BHAVYA (226P1A0540)

B.HASIKA (226P1A014)

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Abstract

Food calorie estimation is a crucial aspect of nutrition tracking, aiding individuals in making informed dietary choices. This project presents a web-based food detection and calorie estimation system using computer vision and machine learning. The system utilizes YOLOv8 for food item detection and XGBoost regression for calorie prediction. Users can upload images or use a webcam to detect food items, after which the system overlays bounding boxes and calorie information on the detected items. A pre-defined dataset of food items and their nutritional values serves as the basis for predictions. The application is built with Streamlit, ensuring a user-friendly interface for real-time food analysis. By integrating machine learning and deep learning, this project enhances automated nutrition assessment, offering a practical tool for dietary monitoring in health-conscious applications. Future improvements may include custom food dataset training, portion size estimation, and multi-food recognition optimization.

Introduction

- In today's digital age, automated nutrition assessment has gained significant traction, helping individuals track their dietary intake more efficiently. This project introduces a food detection and calorie estimation system that leverages computer vision and machine learning to analyze food items in images or real-time webcam feeds. By integrating YOLOv8, a state-of-the-art object detection model, and XGBoost regression, the system accurately predicts the calorie content of identified food items.

- The application is built using Streamlit, enabling an interactive and user-friendly interface for seamless food analysis. Users can either upload food images or use their webcam, and the system will detect food items, overlay bounding boxes, and estimate calorie values. The underlying model is trained on a predefined nutritional dataset, ensuring reliable and meaningful estimations.

- In the era of smart technology and digital health solutions, tracking food intake has become increasingly important for maintaining balanced nutrition and healthier lifestyles. Traditional methods of calorie counting often involve manual logging, which can be time-consuming and prone to errors. To address this challenge, this project introduces a real-time food detection and calorie estimation system powered by computer vision and machine learning algorithms.

Existing System

In the current landscape of food calorie estimation, traditional methods rely on manual input, where users log their meals into calorie-tracking applications. These methods require users to accurately identify food items and enter portion sizes, leading to potential errors in estimation.

Some existing systems include:

- **Manual Food Logging Apps** – Users must search for food items in a database and input quantities.
- **Barcode-Based Calorie Trackers** – Scan packaged food labels to retrieve nutritional information.
- **AI-Assisted Mobile Apps** – Some apps use image recognition but may lack real-time video analysis.
- **Dietician-Assisted Platforms** – Users receive expert guidance but need direct consultation.

Proposed System

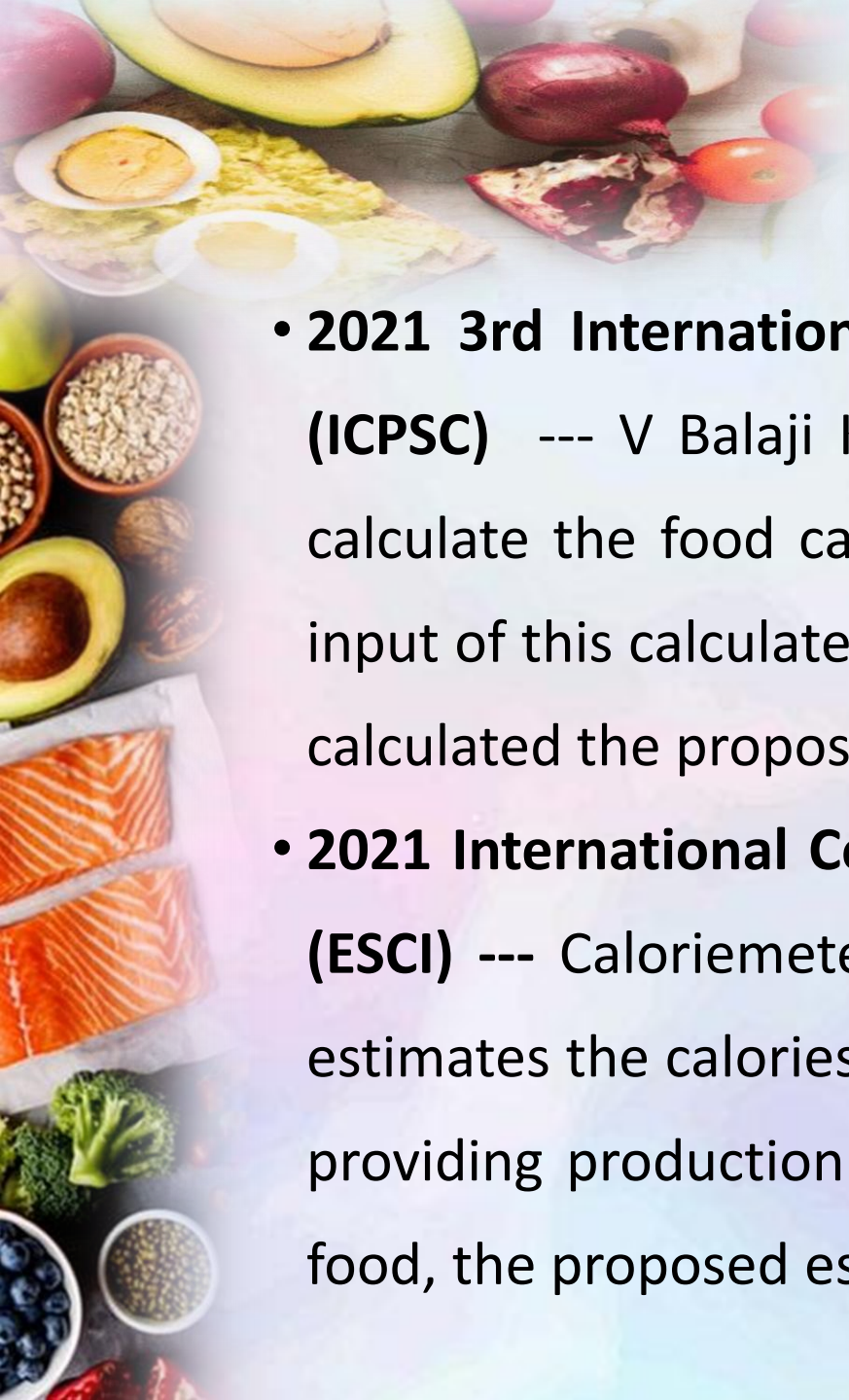
The **Food Calorie Estimator** system is designed to detect food items from images or webcam streams and estimate their calorie content using machine learning. This system provides an intuitive and user-friendly interface, allowing users to either upload an image or use their webcam for real-time food detection and calorie estimation.

