# Image Compared by Election Campaign Algorithm

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**Abstract.** Usually CBIR (Content-based image retrieval) is an image retrieval method that exploits the feature of the image as the retrieval index, which is based upon the content, including colors, textures, shapes and distributions of objects in the image. After the feature detecting, the composition of the similarity matching image set is found, then detecting the most matching image still need to be process in the higher level analysis and retrieval. It is a difficult and slow process. So, if we take an opposite approach, detecting the not-match image from the similarity matching image set but comparing all the images in the set, it can be more easily to achieve. In this paper, we propose an new image comparison method base on Election Campaign Algorithm, which provide parallel and fast optimum feature detecting, to detect the not-match images from the similarity matching image set, then another method would be use to find the most-match images. With this method, the image comparison process is fast, the size-reduce image set is quickly to be received.

## Introduction

In recent years, with the rapid development of multimedia technology and network technology, more and more rich image resources, text based image retrieval method for text annotation of the subjectivity and complexity of tradition, has been unable to meet Retrieval needs, in this case, image Retrieval Content-Based (content based image retrieval (CBIR) technology came into being. The basic idea of content-based image retrieval technology is: firstly, image content analysis, automatically or semi automatically extracted from the shape, color and texture features, and then use a similar function to calculate the similarity between the features or evaluation metrics, and finally the most similar image as the search results returned to the user. Stone slab is directly cut from the natural rock blocks. It has the irregular profile and various surface defects, such as the gall stone, holes, cracks and other defects [1]. It is difficult to get the best utilization rate of cutting and nesting stone slab, artificial realization is usually the solution of this problem [2, 3]. Digital image processing technology provides a technical support to determine such as the minimum external rectangle and maximum inscribed rectangle parallel to the coordinate axes [4]. Detecting maximum inscribed rectangle on irregularly shaped is not a tradition image processing method. Also, the optimal layout and cutting of rectangular stone is feasible method to increase utilization rate of a rectangular material [5]. Get the maximum inscribed rectangle on irregularly shaped and then process the optimal layout and cutting will be the better utilization rate solution for natural stone production plant [6].

In image retrieval, the content of the image is reflected by the characteristic of the image. Image features are divided into two categories, namely, low-level visual features and high-level semantic features. In these two kinds of features, although the semantic feature based retrieval [7].

Compared with the requirements of the use, but due to the current level of development of computer vision and image understanding, and also related to psychology, biological vision and other disciplines, which makes the search for this way is also difficult to achieve. So the research focus of content-based image retrieval is mainly focused on the low level visual features.

In the retrieval based on low-level visual features, color features and description of an image is the most simple and effective features, it not only has rotation invariance and scale invariance, and easier access than other characteristics, so this paper mainly discusses the color feature of the image retrieval based on cable. Include the following aspects: the choice of color space, color quantization, color feature extraction and color similarity measure.

 

In this paper, we use grey scale feature and position relation to detect the similarity of the comparing images. The author uses the election campaign algorithm to find out the grey scale feature of random position and the position relation of them [8]. As an optimization process, the similarity of the images could be detected and the dissimilar images could be easily find out. Between the retrieval based on low-level and high-level visual features, this process exclude the dissimilar images and reduce the quantity of the images to be detected. The next step, more precise high-level retrieval detecting is involved to get the most similar images.

## Grey Scale Feature of Images

Detecting of gray scale feature is not sensitive to the deformation and rotation of the target position in the image, and has good stability [9].

Set the image grey scale level is *L (0 ~ l)*, the general *l* is 255. In order to speed up the computing and improve the real-time performance, the grey scale level is mapped to *m* level, such as *m=8*, which is divided into 8 levels. So, the grey scale level of point is calculated by the Eq. 1.

$$G(r,c)=|x*m/l| \tag{1}$$

Corresponding, assuming that the grey scale level of surrounding points at the center point P(r,c), the objective function can be expressed as S(r,c), the sum of levels of points. As is show in Eq. 2.

$$S(r,c)=\underset{i=1,2,\cdots,n}{sum}(|x_i*m/l|) \tag{2}$$

So, the target localization problem in the process of comparing is transformed into the problem of the candidate target region which is the minimum value. When P(r,c)=S(r,c)-I(r,c) is close to 0, said the target and candidate regions are more similar; when P(r,c)>R, R is the evaluation criterion and in this paper we set R=n/2, n is the number of comparing points, said the target and candidate region are dissimilar.

