Project Proposal – –
Knowing What You Eat: Health Indicator Analysis Through Ingredient Recognition

Project Category: Computer Vision
Team: Shoupei Li (ID: shoupei), Patrick Peixuan Ye (ID: pxye), Jordan Paredes (ID: jordan14)

Objective and Motivation:
By developing a machine learning system that identifies the ingredients in food and ranks its healthiness based on its ingredients, we aspire to provide users with an effective tool that can evaluate and rank the healthiness of their food choices. The goal is to analyze a given plate, identify up to 100 ingredients, and then rank the healthiness of that plate among other possible food options.

Method:

1. Feature Extraction with Convolutional Neural Networks (CNNs): We'll employ CNNs to extract features from images of the dishes. CNNs are effective for image classification tasks and can help in identifying distinct ingredients from a plate.

2. Supervised Learning for Healthiness Scoring: Based on extracted features and labeled data, we'll use supervised learning (possibly a combination of regression and classification models) to predict a healthiness score for the plate. Potential models include Decision Trees, Random Forests, Gradient Boosting Machines, and Neural Networks.

3. Ranking/Recommendation Algorithm: With the healthiness score as an output from our supervised model, we'll develop a ranking algorithm, possibly using techniques like collaborative filtering or matrix factorization, to categorize the healthiness of different plates and provide recommendations.

Intended Experiments:

1. Data Augmentation: To ensure our model is robust and generalizes well, we'll experiment with various data augmentation techniques (random cropping/rotation)

2. Model Architecture Experimentation: For CNN, we'll try different architectures such as VGG, ResNet, and MobileNet to identify the one that works best for our dataset in terms of accuracy and computational efficiency.

3. Hyperparameter Tuning: We'll run a series of experiments to find the best hyperparameters for our supervised learning models. Techniques like grid search and random search will be employed.

4. Evaluation Metrics: Since this is a ranking and recommendation system, we'll use metrics like Normalized Discounted Cumulative Gain (NDCG), Mean Reciprocal Rank (MRR), and Precision at K to evaluate the performance of our ranking algorithm.

5. A/B Testing: Once our model is ready, we can conduct A/B tests where we present users with recommendations from our model and some baseline model to see which set of recommendations they prefer or find more accurate.

Data Collection:

- Utilize Google's search algorithm to gather images of various dishes, ideally with related recipes.
- Leverage restaurant websites with ingredient lists and associated images.
- Build a data-processing pipeline and aim for a dataset size of around 10k data points.
- Find other public dataset like Nutrition5k to supplement our model if needed

—

Healthiness Function Collaboration:

For a holistic and accurate measure of healthiness, we aim to collaborate with the Stanford Wu Tsai Human Performance Alliance. They'll assist in defining what constitutes a "healthy" plate and help to design a healthiness function that our model can use to score dishes.

—
Related Work / Dataset :
Ingredient searching

- Newest and most cited : link here
    - *http://pic2recipe.csail.mit.edu/*
    - *http://wednesday.csail.mit.edu/pretrained/im2recipe_model.t7.gz*
    -
- *Food Ingredients Recognition through Multi-label Learning* (by Rameez Ismail and Zhaorui Yuan) (https://arxiv.org/abs/1707.08816) - 2017

- ALL connected and relevant papers to this paper, linked here

Machine Learning-Based Screening of Healthy Meals From Image Analysis: System Development and Pilot Study (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7652690/) -2020 NIH

We can also reference helpful datasets such as "Nutrition5k: Towards automatic nutritional understanding of generic food."(IEEE 2021)