Image Segmentation Based on Color Feature

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Abstract:
Image segmentation is one of the key steps in image analysis, where the fuzzy theory based methods are widely used, but, none had universally property to segment all types color images. So, to improve segmentation quality and universally property of segmentation algorithm, a new fuzzy color image segmentation algorithm was brought out based on feature divergence and fuzzy dissimilarity. The algorithm measured the otherness of two stylebooks space eigenvector by feature divergence, and extracted sub-images feature eigenvector using watershed algorithm, depressed operation data number. Combination of sub-image was done by dint of fuzzy dissimilarity and morphological theory, and the isolated points were eliminated, and made color image segmentation more according with the human segmentation strategy. The method efficiency and feasibility were confirmed by experimental results.

Keywords: Feature Divergence; Fuzzy Dissimilarity; Color Image Segmentation.

1. INTRODUCTION

Image segmentation, a kind of the basal computer-vision technique, was the key step from image disposal to image analyses, because color image had more image information than gray image, together with the advance of the computer disposal abilities, the color image disposal was more be attended and more be attentend, the segmentations of color image were also more be regarded and more be regarded. Now, the segmentations of color image which were already mentioned mostly included threshold value, clustering value and so on. Thereinto, the most famed clustering way was FCM way. But, the clustering way, segmented color image, was still as follows problem: information quantity was bigger; the algorithmic capability depended on the early clustering center; the number of clustering must be confirmed in advance etc. (Pinto and Montez and Arauj,2014). The ability of traditional FCM applied anywhere was less grade. So, the algorithmic adopted character divergence to measure the otherness of two stylebooks space eigenvector, color image was carried out clustering segmentation by virtue of character divergence and fuzzy dissimilarity.

2. MATERIAL AND METHOD

2.1. Computer-Vision System

Hardware system mostly included computer and digital camera. The computer’s configure was Intel Pentium 1.6GHz CPU, 80G(7200speed) HD,17-inch LCD, Windows XP operating system. Matlab7.10 programmed language was computer image processing technique. In order to obtain first-rank photics effect of plant image, digital camera, having CCD sensitization component, 71 hundred thousand pels, 3072×2304 distinguish rate and thrice photics change-focus, was selected, which sent directly image to computer by USB data line and interface.

2.2 FUZZY THEORY

In the way of FCM mean clustering, every data point was subjected some a clustering center in term definite fuzzy subjection degree. In this way, some clustering centers were selected stochastic, all data points were endued with definite fuzzy subjection degree to the clustering center, then continuously corrected the clustering center by the way of iteration, it was the optimizing object that the mean of subjection degree value and the shortest distance between all data points and very clustering centers during the iterative. Bezdek extended the way to the limitless cluster of a fuzzy object function clustering and proved the astringency of this algorithm (Arikaya and Hinton,2014).

If data musters x= { x_1, x_2, ...., x_n } ∈ R^m was separated into c species, any stylebook X_i in X, the subjection degree value is U_{i,k} to i species ,the class result could be showed by a fuzzy subjection matrix U = {u_{i,k}} ∈ R^{c*n}:
FCM clustering was achieved by the aim function of minimizing subjection matix U and the clustering center V.

\[
J_m(U, V : X) = \sum_{i=1}^{n} \sum_{k=1}^{c} (u_{ik})^m \| x_i - v_k \|_d^2
\]

(2)

In the style: \( U = \{ u_{ik} \} \) was the subordination matrix which satisfied condition (1); \( V = \{ v_1, v_2, \ldots, v_c \} \) was the c clustering centers muster, \( 2 \leq c \leq n \); \( m \in [1, \infty) \) is the Fuzzy Weighting Exponent, when \( m=1 \), fuzzy clustering was deteriorated to hard \( c \) mean clustering. According as the authority’s research, the optimal range of \( m \) was within \([1.5, 2.5]\), as a rule \( m=2 \) was the better perfect value, the distance from the k stylebook to the center i species: \( \| x_k - v_i \|_d^2 = (x_k - v_i)^T A(x_k = v_i) \). \( A \) is the matrix of \( p \times p \) metapositive matrix. When \( A=1 \) it was Euclid distance, FCM executed stepped as follow:

1) Initialization clustering center: \( V = \{ v_1, v_2, \ldots, v_c \} \)

2) Calculating the subordination matrix:

\[
u_{ik} = \frac{1}{\sum_{j=1}^{c} \left( \| x_k - v_i \|_d \right)^{2/m-2}}
\]

(3)

3) updating clustering center:

\[
v_i = \frac{\sum_{k=1}^{n} (u_{ik})^m x_k}{\sum_{k=1}^{n} (u_{ik})^m}
\]

(4)

4) Repeating step 2 and 3 till formula 4 constringency.