Fig. 1 shows the model of target and candidate regions, point (1, 2, 3, 4, 6, 7, 8, 9) is the points surrounding point 5, all together the sum of 9 points gray scale level, such as Eq. 3, is used as the evaluation criterion of the center point.

$$S(r,c)=\underset{i=1,2,\cdots,9}{sum}(|x_i*m/l|) \tag{3}$$

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

Figure 1. Surrounding Points of Point 5

After the criterion calculation of center points, the relation of center points is used as the fitness function of the optimization algorithm. Fig. 2 shows the relation model of center points. The numerical center of gravity of all the center points in target image can be found as the solid dot, hollow dots are center points. The relative position relation in target image is used when the same relation is detecting in the candidate image.

 

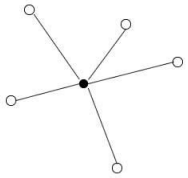

Figure 2. Comparing Model of Center Points

**Election Campaign Algorithm**

Election campaign algorithm (ECA) is a new optimization algorithm simulating election process [10]. Election candidates always pursue the maximum support from voters by means of various election behaviors. They get the overview of their support from the voters according to the sample survey, and then decide what to do on the next move. Solution space is imagined as voters and current solutions are imagined as candidates in ECA. The function value of a feasible solution is named as the prestige of a voter and the function value of a current solution is named as the prestige of a candidate.

In ECA, the candidates influence the voters round them, the voter's support is in proportion to the distance between the candidates and the voters. The voter will vote to the candidate which he pefer the most. The sum of location coordinates of every voters supported the candidate powered by its contribution is a new location coordinates, which is named support focus, it is the next position of the candidate. Such computational cycle is done continually until a candidate finds the position of the highest support, which is the global solution of the optimization problems.

Framework of the election campaign algorithm is described as the follows:

**Set the Algorithm Parameters.** Main parameters of Election campaign algorithm are:

- The number of candidates.
- The number of voters.
- The number of floating voters.
- Target accuracy.

**Generate the Candidates and Calculate the Prestige of Them.** Generated the define number of candidates in feasible solution field on the uniform distribution. Use the objective function to calculate the prestige of each candidate.

**Generate the Voters.** The uniform distribution is employed to generate the voters in feasible solution field.

**Compute the Investigate Mean Square of Candidates.** Higher prestige of a candidate, smaller the mean square deviation of local voters, so that ECA is able to converge to local optimization solution rapidly and steadily. The following formula is used to describe the relation of the prestige and the mean square deviation of a candidate.

$$\sigma_{C_i} = \frac{(P_{Max} - P_{C_i})}{(P_{Max} - P_{Min})} \tag{4}$$

Where $\sigma_{C_i}$ represents the mean square deviation of candidate $C_i$; $P_{Max}$ and $P_{Min}$ are the maximum and minimum prestige of candidates.

Next step, voters are generated around each candidate on the normal distribution.

$$N_{C_i} = \frac{(P_{Max} - P_{C_i})}{(P_{Max} - P_{Min})}(N_V - N_{FV}) \tag{5}$$

$N_{C_i}$ is the voter number of candidate $C_i$, $N_V$ is the number of all voters, $N_{FV}$ is the number of floating voters. Floating voters are generated on the uniform distribution. Here, it is supposed that candidate's effect on voters declined linearly.

 

**Calculate the Supported of the Voters.** Candidates can influence the voters within their effect range, the effect on voter $V_j$ from candidate $C_i$ is

$$F_{C_iV_j} = \frac{D_{C_iMax} - D_{C_iV_j}}{D_{C_iMax}} P_{C_i} \tag{6}$$

$F_{C_iV_j}$ is the effect on voter $V_j$ form candidate $C_i$, $V_j$ is the global or local voter. Here, it is supposed that candidate's effect on voters declined linearly.

Then Compute the prestige of voters by means of objective function.

