AR DeepCalorieCam V2: Food Calorie Estimation with CNN and AR-based Actual Size Estimation

Ryosuke Tanno, Takumi Ege and Keiji Yanai
(The University of Electro-Communications, Tokyo)

## Introduction

- Many recording meal apps
  - Semi-automatic calorie estimation
  - Need to teach food amounts manually (e.g., FoodCam)
- New method
  - No need to register a size-known reference object
  - No need of a recognition server

### Previous Method

**Ex. CalorieCam [Okamoto et al. 2016]**

1. Take a photo with a reference object
2. Recognize a category of each food item
3. Calculate food calories based on the relative size and food categories

**CalorieCam [Okamoto et al. 2016]**

- Food Cam [Kawano et al. 2014]
- Need to teach the amount of foods by the slider
- Need to prepare a reference object

### New System: AR DeepCalorieCam V2

- Food Calorie Estimation with CNN and AR-based Actual Size Estimation
  - Directly calculate regions
  - Based on edge-based seeds
- Calibration
  - No need a reference object
  - Calculating the meal area more accurately than the previous method

## Proposed Method

### Food Category Recognition

- Convolutional Neural Networks (CNN)
  - Light memory, faster inference and high classification accuracy
  - Fine-tune a pre-trained ImageNet model in Keras Deep Learning framework with UEC-FOOD100 dataset

### AR-Based Actual Size Estimation

- Measure the actual size of the meal area using Apple ARKit framework
  - Acquiring the coordinates on the real world as a three-dimensional vector
  - Calculate food calories based on their actual size and food categories

### Evaluation of Automatic Calorie Estimation

<table>
<thead>
<tr>
<th>Dish</th>
<th>GT</th>
<th>Avg. err</th>
<th>Avg. SD</th>
<th>Avg. err</th>
<th>Avg. SD</th>
<th>Avg. err</th>
<th>Avg. SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef bowl</td>
<td>962</td>
<td>-53.25</td>
<td>±209.79</td>
<td>-242</td>
<td>±55.10</td>
<td>-67.14</td>
<td>±18.8</td>
</tr>
<tr>
<td>Croquette</td>
<td>552</td>
<td>-242</td>
<td>±91.26</td>
<td>-47.08</td>
<td>±52.52</td>
<td>-127.0</td>
<td>±9.0</td>
</tr>
<tr>
<td>Salad</td>
<td>14</td>
<td>54.83</td>
<td>±36.28</td>
<td>4.86</td>
<td>±11.87</td>
<td>-0.95</td>
<td>±0.16</td>
</tr>
</tbody>
</table>

## Conclusions

- Propose a new approach for food calorie estimation with CNN and AR-based actual size estimation

## Future Works

- Combines the proposed method and segmentation, taking into account the size of the meal area