Fuzzy color image segmentation based on characteristic divergence: The definition of characteristic divergence: cross-entropy, (namely directed-divergence) was a quantity to measure the difference of information between the 2 probability distributings: \( p = (p_1, p_2, \ldots, p_n) \) \( P = \{ p_1, p_2, \ldots, p_n \} \), \( Q = \{ q_1, q_2, \ldots, q_N \} \), the definition formula was as follow:

\[
D(P, Q) = \sum_{i=1}^{n} p_i \ln \frac{p_i}{q_i}
\]

(5)

Its symmetry form was intituled symmetry cross-entropy:

\[
D(P : Q) = \sum_{i=1}^{N} p_i \ln \frac{p_i}{q_i} + \sum_{i=1}^{N} q_i \ln \frac{q_i}{p_i}
\]

(6)

Directed-divergence could be regard as the information difference of 2 probability system, might be regard as the expectation value of single information system change when P replaced Q regarded as system probability distributing, in this time P is called posterior distribution, Q is called prior distribution. Directed-divergence is a kind of lower convex function, satisfying nonnegative and identity. The least zero value could be gained when P and Q was consistent entirety. Although we can’t estimate the correct probability distributing of some character value by only one or two images in the image edge detective, the eigenvector could be observed straight or gotten by calculating, for example, gray, grads and power chart and so on. Based on these definitions, characteristic divergences were definite.
Binary morphology principle: the first morphology was a branch of biology studying animals and plants, afterward, mathematics morphology was used to show image analyse tool based on its shape. The base idea of morphology was that using certainty form element measured and distilled corresponding shape, consequently obtained the purpose of analyzing and identifying image(Pinto and Montez and Araujo, 2014;Xing and Sun, 2015). Mathematics morphology might predigest image data and retain image basic shape characteristic, at the same time, got rid of outlying parts with research purpose in image. Watershed region segmentation was a sort of morphologic method of segmentation object touching each other in image (Kopparla and Natraj V and Spurr, 2016). Its basic course was that eroding image continuous.

Segmentation algorithm based on fuzzy clustering: Processing ways and segmentation algorithm of image were introduced in the preceding chapter, in the experimentation Matlab 7.10 was used to come true image processing and come true the separation with crops and backgrounds of image, the flow chart of color image segmentation algorithm provided in the text was shown as follows (Figure 1):

3. RESULTS AND ANALYSIS

It was shown from original image that the image had a comparatively complex background, if we wanted to separate the crop (cucumber plant) from image, four parts were eliminated at least: white wall, floor board, chessboard and flowerpot. Based on the flow chart provided by the text, the first original image (Figure 2) was changed to gray image (Figure 3), then gray histogram was given. According to the gray histogram (Figure 4), four regions could be chosen, and used 70,137 and 225 three troughs to segment, what's more, fuzzy clustering number could be confirmed, the value was 4. According to the fuzzy clustering number, the following four breadths segmented gray image(Figure5-8) were given by dint of watershed beforehand segmentation. Their segmentation value in turn was less than 70, bigger than 70 and less than 137, bigger than137 and less than 225,bigger than 225.Finally we got the end watershed beforehand segmentation image (Figure 9),from Figure 9 the yawp could be seen, we gave a median filter to Figure 9 and got Figure 10. The next, the image was given fuzzy processing, extracted character gray mean, and then eroded, dilated and growing was given continuum by dint of morphologic, In the end, the crop was separated from the background that had the same gray as crop, the last segmentation image was gotten,(namely Figureure11).It was shown from Figure 11 that the segmentation quality was better, the segmentation way was efficient and

**Figure 1.** The flow chart of color image segmentation based on fuzzy
feasible.

**Figure 2.** Original color image

**Figure 3.** Image of gray degree

**Figure 4.** Gray-level histogram

**Figure 5.** Image of the first segmentation

**Figure 6.** Image of the second segmentation

**Figure 7.** Image of the third segmentation

**Figure 8.** Image of the fourth segmentation
4. CONCLUSIONS

The text provided the photograph that was a complicated background, a better segmentation result was given from the end segmentation photograph. Nowadays, color photographs were widely applied in our lives, it has been the focus extracting some interested parts of the color photographs, the region eigenvector , extracted using watershed algorithm, debased operation data quantity(Daliri,2012). The results validated that it was efficient and feasible that the way of segmentation color image by dint of fuzzy theory and morphologic theory.

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REFERENCES


