e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

FOOD DETECTION

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ABSTRACT

This project delves into food recognition using YOLOv3, a cutting-edge and outstanding computer program for detecting objects. We excel in applying YOLOv3 to diverse food datasets to gain accurate insights into distinct food items in pictures and videos. The resulting model has practical applications in dietary assessment, menu analysis, and food security, rendering it a valuable asset for numerous businesses.

I. INTRODUCTION

People are really interested in using new computer methods to look at snacks and meals. The ultimate goal is to create a smart computer system that can quickly identify different ingredients in food, which can be used with various food-related applications. Thanks to advanced neural networks, our ability to recognize objects in images has greatly improved, surpassing human performance in many cases. For those working on food recognition, deep learning is seen as the future.

Food recognition is important for various things like keeping track of what you eat, analyzing restaurant menus, and ensuring food safety. In our project, we're using YOLOv3, a leading tool for recognizing food. YOLOv3 is known for its speed and accuracy in identifying objects, making it a great choice for this task. YOLOv3 uses a unique approach by processing the entire image at once, dividing it into sections, and making predictions for each section. If you want more details, you can read the original paper "Look Only Once: Unified Real-Time Object Detection."

YOLOv3 is a popular tool for quickly identifying objects in videos, live streams, and images. It uses a deep neural network to make these identifications. The YOLO system has evolved through versions 1 to 3, with version 3 being the most advanced. It was created by Joseph Redmon and Ali Farhadi. YOLOv3 can be implemented using Keras or OpenCV deep learning libraries.

In traditional object detection, we use convolutional layers to help make predictions. YOLO makes predictions based on some unique techniques, and it's called "You Only Look Once" because the size of the prediction map matches the size of the input feature map.

II. YOLOV 3

YOLO is a fast, accurate Convolutional Neural Network (CNN) for object detection that processes everything at once, without delays. CNNs usually work as classifiers by breaking down images into structured data and finding patterns in them. YOLO is exceptional because it's quicker than other networks and remains highly accurate. It allows the model to see the whole picture simultaneously, making predictions based on the complete context within the image. YOLOv3 stands out from its older versions in terms of speed, accuracy, and detail.

YOLOv3 differs significantly from YOLOv2 in terms of quality, speed, and design. YOLOv2 was introduced in 2016, two years before YOLOv3.

YOLO-V3 incorporates ideas from ResNet and FPN (Feature-Pyramid Network) to create a feature extractor called Darknet-53 with 52 intricate layers. It includes jump connections, similar to ResNet, and three prediction heads, like FPN, each analyzing the image at different resolutions.

III. MODEL OF YOLVO

YOLO, a computer program for spotting things in images, starts by using a simplified deep neural network to identify objects. The key part of YOLO, which is the heart of the program, consists of the first 20 convolution layers pre-trained with ImageNet. These layers are combined with average calculations and fully connected layers. This combination enhances performance. The last fully connected layer is responsible for determine the likelihood of the object's class and the coordinates of its bounding box.

YOLO divides the input image into a grid of cells. If the center of an object falls within a cell, that cell is responsible for detecting the object. Each cell predicts multiple bounding boxes and assigns a confidence score

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to each box. This score shows how confident the model is about the box containing the object and how accurate it believes the box's dimensions are.

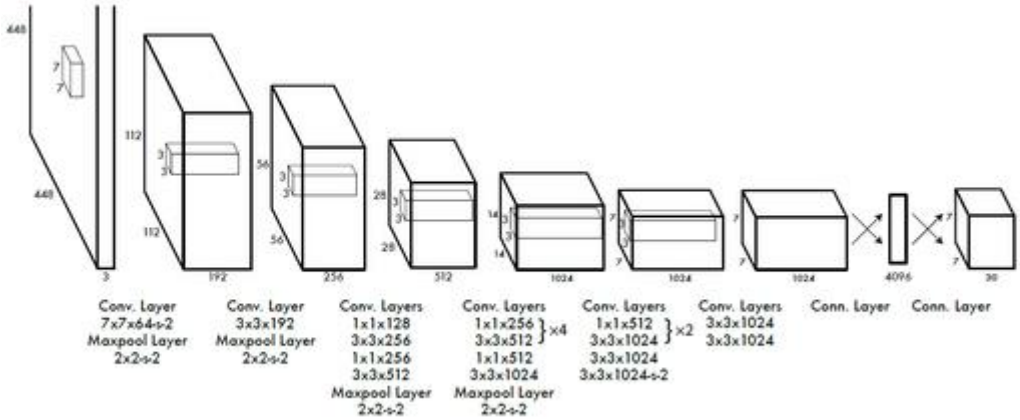

Figure 1: YOLO

At training time, we want only one bounding box to be responsible for each object. YOLO determines this by picking the box with the highest current Intersection over Union (IOU) score, creating focus and improving accuracy.

A vital tool used in YOLO is Non-Maximum Suppression (NMS). NMS is a step that helps improve the accuracy and efficiency of object detection. It deals with the common issue of having multiple bounding boxes for a single object. NMS removes redundant or incorrect boxes, ensuring only one box represents each object in the image.