Key Features & Components

1.YOLOv8 for Food Detection : The system uses a YOLOv8 model to detect food items from images or webcam frames. Bounding boxes and labels are applied to detected foods.

2.XGBoost for Calorie Prediction : The calorie prediction model is trained using XGBoost on predefined nutritional values. When a food item is detected, the system predicts its calorie content using this model.

3.Streamlit-Based UI : Provides an interactive web interface for users. Supports both image upload and webcam-based detection.



Literature Survey

- **2021 3rd International Conference on Signal Processing and Communication (ICPSC)** --- V Balaji Kasyap; N. Jayapandian --- his method is implementing to calculate the food calorie with the help of Convolutional Neural Network. The input of this calculated model is taken an image of food. The food calorie value is calculated the proposed CNN model with the help of food object detection.
- **2021 International Conference on Emerging Smart Computing and Informatics (ESCI) ---** Caloriemeter: Food Calorie Estimation using Machine Learning --- it estimates the calories of each food and experimental studies have shown that by providing production with information of calories and nutrients present in the food, the proposed estimation method is effective.

- **2016 IEEE International Instrumentation and Measurement Technology Conference Proceedings---**Parisa Pouladzadeh; Pallavi Kuhad; Sri Vijay Bharat Peddi; Abdulsalam Yassine; Shervin ShirmohammadiAll--Accurate methods to measure food and energy intake are crucial for the battle against obesity. Providing users/patients with convenient and intelligent solutions that help them measure their food intake and collect dietary information are the most valuable insights toward long-term prevention and successful treatment programs.

Software & Hardware Requirements

SOFTWARE REQUIREMENTS:

1. Operating system : Windows 10/11

2. Python version : 3.8 to 3.11

3. Libraries : opencv, numpy,
xgboost, ultralytics, pillow

4. Browser (for running Streamlit UI)

HARDWARE REQUIREMENTS :

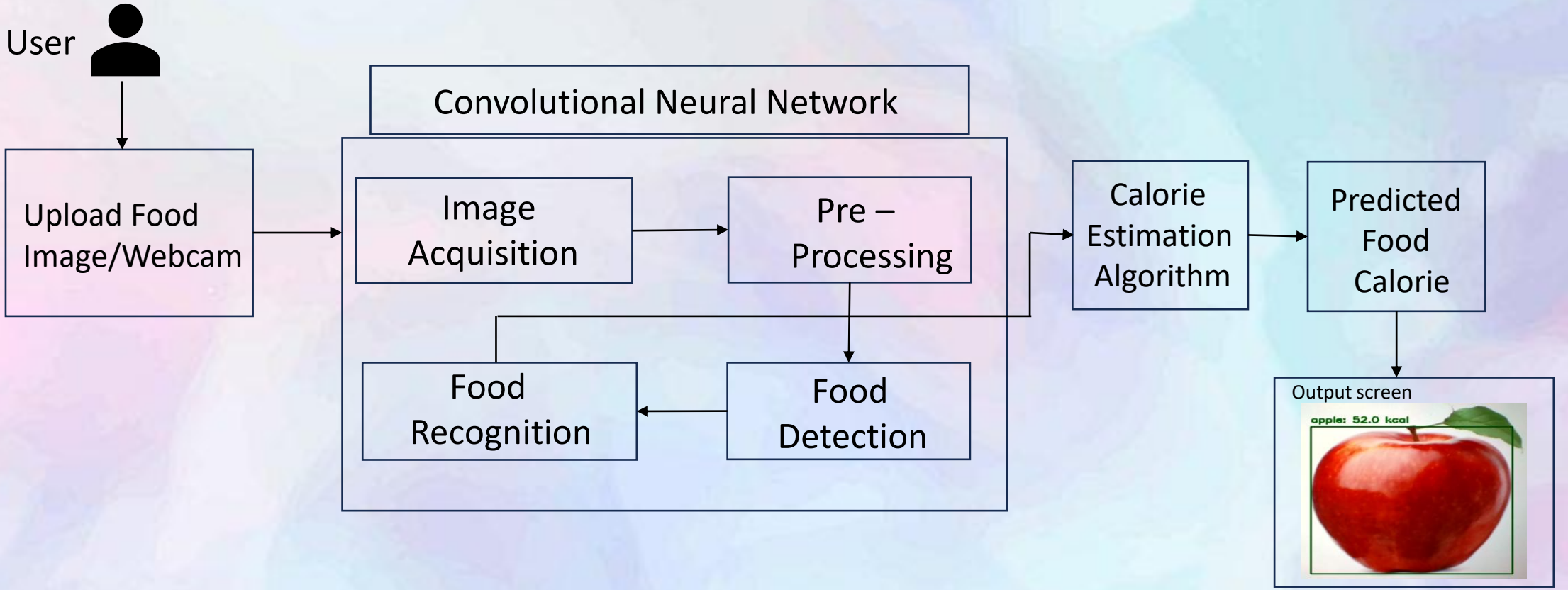
1. Processor : Intel i7/AMD Ryzen 5 minimum

