Digital Image Processing, Spring 2018

Homework 4

DUE DATE: May 30, 2018

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README

To run my program, simply type **README** in the Command Window of MATLAB application, then it'll run all .m files and output the .raw images.

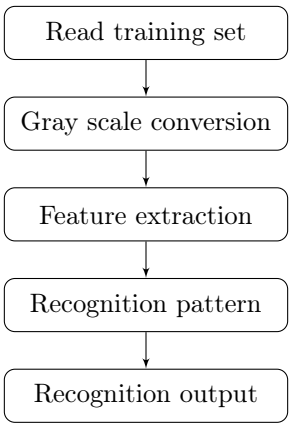
Listing 1: README.m

```
% DIP Homework Assignment #4
% May 30, 2018
% Name: Jay Chen
% ID #: B03902129
% email: b03902129@ntu.edu.tw

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Add path first
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

disp('Add path ./prob1');
addpath('./prob1');
addpath('./readwriter');

% disp('Make a parent folder ./outputs');
% mkdir . outputs

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Problem 1: Optical Character Recognition (OCR)
% Implementation: Using training set to perform OCR on given images
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

fprintf('————————————————————————————————————————\n');
fprintf('Running prob1\n————————————————————————————————————————\n');
prob1();
```

PROBLEM 1: Optical Character Recognition (OCR)

In this assignment, I used the method mentioned in the paper - Optical Character Recognition Implementation Using Pattern Matching.

The flowchart of the algorithm:



First, I extract the features of TrainingSet.raw into 70 binary images sizes of 15×15.

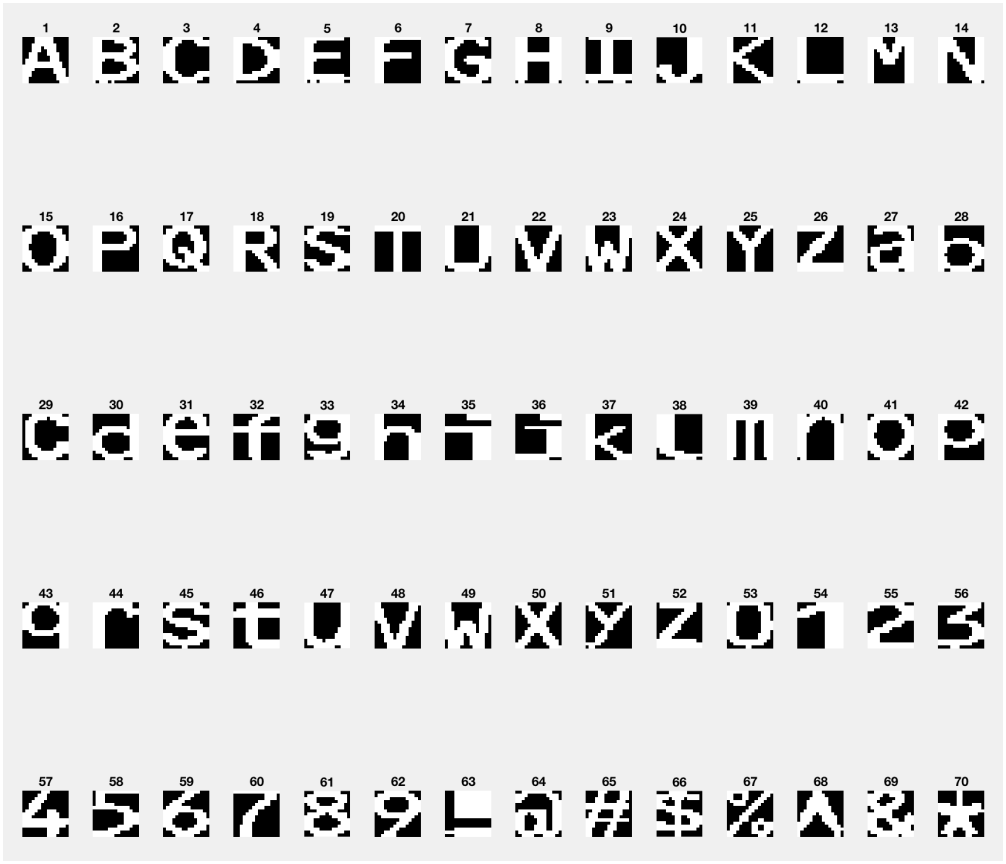


Figure 1: Characters of TrainingSet.raw

Both sample1.raw and sample2.raw will run the following algorithm except that I perform a Cross Median Filter on sample2.raw first since there are pepper & salt noises in sample2.raw.

Algorithm

1. Label the input image by connected component algorithm implemented in Homework 3.
2. Get characters of the image.
3. Extract features of the image.
4. Reconize the characters based on the RMSE between the feature of the image and the features of TrainingSet.raw.
5. Output the resulting characters.

Here I want to detail the step of feature extraction. In the following figure, we can see that the binary image has been divided into 5 tracks and each track subdivided into 8 sectors. So we have to calculate number of pixels in each region. (There are $5 \times 8 = 40$ regions.)

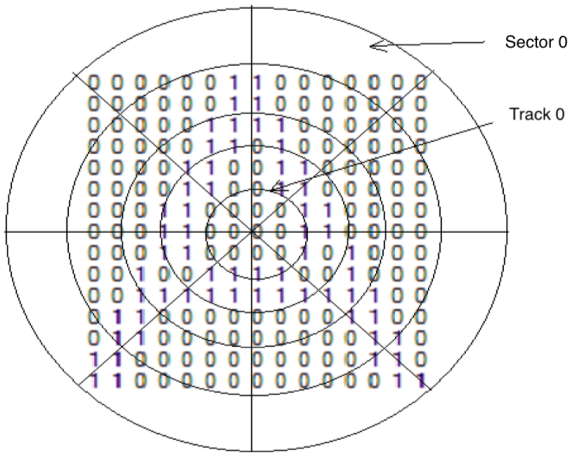


Figure 2: Division into tracks and sectors

1. Identify the center of the binary image. (Here the center is $I(8, 8)$ since the iamge size is 15×15.)
2. Calculate radius by finding pixel with maximum distance from center using distance formula.
$$d(point, center) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$
3. Perform $(rad \div 5)$ to identify size of each imaginary track.
4. Identify 8 imaginary sectors.
5. Calculate number of 255 (white point) in each region.

I identify the desired character by calculating the RMSE (Root Mean Square Error) between the feature of the image (I) and the features ($trainingFeature$) of TrainingSet.raw. Here $c = 1, 2, \ldots, 70$ represent 70 characters in the TrainingSet.raw:

$$arg\min_{c} \sum_{n=1}^{40} (I^n - trainingFeature_c^n)^2.$$

Finally, I can obtain the output string 'HigX8' and 'SB4T7I'.