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An Algorithm to acquire the reaction area of skin allergy images

In Soo Kim,Myong Gu Lee,Mignon Park,Sang Bae Lee

Department of Electronic Engineering,
Yonsei University,
134 Shinchon-dong,Sudaemun-gu,Seoul,Korea

Abstract

Generally, we can't acquire clear boundary or area from an image having obscure boundary like allergy image by using Sobel or Lapalace operator. Also, when the image not uniform in some part of a image in brightness, there are difficulties to use the global operator such as histogram, for the contour line doesn't have the same grey level. In this paper, we will propose an algorithm to improve those difficulties.

The main idea of the algorithm is that we divide the image into many rectangular parts like a chess board, calculate the average of each part, and decide the local threshold for each pixel on the calculated value.

In experiment, we can get the contour and area by this algorithm which is much like to the contour and area measured by a doctor. Also, This algorithm has many advantages such as short processing time and little influences of noises and can be used in the robot vision, etc..

1. Introduction

The most popular allergy test method in these days is the skin allergy test method. This is the method which decides the contour of the reaction part by the sense of sight. Then, the grade of allergy is given by the lengths of two diameters which are perpendicular to each other, or area of the reaction part. Up to now, a doctor draw the contour in a tracing paper and then calculate the area by using grid paper.

In this paper, we proposed the algorithms for these procedure, which decide the reaction part and calculate the area automatically.

In many case, it is difficult to get the boundary of allergy reaction part because of the ambiguity. So, we use the histogram as in Fig.1-1 when determine the grey level of boundary. However, when the brightness of the image is maldistributed, this method makes wrong results. Therefore, this histogram method can be employed only when the acquired image is well-distributed in brightness.

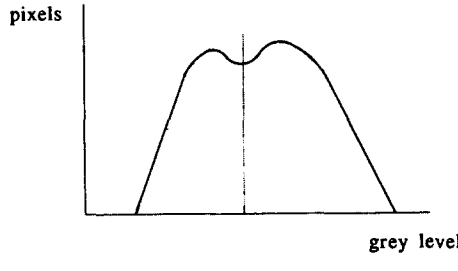


Fig. 1-1 Determination of a thresholding level for bimodal image

Since the original images of Fig.1-2 is lighted partially, the thresholding results of the image have

(a) (b) (c)

Fig. 1-2 Thresholding results of the allergy image

unresonable shapes.

So, we propose two algorithms that can be applied to those maldistributed images. The first algorithm is to determine the reaction part according to the local state of image, and the second is to calculate the reaction area.

2. Algorithm for determining the reaction part.

The algorithm is as follows. It can determine the reaction part regardless of the maldistributed allergy image in brightness.

(1) preprocess the image
(2) divide the image according to the size of image and the ratio of the image
(3) calculate the total average, block average and maximum and minimum value of the block average
(4) block extension for boundary block processing
(5) process each block according to the local state
(6) noise elimination
(7) calculate the area of reaction part

During preprocess, we use histogram equalization and average filtering. Processing each block in step (5) is as follows.

① decide the reaction part by using total average

```
if pixel_grey > total_average * A
then background part

if pixel_grey < total_average * B
then reaction part
```

② decide the reaction part when the block_average is similar to the near_block_average.

```
if (block_average - near_block_average) <
(max_block_average - min_block_average) * C

then  if pixel_grey > near_block_average
        then background part
        else reaction part
```

③ decide the reaction part by using near_block_average

```
if (near_block_average > block_average)

then if pixel_grey > block_average
+ (near_block_average - block_average) * D
     then background part
     else reaction part
```

④ decide the reaction part by using near_block_average

```
if (near_block_average < block_average)

then if pixel_grey > block_average
- (near_block_average - block_average) * E
     then background part
     else reaction part
```

Through this algorithm, we can obtain the contour line of reacton part which is similar to the draw line of a doctor. Also, this algorithm can be used to process maldistributed image.

We determine the values A, B, C, D and E through many experiments. But, we must research for automatic and adaptive method which reflected the characteristics of each image.

3. Algorithm for calculating the reaction area

The resulting image obtained by previous algorithm include cluster type of noise. Regardless of those noise clusters, we can calculate the area of reaction part by *raster scan clustering algorithm*. This algorithm is as follows.

(1) calculate each cluster size by using raster scan clustering algorithm
(2) determine the reaction part with the first of dark cluster and the second of white cluster.

In step (1), raster scan clustering method is as follows.

To begin with, we define the type of cluster variable and line state variable. Cluster variable consists of size variable and color variable, and line state variable consists of several variables which are cluster number variable, color variable, start position variable, and end position variable.

① initialize the cluster variable with first line state, and set upper_line with this.
② set lower_line with second line state.
③ set cluster number of lower_line by the comparing lower_line to upper_line
④ if a cluster join with other cluster in lower_line and has different cluster number, put together these two clusters
⑤ if a cluster number cannot determine for a part of lower_line in comparing to upper_line, create a new cluster
⑥ transfer the information of lower_line to upper_line variable, and read next line of image for lower_line variable
⑦ repeat from the step (3) to the step (6), till end line of the image

By using this algorithm, we can get the area of reaction part. And, it takes very short time for this processing.

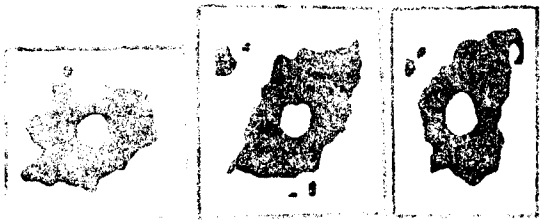
4. Experiments and Results

In experiment, we use three images of Fig. 4-1. Among these image, two images have maldistributed in brightness.

(a) (b) (c)

Fig. 4-1 Skin allergy test image

We can get the reaction part by using the algorithm. As shown in Fig. 4-2, the shapes of results are much alike to the shapes by the sense of sight.



(a) (b) (c)

Fig. 4-2 Processed image of reaction part

And, the reaction area can be calculated by the algorithm. This results is the Table 4-1.

(pixels)

	first of dark part	second of white part	reaction area
(a)	5,597	457	6,054
(b)	7,553	444	7,997
(c)	6,154	547	6,701

Table 4-1 The reaction area

5. Conclusions

In this paper, we proposed the new algorithms to decide the reaction part of skin allergy image, and to calcluate the area of reaction part quickly.

We can get the shape of the reaction part which is similar to that of a doctor. Also, the area is calculated fast by using this algorithm.

The proposed algorithm can be applied to the robot vision and pattern recognition system.

However, there is no reference to verify the accuricy of the proposed algorithm except by a doctor. So, It is essential to find a criteria to develop the proposed algorithm.

Some methods to enhance the proposed algorithm is as follows.

(1) The chracteristic of the total histogram may be used to decide the value of A and B in the proposed algorithm.

(2) The adaptive method to decide the value of C, D and E in the proposed algorithm is to be developed.

(3) The proposed algorithm must be improved not only in grey levels but also in color levels so that the algorithm is adapted.

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