2. RAM: 4GB

3. Webcam: any USB cam (e.g., Logitech C920 or better)

System Architecture & Methodologies

System Architecture :

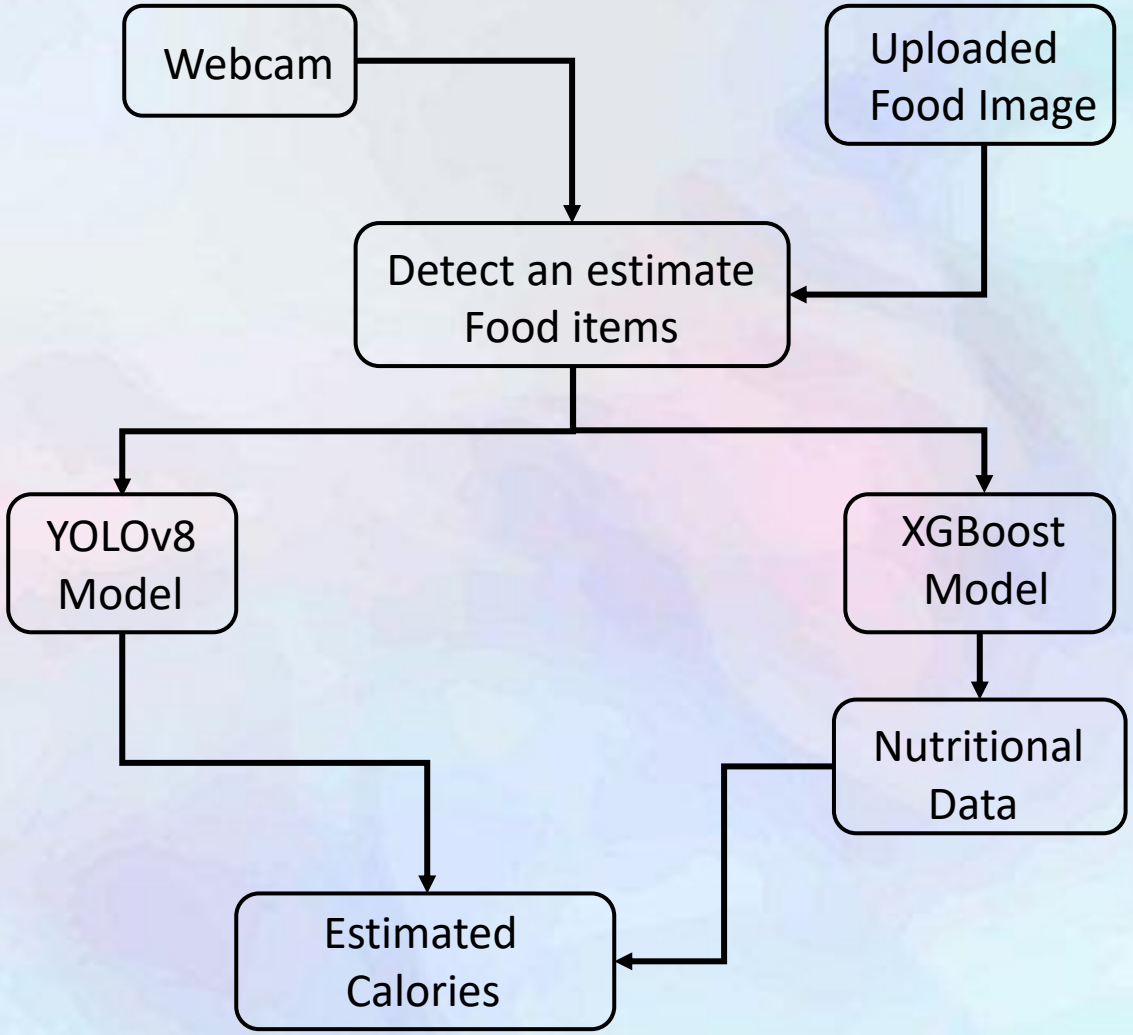


Methodologies :

