Assignment 2 : Chinese Herbal Medicine Classification

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Motivation

- Traditional Chinese medicine (TCM) has a history of thousands of years in China. Currently, due to its distinguished therapeutic effects with minimal or negligible side effects, TCM is gaining increasing attention around the world.
- So far, the results of manual examination are vulnerable to influence by artificial factors. And it lacks efficiency and inheritance of experience. With the development of computerized image analysis, computer aided procession is applied in the identification and quantitative analysis of TCM.

Problem Proposed

- Seven types of TCM images and corresponding background images are provided. Individual sample number is listed in Table. 1.

Areca catechu	Gastrodia elata	Ligusticum	Liriope
19	20	6	9
Nux vomica	Pinellia ternate	Radix curcumae	
48	60	6	

Table 1: Sample number of individual TCM.

- **For individual class samples**, ratios for training, testing and validation are 0.7, 0.15 and 0.15, respectively.
- Based on image processing technologies,
  1. **extract the target regions of TCM**,
  2. choose proper features,
  3. design a reasonable classifier to categorize the CHM images.
- To deliver your report before or on February 10 is preferable.

TCM images and background images

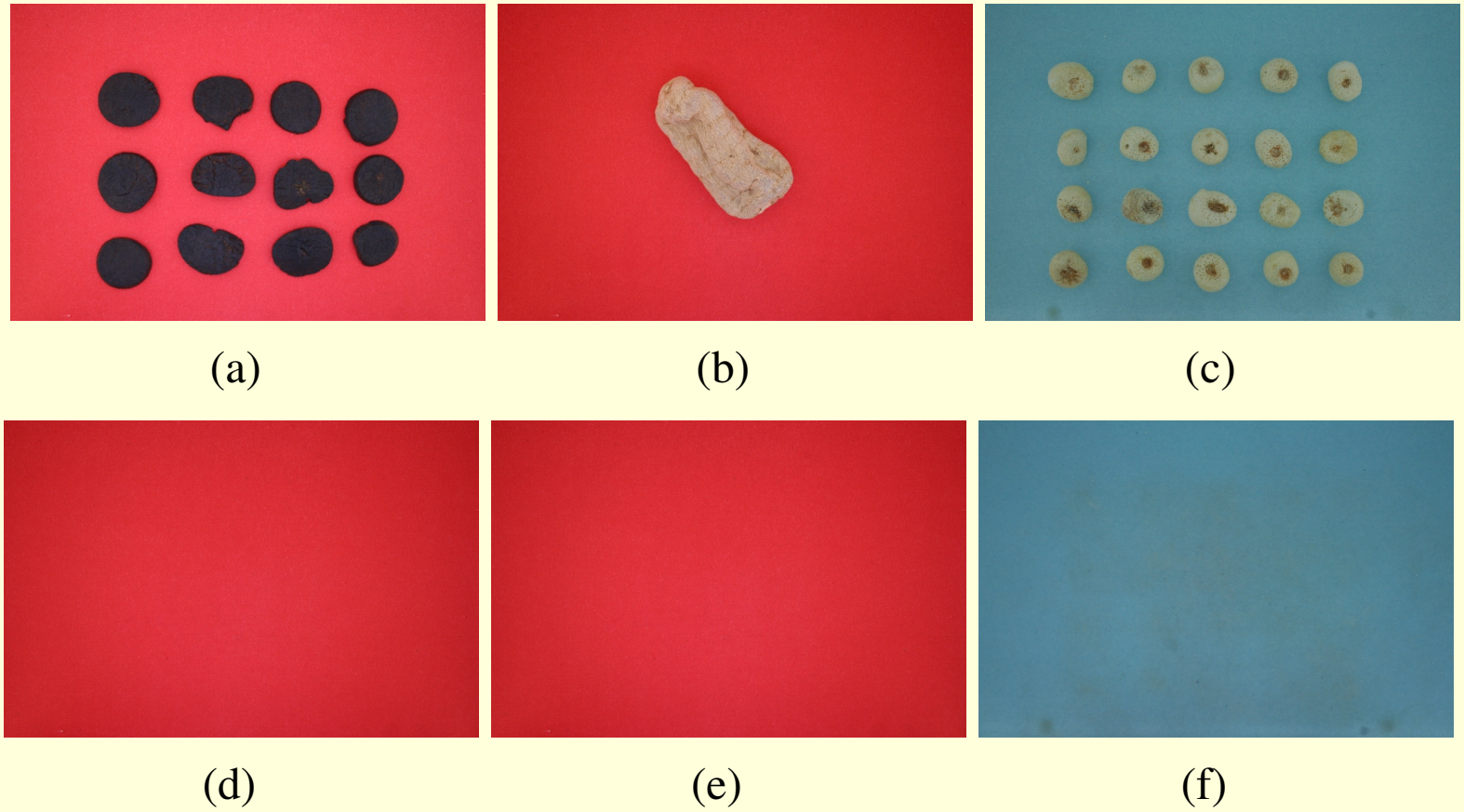


Figure 1: (a)-(c): TCM images (d)-(f): background images corresponding to images (a)-(c).

Flow chart of TCM Classification

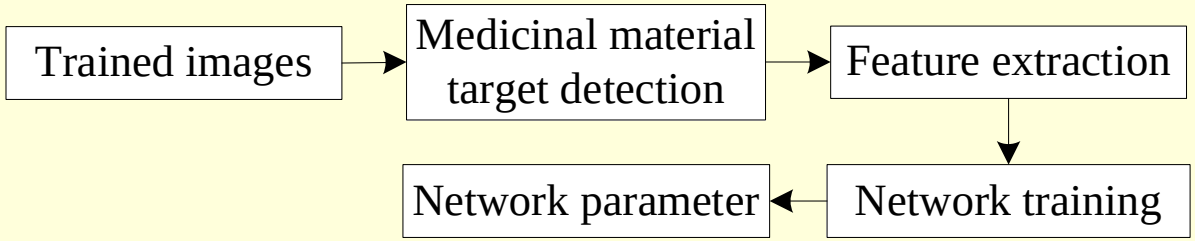


Figure 2: Network training process

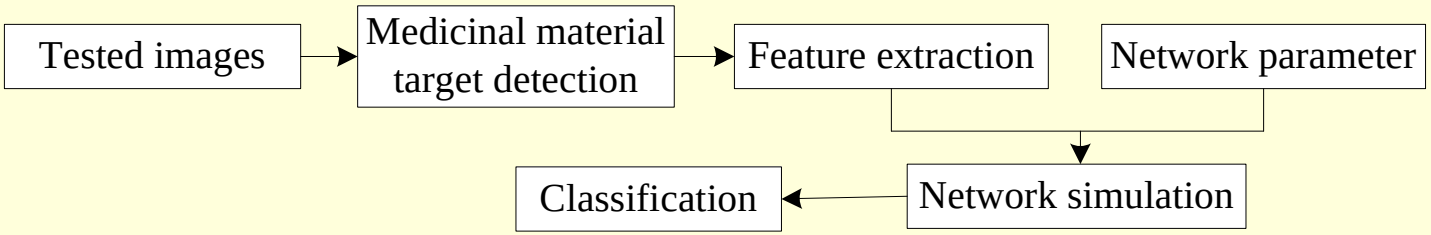


Figure 3: Network classifying process

TCM target region extraction

- TCM images $\rightarrow$ Automatical background extraction * $\rightarrow$ Background removal $\rightarrow$ Isolating connected objects.

