Project Report

Project Name: Weigh My Plate

Group Number: 19

Github Link: https://github.com/Sushrut-naik/SSD_Project_19

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Objective

The aim of this project is the precise estimation of calorie content within an image depicting a plate adorned with various food items.

Methodology

In our methodology, we employed a custom dataset consisting of 557 images across 14 distinct classes to train the YOLOv5 model. The images were meticulously annotated using makesense.ai. The YOLOv5 model facilitated the extraction of precise coordinates, including the midpoint, height, and width of the bounding boxes.

We then pass the annotated image to a pre-trained Faster R-CNN model for further object detection. There are no common classes between Faster R-CNN and our custom dataset. Hence, we are able to detect a large set of objects, including indian food items including samosa, dhokla.

To delve into the intricacies of caloric estimation, we initiated the process by calculating the area of each bounding box using its respective height and width. This step served as a fundamental precursor for subsequent depth calculations. Leveraging the MiDaS model, we acquired a two-dimensional depth matrix for every pixel in the image. The depth at the midpoint of each bounding box was extracted, offering a three-dimensional context to our objects.

The volumetric data, a critical component for caloric estimation, was then derived by multiplying the area of the bounding box by its depth. This comprehensive approach allowed us to capture the spatial intricacies of the food items, enhancing the accuracy of our caloric predictions.

$$volume = area\ of\ bounding\ box \times depth\ of\ midpoint \tag{1}$$

The caloric estimation was accomplished by referencing a predefined list of calories per gram for each class. The final step involved applying the formula:

$$total\ calories = \sum_{number of objects} (volume \times calories\ per\ gram) \times count\ of\ object \tag{2}$$

For seamless integration and visualization, we implemented the MERN stack for the web API. Python scripts were invoked to execute the machine learning tasks, and the output was meticulously processed to generate insightful visualizations through graphical representations.

Use Cases

1. Nutritional Awareness
    - Scenario : Individuals aiming to maintain a balanced diet or adhere to specific nutritional goals
    - Use Case : Users can capture images of their meals to gain an instant understanding of the estimated caloric content, aiding them in making informed dietary choices
2. Dietary Planning
    - Scenario : Nutritionists or individuals planning customized diets for health or fitness purposes
    - Use Case : Our system provides a quantitative basis for designing personalized meal plans by accurately estimating the caloric intake associated with different food items
3. Fitness Tracking
    - Scenario : Fitness enthusiasts monitoring their calorie consumption and expenditure
    - Use Case : Users can conveniently track their daily caloric intake by analyzing images of meals, facilitating a more holistic approach to fitness management
4. Restaurant Menu Analysis
    - Scenario : Consumers curious about the nutritional content of restaurant dishes
    - Use Case : By capturing images of restaurant meals, patrons can make informed decisions based on estimated calorie counts, aligning with their dietary preferences

5. Research in Dietary Sciences

    - Scenario : Researchers exploring the relationship between dietary habits and health outcomes
    - Use Case : Our system serves as a valuable tool for researchers studying dietary patterns, allowing for the efficient analysis of caloric content in diverse food itemss

6. Educational Platforms

    - Scenario : Educational institutions teaching nutrition or related subjects
    - Use Case : Integrating our system into educational programs provides students with hands-on experience in applying machine learning to real-world problems in nutrition analysis

Illustrations

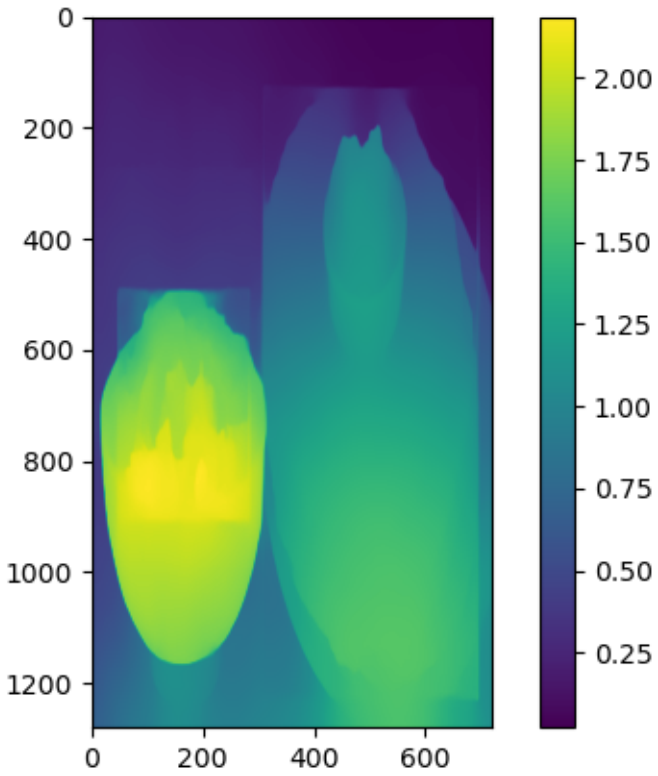

Figure 1: Heatmap Produced from the MiDaS model

Figure 1: Annotated image produced from our custom dataset of YOLOv5