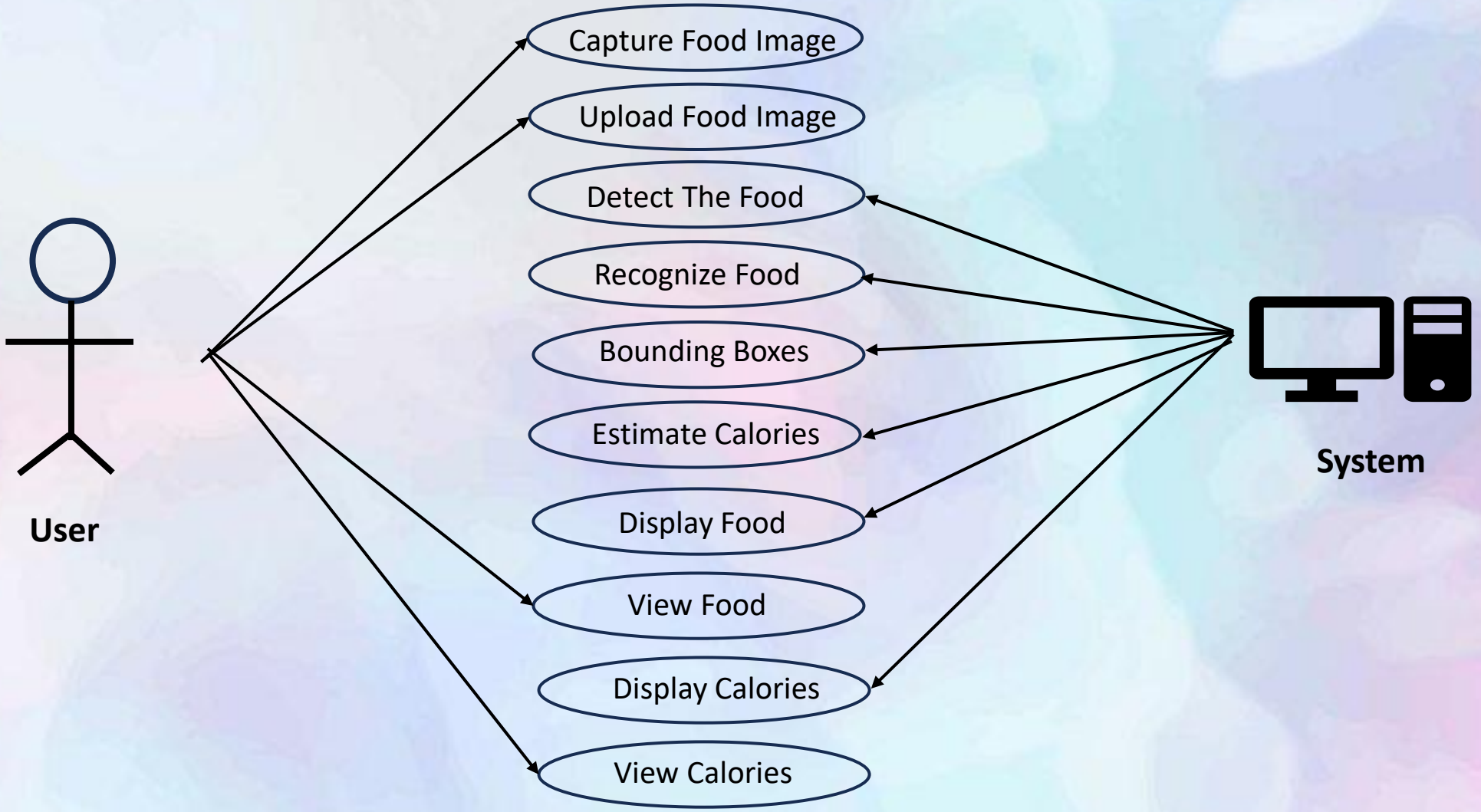
1. **Object Detection Using YOLOv8**
   - YOLOv8 (You Only Look Once) is employed for real-time food item detection in images or webcam streams.
   - It detects food items using bounding boxes and labels, ensuring quick identification.
2. **Feature-Based Calorie Prediction Using XGBoost**
   - Nutritional values (calories, carbs, proteins, fats) are used as input features for training an XGBoost regression model.
   - The trained model predicts calorie values based on detected food items.
3. **Image Processing with OpenCV**
   - OpenCV is used for handling image input, processing frames, and displaying bounding boxes.
   - It converts color formats (BGR to RGB) for compatibility with Streamlit visualization.

4. **Interactive Web Application Using Streamlit**
   - Streamlit enables a user-friendly interface where users can upload images or use a webcam.
   - UI components like buttons, toggles, and image display allow seamless interaction.
5. **Data Handling & Mapping**
   - Food items are mapped to predefined nutritional data for structured processing.
   - Food labels detected by YOLOv8 are used to retrieve corresponding calorie estimates.