The support of a voter is proportional to his prestige, and then the proportional constant will be reduced, so the prestige of a voter can used to denote the support of a voter directly. A voter may be influenced by several candidates; the voter should distribute his support to candidates proportionally on the magnitude of effect from candidate to voter. The support from voter $V_j$ to candidate $C_i$ is

$$S_{C_iV_j} = \frac{F_{C_iV_j}}{\sum_{i=1}^{m} \max(F_{C_1V_j}, F_{C_2V_j}, \cdots, F_{C_iV_j}, \cdots F_{C_mV_j})} P_{V_j} \tag{7}$$

$S_{C_iV_j}$ represents the support from the voter $V_j$ to candidate $C_i$.

**Find the Support Focus of Candidates.** A new position coordinate will achieve by means of summing the products of the support from the voters to the candidate and the position coordinate of the voters. It is named the support focus.

$$x^*_{C_i} = \frac{\sum_{j=1}^{n} S_{C_iV_j} x_{V_j}}{\sum_{j=1}^{n} \max(S_{C_iV_1}, S_{C_iV_2}, \cdots, S_{C_iV_j}, \cdots S_{C_iV_n})} \tag{8}$$

$x^*_{C_i}$ is the support focus of the candidate $C_i$. The support focus of a candidate is obtained by investigating, which depends on those voters whose distances to the candidate are nearer and the prestige is higher relatively. The next post of the candidate should be the support focus, where the candidate will have the higher support.

**Calculate the Prestige of the Candidates and Compare the Prestige of the Voters with the Candidates.** In order to jump out of local optimization solution and increase search rate, the prestige of candidates are compared to that of voters, if the prestige of a voter is higher than that of a candidate, the voter with higher prestige will substitute for the candidate and the that candidate of lower prestige will be eliminated in election.

**Check Whether the Condition is Reach.** Check whether the condition is reach, otherwise return to step B to execute the period. Here, the condition could be the relative position relation in target image. Do that circularly until the highest support is not change.

$$|\underset{i=1,2,\cdots,9}{sum} S_c(r_i^r, c_i^r) - \underset{i=1,2,\cdots,9}{sum} S_t(r_i, c_i)| > R \tag{9}$$

$S_c$ represents the position relation of candidate image, $S_t$ represents the position relation of target image. Center points of candidate image $P_r(r_i,c_i)$ and points of target image $P(r_i,c_i)$ have the same relative position relation with the numerical center of gravity. Random position is set as the numerical center of gravity in the candidate image as voters in ECA and the support focus in the previous ECA

 

cycle is position to detect more similar position. If the highest support is not change, the computation stop. When ECA stop, the candidate image is dissimilar if Eq. 9 is workable.

## Experiment and Result

In image set of Fig. 3, the first image is the target image, others is the candidate images.

Figure 3. Image Set for Comparing

The relative position relation in target image is easily found and random points surrounding are set to build the relation. Using Election campaign algorithm, the number of candidates define as 5, the number of voters is 10, the number of floating voters is 5, and the target accuracy is set as 2.5. The experiment get the number 5 image is left for the next step of comparing in every times.

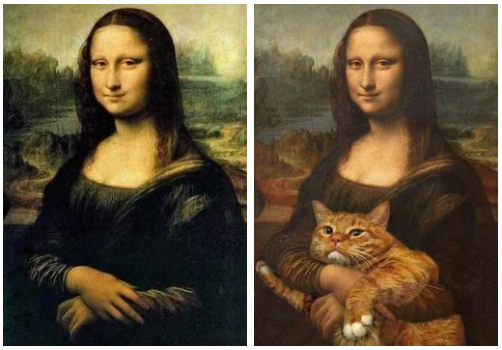

Figure 4. Results of ECA Image Comparing

## Conclusions

With the method of comparing the relation of gray scale feature levels, the dissimilar images of image set can be detected. Between low-level and high-level retrieval detecting, Election campaign algorithm optimization program detect the dissimilar images, the number of similar images can be reduce and the amount of calculation is very small. Election campaign algorithm has the advantages of parallel computing and good performance to avoid the solution trapped in local optima. This is suitable method to find the relation between two set of numerical value. For future work, another feature and different comparing function will be used in the detecting of relation of features.

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