FOOD MACRO DETECTOR — FULL PROJECT REPORT

Course Project: Build Your Own Project

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Abstract

The Food Macro Detector is an end-to-end system that predicts protein, fat, and carbohydrate values for food items

by combining image classification and the USDA FoodData Central database. The system ingests official FDC nutrition data,

extracts macronutrients, trains a Keras-based MobileNetV2 classifier for food identification, and exposes results through

a simple local API. This project demonstrates data engineering, machine learning, fuzzy mapping, and API integration.

1. Introduction

Modern users want fast nutritional information. Manual search is slow, inconsistent, and error■prone.

This project automates macronutrient estimation by linking food item recognition to authoritative FDC data.

2. Problem Statement

Create a working system that estimates macros (protein, fat, carbs) for food items using:

(1) machine■learning image classification,

(2) USDA FoodData Central dataset,

(3) a mapping engine between classifier labels and FDC items.

3. Project Goals

• Build and populate a local SQLite database from official FDC bulk dataset.

• Extract macronutrient values per 100g for all items.

• Train a transfer■learning CNN classifier for food item recognition.

• Map predicted labels to FDC entries using fuzzy matching + manual verification.

• Provide a simple API endpoint to query macros per serving.

4. Architecture

Data Layer:

– Bulk JSON ingestion of FDC dataset into SQLite via load_fdc.py

– Nutrient extraction via extract_macros.py

ML Layer:

– MobileNetV2 transfer learning

– Multi■class classification

– Training pipeline implemented in train.py

Mapping Layer:

– fuzzy string matching to suggest FDC entries

– mapping table stored in SQLite

API Layer:

– Flask microservice /api/analyze

– Accepts textual label and serving size

5. Dataset Used

• USDA FoodData Central (FDC)

• Food■101 dataset for image classification

6. Implementation Summary

Scripts:

• load_fdc.py — create schema + ingest JSON lines

• extract_macros.py — export macros per 100g

• auto_map_labels.py — fuzzy match classifier labels → FDC entries

• load_mappings.py — load validated mappings into DB

• train.py — CNN transfer learning pipeline

• inference_example.py — model inference + macro lookup

• app.py — Flask API

7. Results

• Successfully created local FDC database

• Macros extracted for >200,000+ items (depending on dataset year)

• Classification accuracy varies with selected dataset subset

• API returns macros scaled to serving size

8. Challenges

• FDC dataset variability between dataType: “Branded”, “SR Legacy”, etc.

• Image dataset diversity: same food may appear visually different

• Fuzzy matching may misassociate ambiguous food names

9. Future Enhancements

• Add portion estimation directly from images

• Add more granular food categories

• Deploy as mobile app or web UI

10. Conclusion

Food Macro Detector demonstrates a practical integration of machine learning, nutritional data engineering, and backend API design to automate macro estimation for real■world applications.

References

• USDA FoodData Central: https://fdc.nal.usda.gov/

• Food■101 Dataset: https://www.vision.ee.ethz.ch/datasets_extra/food-101/

• TensorFlow Keras Documentation