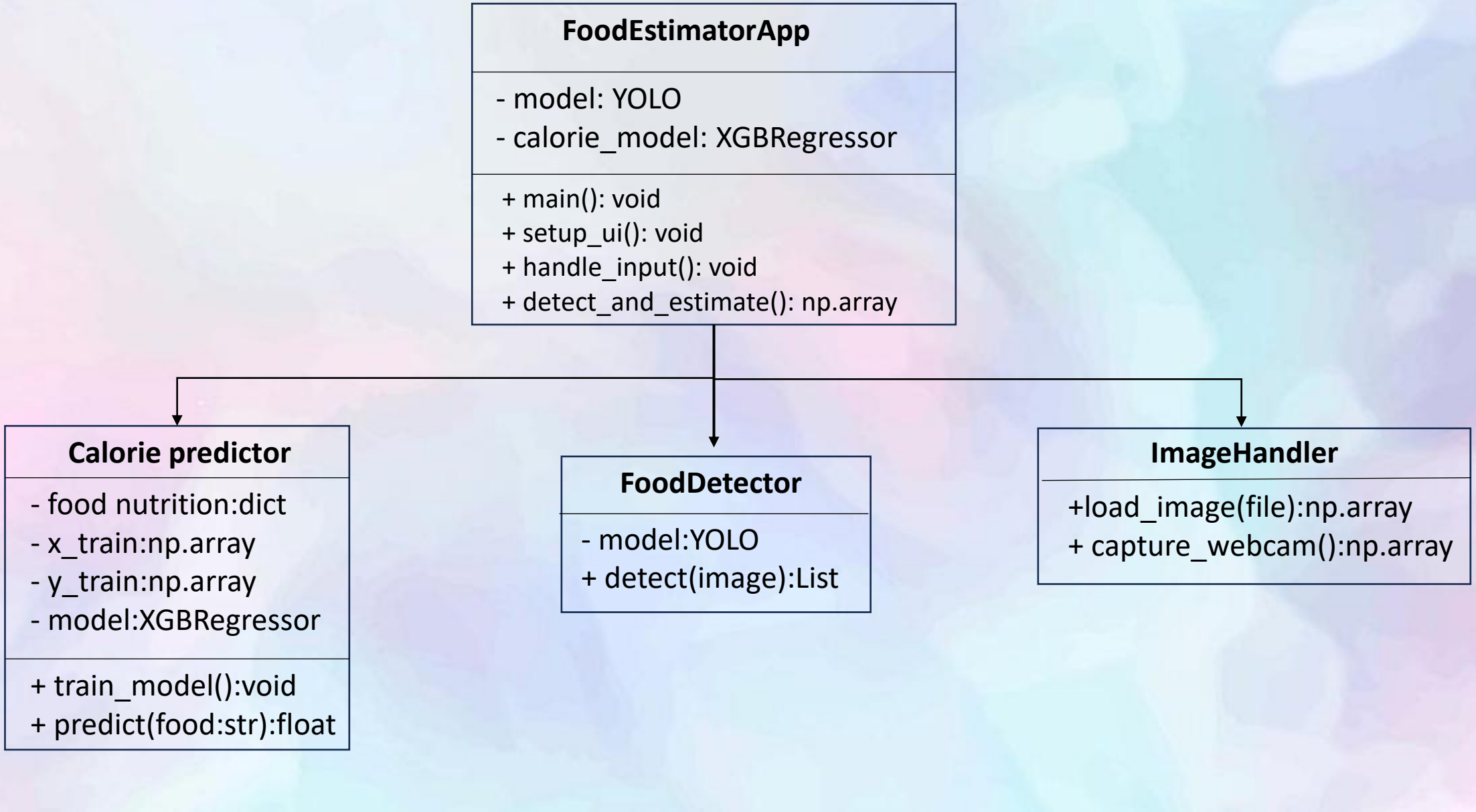
Data Flow Diagram



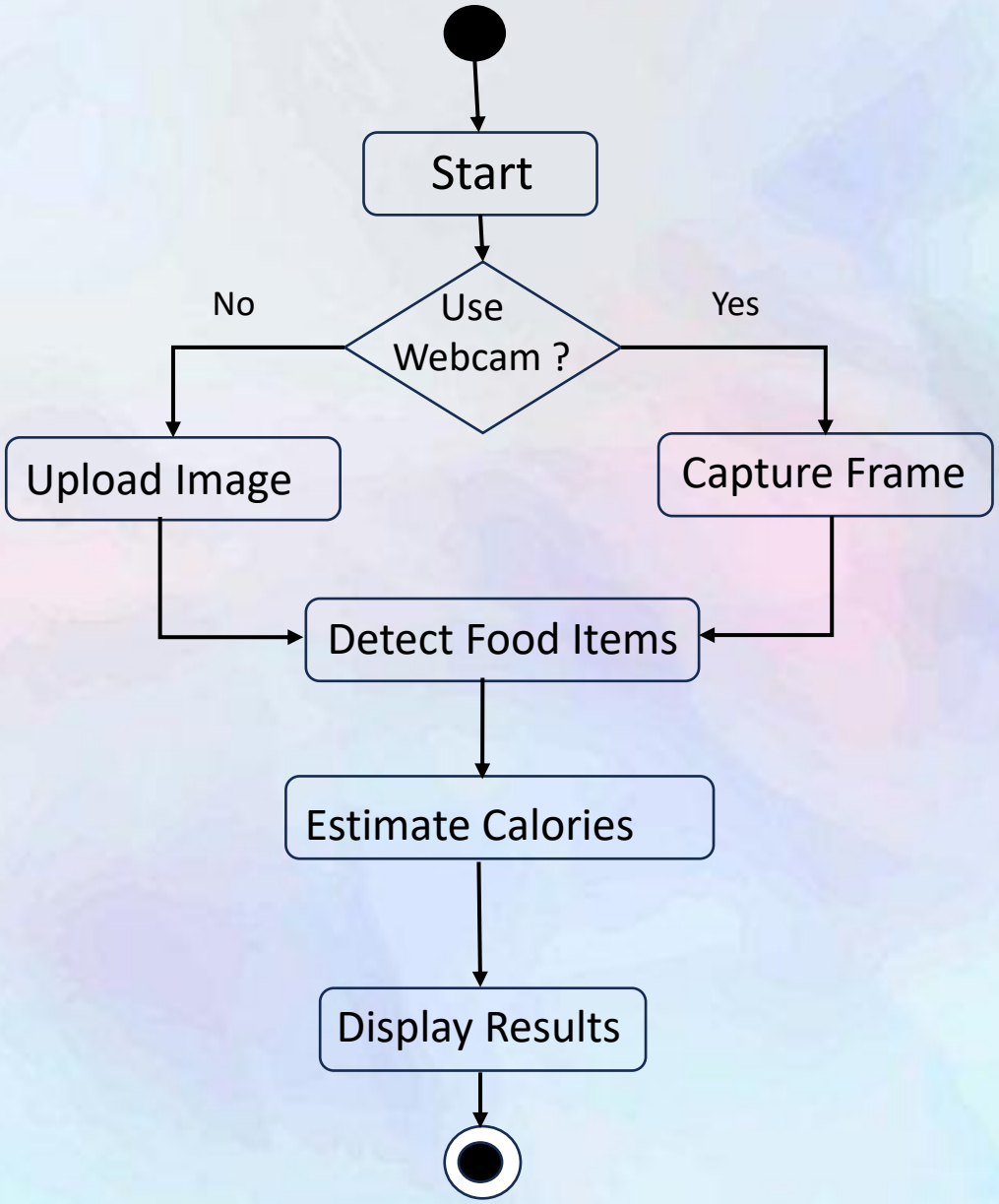
UML Diagram : Use-Case Diagram



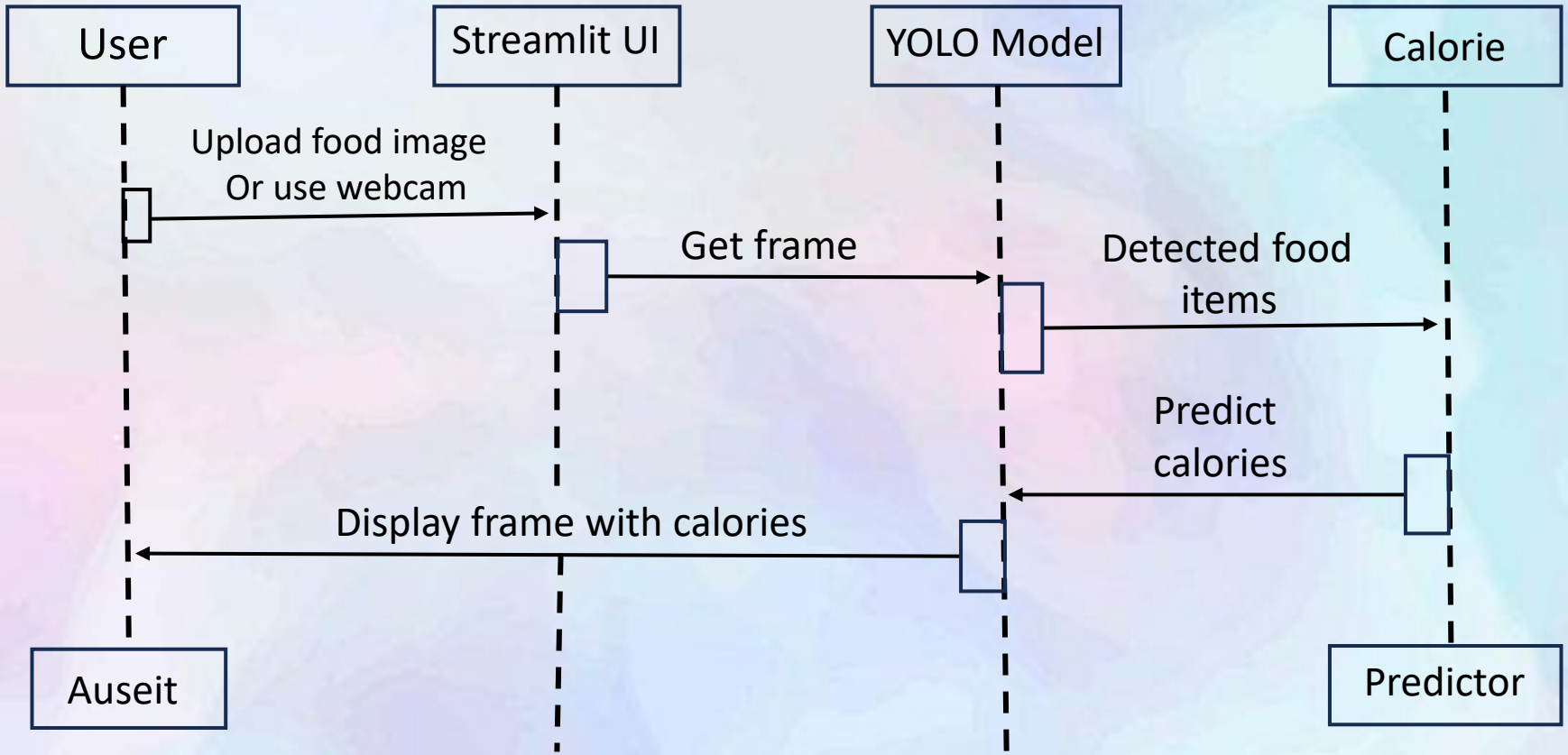
Class Diagram



Activity Diagram

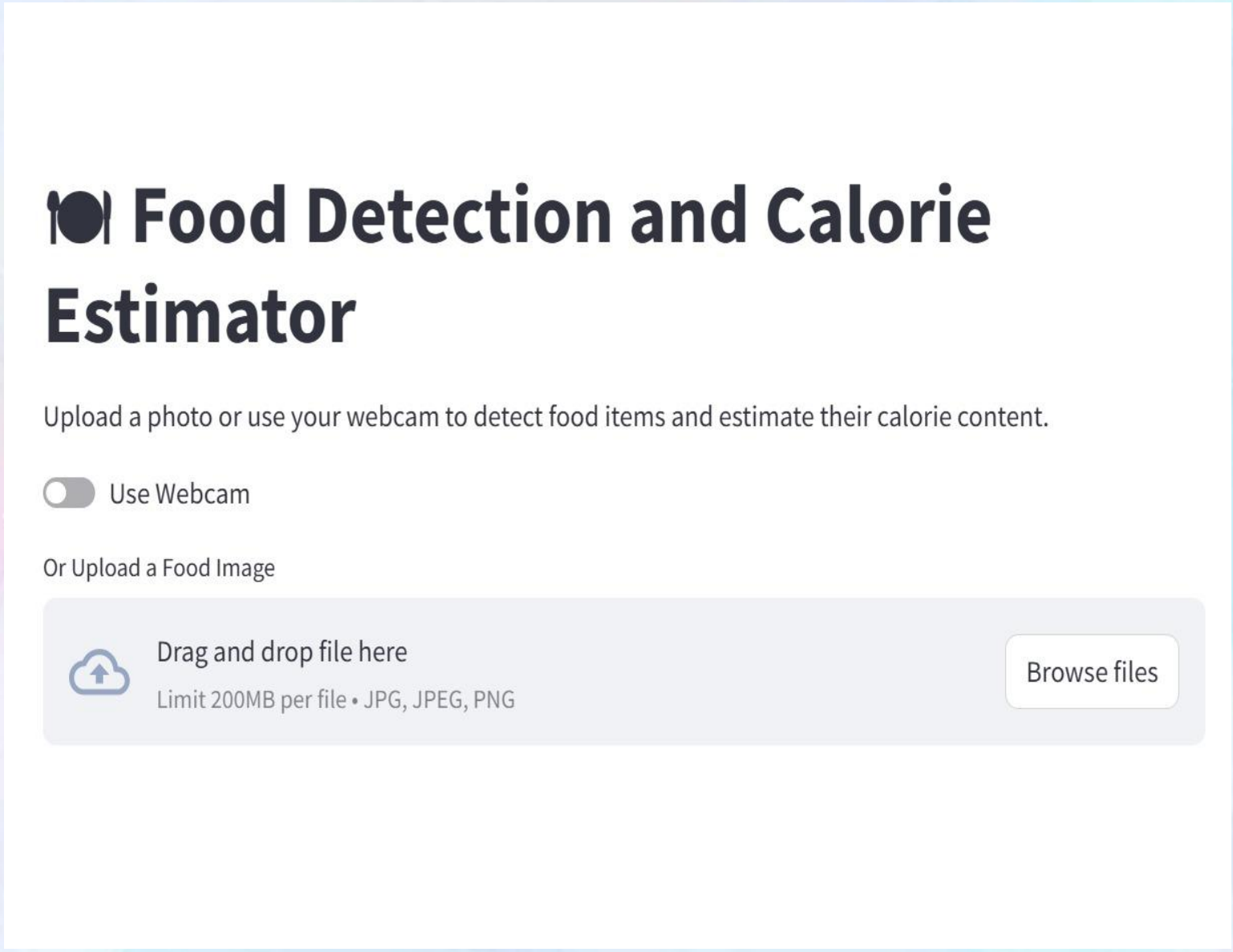


Sequence Diagram



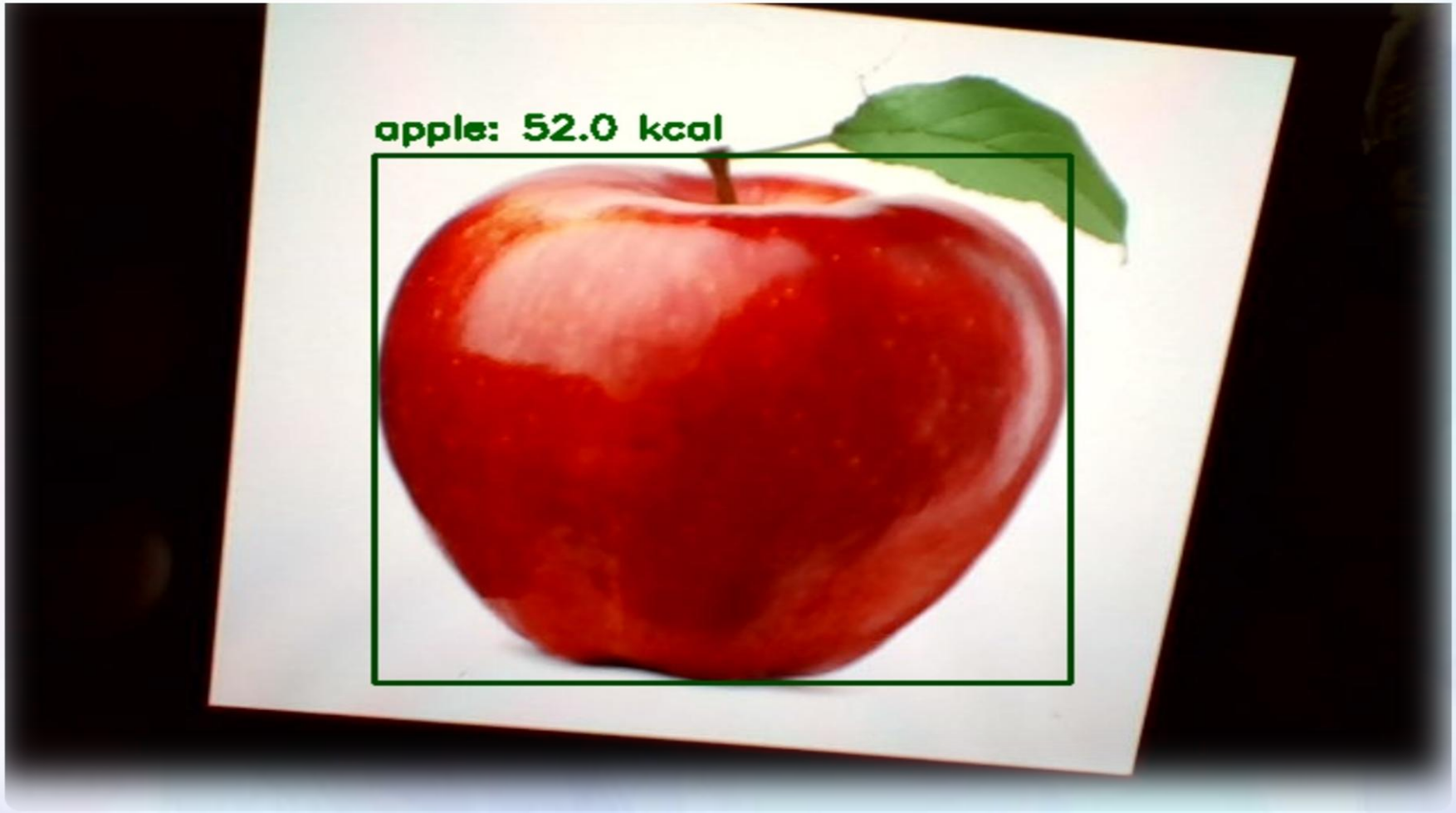
Output Screens

Main Page :



Output : Upload Image

Output : Webcam



Testing

Test Case ID	Test Category	Description	Input	Expected Output
TC_F01	Functional	Upload valid food image	Image of apple	“apple: 52 kcal” with bounding box
TC_F02	Functional	Upload image with multiple food items	Image with apple and banana	Multiple bounding boxes with labels and calories
TC_F03	Functional	Use webcam for detection	Enable webcam and show food	Real-time bounding boxes with calorie info
TC_N01	Non-Functional	Load time performance	5MB food image	Response within 2-3 seconds
TC_N02	Non-Functional	Image quality tolerance	Slightly blurry food photo	Detection with slightly lower confidence
