

Introduction

Our project is to build a Calorie Calculator based on picture taken by Mobile Devices. In order to find out calories contained in a picture, we build up an image recognition system.

Motivations

- ❑ Motivations
 - People calculate calorie contains in the food by searching in the web, we want to develop a simple way to accomplish calorie estimation by simply taking a photo of the food.
 - The core technology, object recognition based on image, we used for calorie estimation can be applied to many other applications.
- ❑ Objective
 - Taken photos with cellphone and send image to the server.
 - Locate the object in the image and recognize different object (foods & drinks).
 - Calculate the calories of all the food in the image and send feedback to cellphone.

Research Challenges

- ❑ The complexity of Multiclass Detection in order of hundred magnitudes.
- ❑ The variability of object shape/scale/rotation in different scenarios.
- ❑ User-Friendly Design for Android Device.

Future Work

- ❑ Try Deep Learning Methods: Convolutional Neuron Network to improve the order of magnitudes of image classes.
- ❑ Transplant the distribute system completely into Android Device.

Acknowledgement

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Methodology

- ❑ Step 1: Sliding Window & Gaussian Pyramid

The sliding window is to extract a small window of image with proper size, and slide this window throughout the whole image. Gaussian Pyramid is creating multiple scalar layers of image to deal with different scalar of object in image.
- ❑ Step 2: HOG Feature of Image

HOG feature extract the information from multiple pixels into oriented vector, which keeps information of the geometric edge and illumination.
- ❑ Step 3: Random Forest Classifier Model

Random forests is a notion of the general technique of random decision forests which are an ensemble

learning method for classification & regression. This method operates by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes (classification) or mean prediction (regression) of the individual trees.

- ❑ Step 4: Locate & Label Objects

We classify the label of each sliding window with RF Model and generate a probability heat map, based on which we are able to find the highlighted location which infers to the object location.

- ❑ Step 5: Build Up Connection

Establishing TCP/IP connection between Android device and computer via TCP/IP socket.

Results

- ❑ Training: Training with 5 classes of objects returns high accuracy for single image classification.

Figure 1: Confusion Matrix.
Row axis are object labels while Column axis are classified labels.

```

--- Confusion Matrix ---
      a  b  c  d  e  <-- classified as
a  17  0  0  1  2  | a = 1
b  0  18  2  0  0  | b = 2
c  0  0  20  0  0  | c = 3
d  0  0  0  19  1  | d = 4
e  0  1  1  1  17  | e = 5
    
```

- ❑ Terminal: The Terminal UI shows the technique details and the final location & label for object.

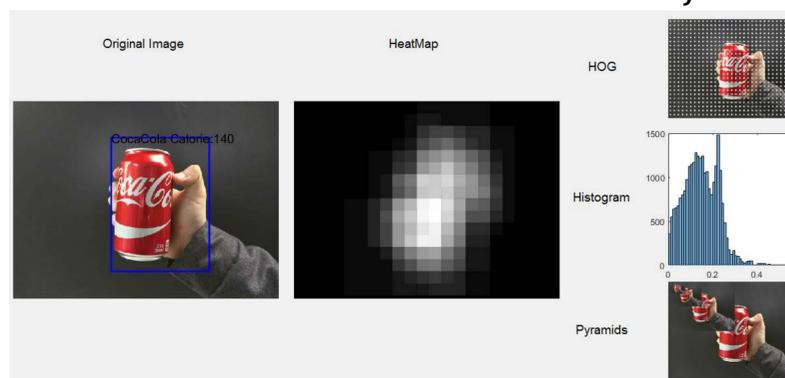


Figure2: User Interface of Processing Terminal via MATLAB

- ❑ Android: The Android Device Interface is like these two figures. Before processing, user is highly recommended to take picture inside the red square. Afterwards, marked object names and total fat or calories will be printed on screen.

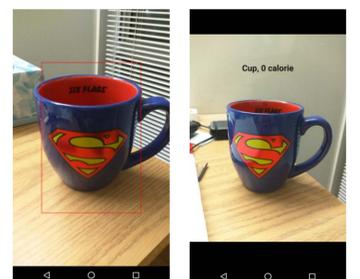


Figure 3: Before Processing

Figure 4: After Processing

- ❑ Discussion: The limitation of traditional machine learning approach for object detection is reached. We cannot handle large number of classes. The Sliding Window & Gaussian Pyramids successfully handle the scalar challenge of detection, however the rotation problem still remains. The trade-off between precision and functionalities still remains optimizing.

References

- [1] "Histograms of Oriented Gradients for Human Detection" seminal paper by Navneet Dalal and Bill Triggs, 2005
- [2] "Histogram of Oriented Gradients and Object Detection" by Adrian Rosebrock on November 10, 2014
- [3] "Random Partial Differential Equations" Proceedings of the Conference held at the Mathematical Research Institute at Oberwolfach