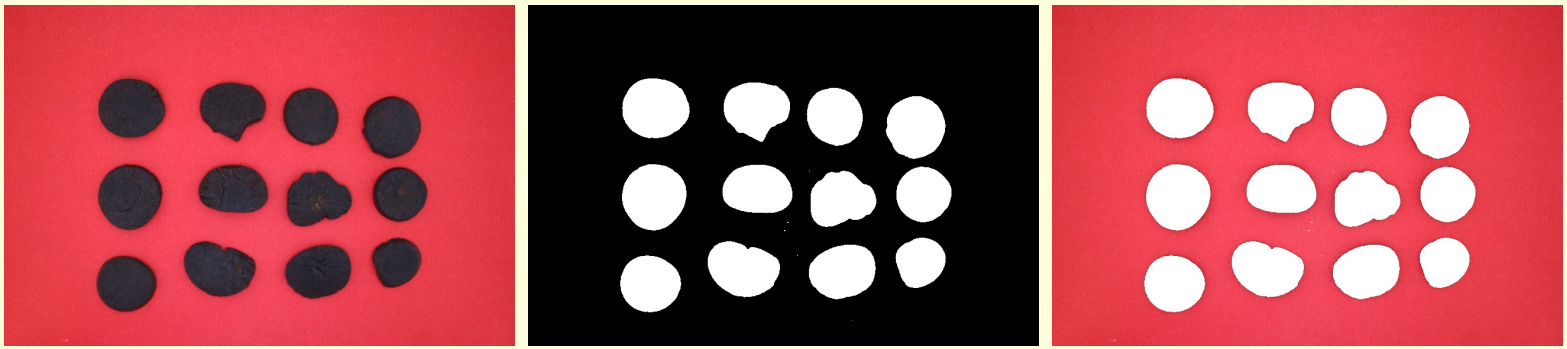
* Background extraction can be fulfilled using region growing method. Provided that background images are employed, background extraction process can be omitted.

Region growing algorithm is briefly described as:

$$R_n = \{R_{n-1} \bigcup \{(i,j) || f_k(i,j) - f_k(i_0,j_0)| \leq T,$$

$$0 \leq |i - i_0| \leq 1, 0 \leq |j - j_0| \leq 1, (i_0,j_0) \in R_{n-1}\}\} \quad (1)$$

where R_0 is the initial seed region, T is a threshold depicting the property similarity in a same region, $f_k(i,j)$ is the image feature measurement (pixel intensity, gray-scale texture, or color, etc.) in the kth channel. The regions are then grown from the seed points to 8-connected neighborhood adjacent points depending on the similarity threshold.

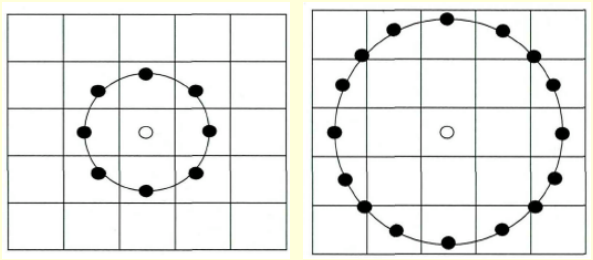


(a) (b) (c)

Figure 4: TCM target region extraction (a) Original image (b) Target region highlighted in white (c) Background extracted based on region growing algorithm

An Example of LBP Calculation

For instance, sampling points in $\text{LBP}_{8,1}$ and $\text{LBP}_{16,2}$ calculations are shown in Figure ,where circular points are current points.



(a) (b)

Figure 5: Sampling points (a) $\text{LBP}_{8,1}$ (b) $\text{LBP}_{16,2}$

A 5×5 image is shown as below:

136	142	144	143	149	
135	136	134	136	147	$\rightarrow LBP_{16,2} = (1111110000001110)_2 = 64526$
142	137	**132**	125	131	
137	134	131	127	127	$\rightarrow u(LBP_{16,2}) = 4 \Rightarrow LBP^{u_2}_{16,2} = 17$
137	129	127	124	124	

In this case, we can statistic the frequency of the occurrence $LBP^{u_2}_{16,2}(= 0, 1, \ldots, 17)$ and use this histogram (18 bins) as a feature vector.

An Example of GLCM Calculation

For example, there are only 4 gray levels in an image, see Figure 6.

0	0	1	1
0	0	1	1
0	2	2	2
2	2	3	3

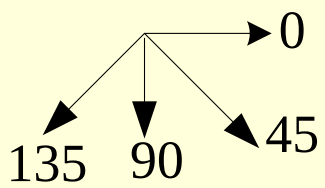


Figure 6: Original image and angle illustration

A GLCM matrix is $G \times G$, where G is ray levels of the image. The $0^o, 45^o, 90^o$ and 135^o GLCM are calculated as:

$$\begin{pmatrix} 2 & 2 & 1 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 3 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 1 & 3 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 3 & 0 & 2 & 0 \\ 0 & 2 & 2 & 0 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 0 \end{pmatrix} \begin{pmatrix} 2 & 0 & 3 & 0 \\ 1 & 1 & 2 & 0 \\ 0 & 0 & 2 & 1 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$