YOLO v3 is the third version of the YOLO object detection software, introduced in 2018 to enhance accuracy and speed. Key improvements include the use of Darknet-53, a deep network that excels in object detection, and the introduction of anchor boxes with different sizes to better handle objects of various shapes. YOLO v3 also incorporates Feature Pyramid Networks (FPN) to detect objects at multiple scales, making it more effective at spotting small objects and handling a wider range of object sizes with greater stability compared to previous versions.

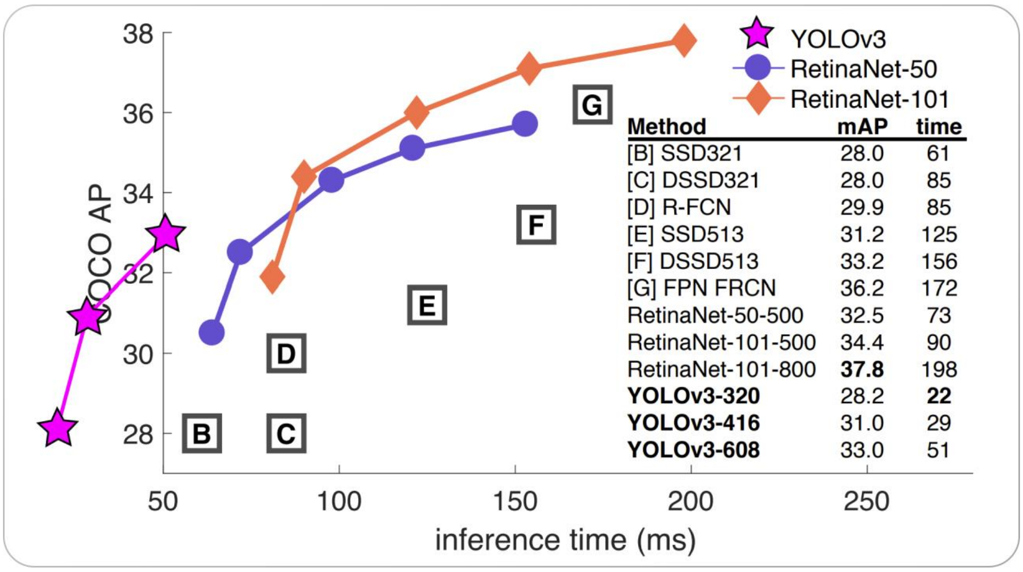

Fig 2: Results obtained by YOLOv3

IV. RESULTS AND DISCUSSION

In YOLOv3, Food Watcher aims to be a highly advanced AI that can instantly recognize common foods with great accuracy and understanding. AI strives to better understand human dietary needs and preferences for these delicious carbohydrate-rich meals.

To train YOLO with Darknet, you need the following:

- Bounding box files for each image

- Class name files containing category names
- Training dataset with a list of training images
- Validation dataset file with a list of validation images
- A configuration file to specify the YOLO neural network
- A data location file to find all data information

For our experiment, here's what we did:

- **Data Collection**: We gathered images of readily available foods and fruits, totaling 50 images, taken with a mobile camera. Additional images were sourced from various internet locations.
- **Importing and Installing Libraries**: We imported several Python libraries for tasks like matrix operations, visualization, and file handling. - Numpy: Used for mathematical operations and image processing. - Matplotlib: For visualizing detection results, including bounding boxes around foods. - TensorFlow: The deep learning framework used to implement YOLOv3 models in Darknet. - Pandas: Employed for data analysis and organization of detection results. - OpenCV: A computer vision library used for image loading and processing in food detection.

When using YOLOv3 for food detection, you can expect:

- **Object Detection**: YOLOv3 can identify multiple food items in an image or video simultaneously, including various types of food such as fruits, vegetables, fast food, and more.
- **Bounding Boxes**: YOLOv3 provides bounding boxes around each detected food, indicating their positions in the image.
- **Class Labels**: YOLOv3 assigns class labels to each detected food item, specifying what type of food it is (e.g., "apple," "pizza," "hamburger").
- **Confidence Score**: Each detection comes with a confidence score, reflecting the reliability of the detection. Higher scores mean more trustworthy results.
- **Real-Time Detection**: YOLOv3 excels at instant object detection, making it suitable for real-time applications like monitoring food choices in a self-service restaurant or tracking food intake in a video stream.
- **Multiple Classes**: YOLOv3 can recognize a wide range of food classes, including hamburgers, pizzas, fruits, vegetables, and more. The specific classes and their accuracy may vary based on training data and settings.
- **Localization**: YOLOv3 accurately outlines the shape and position of each food item in an image.
- **Customization**: You can fine-tune YOLOv3 on custom food datasets to make it proficient in recognizing specific food types relevant to your application or research.

Using YOLOv3 for real-time food detection produces output like:

(Include an example of the expected output or a description of the results of food detection.)

Fig 3. Food detection using YOLOv3 results

V. CONCLUSION

This research employs the YOLOv3 algorithm to spot various types of food. The YOLOv3 food detection project has demonstrated the potential of computer vision and deep learning in addressing real-world challenges related to recognizing and categorizing food. Using YOLOv3 for food detection has revealed the strength of deep learning in addressing practical food recognition issues. With technology continually advancing, these models are expected to get even better, serving as valuable tools to promote healthier eating habits and streamline various food-related processes.

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