Fruit Calories Estimation using 3D Measurements

Pyone Thant Win

Department of Computer Science, Earlham College, Richmond, IN

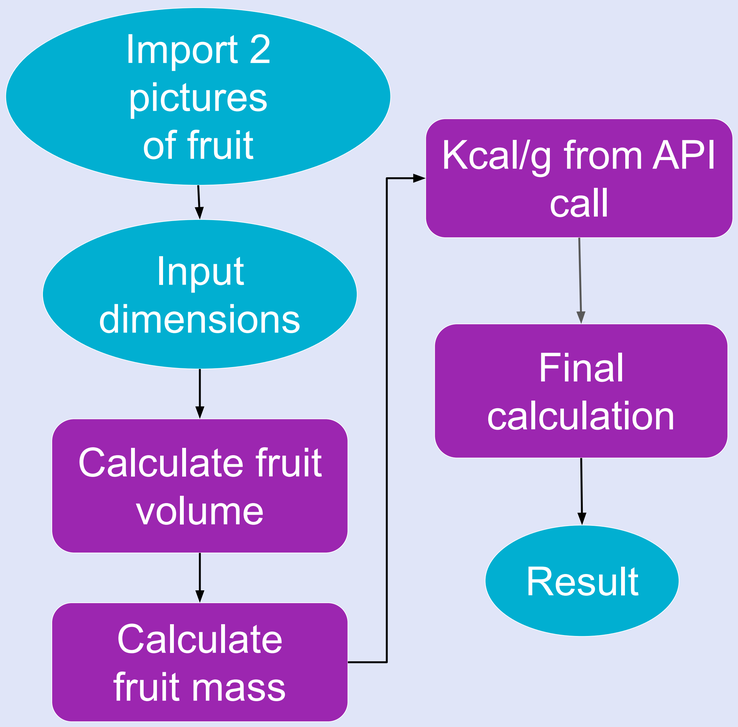
INTRODUCTION

- As of May 2018, 27.4 million people per month are using “Fitbit”, the most popular calorie tracking application.
- Past research on image-based volume calculation of food requires reference object
- This project attempts at a new way of measuring calories of fruits by using computer vision technologies **without** physical reference object

CONTRIBUTIONS

- Open-source, well-documented application for reproducibility
- More user-friendly image-based calories estimation
- Fruit density database

SOFTWARE ARCHITECTURE



METHOD

Input Validation

- Fruit must be in the density database
- Users cannot put same picture twice

Volume Calculation without Physical Reference Object

- 2 input pictures: one from side, one from top
- Reference ruler attached in the picture for the user to compare
- Estimate dimensions with the help of reference ruler

$$\text{Object size} = \frac{\text{Object size in image} * \text{Object distance}}{\text{Focal Length}}$$

- Fruit’s dimensions will be put into a cube’s volume

Estimation of Fruit Mass

- Mass = density * volume

Calorie Estimation

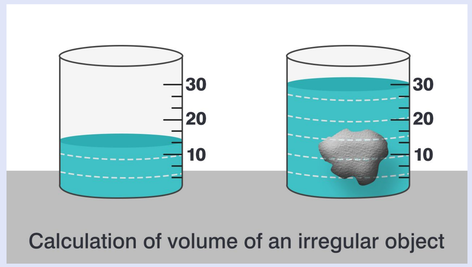
- API call to get the kcal/100g
- **Total kcal of fruit = mass(g) * kcal/g**

Density Database

- Information from USDA FOOD CENTRAL API
- 1 cup of fruit = 236.558 cm^3 / weight of fruit per cup
- 1 cup = raw fruit, chopped/diced/sectioned

ACCURACY TESTING

- Manual Calculation: Submerge fruit into water to calculate volume
- Compare two final calculations of 6 apples



Calculation of volume of an irregular object

Image source: https://sciencestruck.com/how-to-find-volume-with-water-displacement-method

RESULT

	Apple A	Apple B	Apple C	Apple D	Apple E	Apple F
Real Calories	85.49	85.72	86.98	87.31	86.39	84.76
Estimated Calories	62.48	82.01	115.5	58.58	78.1	52.72
Difference	23.01	3.71	-28.52	28.73	8.29	32.04

- Best Accuracy Rate:95.67% of the actual value
- Worst Error Rate: 37.8% less than the actual value
- Average Accuracy Rate: 86.98%
- The results show that the dimensions estimation is crucial in this project.

Future Work

- Integrate image recognition to recognize fruit name
- Expand the density database

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