TC_B03	Boundary/Negative	Corrupted image file	Malformed PNG	Graceful failure or error message
TC_B04	Boundary/Negative	Unknown/untrained food item	Exotic fruit image	“Unknown item” or low-confidence prediction

Conclusion

The provided code successfully integrates computer vision and machine learning to build an intelligent, real-time food calorie estimation system using Streamlit. It utilizes the YOLOv8 object detection model to identify food items either from webcam input or uploaded images. Once a food item is detected, its nutritional features—such as carbohydrates, proteins, and fats—are used as input for an XGBoost regression model trained to estimate the total calorie content. The results, including bounding boxes and calorie values, are visually overlaid on the detected food in the image or video stream. The application offers a simple and interactive UI for users to toggle between webcam and image upload modes, making it user-friendly and accessible. This solution demonstrates a practical implementation of AI in health monitoring and dietary planning by combining deep learning, machine learning, and web deployment technologies.

Future Enhancement

1. Expand the Food Database – Add more food items and nutritional details for better calorie estimation accuracy.

2. Improve Model Accuracy – Train the XGBoost model on a larger dataset or explore deep learning **models** like CNNs for better predictions.

3. Real-Time Multi-Food Detection – Modify the YOLOv8 implementation to detect and analyze multiple food items in one frame efficiently.

4. Diet Recommendation Feature – Suggest portion sizes or alternative food choices based on user goals (weight loss, muscle gain, etc.).

5. User Authentication & Profile Tracking – Allow users to create accounts and track their daily calorie intake based on past analyses.

6. Voice Input & AI Assistant Integration – Enable voice-based food logging and interaction with AI assistants for hands-free usage.

7. Mobile App Version – Convert the Streamlit web app into a native mobile application for a smoother experience on phones.

References

1. **2021 3rd International Conference on Signal Processing and Communication (ICPSC)**

https://ieeexplore.ieee.org/abstract/document/9451812

2. **2021 International Conference on Emerging Smart Computing and Informatics (ESCI)**

https://ieeexplore.ieee.org/abstract/document/9397023

3. **2016 IEEE International Instrumentation and Measurement Technology Conference Proceedings**

https://ieeexplore.ieee.org/abstract/document/7520547

4. **Food Detection using YOLO GitHub Repo**

https://github.com/ultralytics/ultralytics

5. **Deep-Learning-Based-Food-Recognition-and-Calorie-Estimation-for-Indian-Food-Images**

https://github.com/Yogeshpvt/Deep-Learning-Based-Food-Recognition-and-Calorie-Estimation-for-Indian-Food-Images

Thank You