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Environmental Greening And Tree Health Maintenance Based on Color Histogram

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Abstract. Due to man-made damage, plant diseases and insect pests, environmental greening, ecological environment and other reasons, ancient and famous trees have been severely damaged. The protection of ancient trees requires diagnosis of their health and biological and chemical treatment measures. Aiming at the inconvenience, high cost and low degree of automation of manual methods for health diagnosis of ancient trees, the solution and overall architecture of a tree health diagnosis system based on OpenCV and genetic algorithm are analyzed and designed. Firstly, the leaf image mode is trained, and the color histogram is used to distinguish the leaf density and color difference between different individuals, and the fitting index is used to obtain more accurate diagnostic classification standards. Then, the matching value is calculated by genetic algorithm training through the H average value in HSVHSV and the H average value of healthy ancient trees in the histogram to obtain the matching grade. Then, the tree image is read, artificial segmentation is carried out to obtain the quasi-healthy crown score, weighted summation is carried out to obtain the leaf score, and the health grade is separated according to the ratio. Finally, the two are weighted to obtain the final health grade. The experimental results show that the system can accurately and effectively distinguish different leaf health grades according to the difference of leaf color and density, and provide quantitative data for health diagnosis research of ancient and famous trees.

1. Introduction

Ancient trees have rich cultural and ecological values and are non-renewable. However, due to a variety of reasons, ancient trees in our country have been seriously damaged, and the protection of ancient trees is extremely urgent. Diagnosing the health of ancient trees is an indispensable link in the measures to protect ancient trees.

The study of ancient and famous trees has already had a tree health evaluation system for different tree species [1,2]. The tree health evaluation system mainly evaluates the health status of ancient trees



through tree shape, leaf color, crown and other indicators, and also evaluates the tree health level through electrical indicators from a biological perspective [3]. Appearance inspection and evaluation can better reflect the growth status of trees. Previous people often judge the growth potential of trees according to the tree shape, tree height, dry weight, leaf/branch ratio, new shoot growth, leaf color, leaf area size and other morphological or appearance conditions. The growth position of trees, trunk, crown damage, diseases and insect pests, etc. are also items to be considered in checking the health status of trees [4]. In a series of evaluation indexes of the tree health evaluation system, the appearance evaluation index is used to predict the tree health grade, which has more qualitative components and less quantitative data, and cannot provide data basis for research. At the same time, the evaluator needs to have certain experience and the evaluation is relatively subjective. Bioelectrical indicators are more accurate and objective in assessing the health grade of trees, but the implementation methods are complicated and labor costs are high, which is suitable for diagnosis of diseased trees and not for prediction and assessment of the health of ancient trees [5]. At present, the acquisition of tree evaluation information basically adopts manual collection methods such as on-the-spot investigation, sample collection, etc. There are many problems such as repetitive and tedious work, lack of data, unable to trace back, etc.

The research on the health status of ancient and famous trees requires a high degree of detail. For example, Chen Junqi [6] evaluated the health of ancient and famous trees in Beijing by selecting the degree of trunk damage, the inclination of trunk, the proportion of withered and broken branches, the growth of new branches, the dense degree of leaves, the proportion of green loss, the proportion of abnormal fallen leaves and the degree of bare roots as morphological evaluation indexes through analytic hierarchy process. Gao Yang [7] proposed a tree modeling method based on parameter L and using mapping technology to draw banyan leaves to model southern lobular banyan trees, which achieved good results, but ignored the diversity of leaf morphology and could not be applied to other trees. There are also people who use digital image engineering technology to diagnose the health of ancient and famous trees. For example, metcalf jv [8] uses an improved Robust matting algorithm to extract tree images, and calculates the green loss ratio in combination with the range of three green components to evaluate the growth status and health grade of ancient and famous trees. However, the evaluation of ancient trees based on the proportion of green loss only extracted green characteristic values, and did not consider the seasonal changes of yellow tree species such as ginkgo and leaf color. In order to obtain higher 3D reconstruction accuracy, Cao Shuai [9] proposed an image-based tree 3D point cloud reconstruction scheme in 2016 and obtained higher reconstruction accuracy and better modeling efficiency, but it showed certain limitations when applied to higher trees.

Since the end of the 21st century, computer vision technology has developed and matured under the constant exploration of scientists in different fields. Because of its fast speed and high accuracy, it is widely used in life. The image processing branch of computer technology has developed rapidly, and its methods have formed a complete system. There are many mature methods and classical theories [10] and many new methods have emerged in the processes of preprocessing, feature extraction, detection and segmentation, and image recognition. For example, Yang Yinhui of Zhejiang University [11] proposed a variable fraction inverse modeling algorithm and an efficient optimization algorithm combining tree branch structure characteristics on the basis of inverse modeling. Its computational efficiency is one to two orders of magnitude higher than that of previous algorithms, but it still has much room for improvement in establishing a more realistic number. Chen Yutuo et al. [12] proposed a trunk method based on a small number of characteristic parameters and variable control to construct arbitrary deformation and smooth connection, and a leaf fine intelligent rendering and simple expression simulation method based on leaf image processing. The modeling speed, authenticity, flexibility and interactivity of the tree model have been improved, but how to effectively integrate with the tree and stand growth modeling still needs further research.

2. A brief introduction to the algorithm

2.1. Based on RGB color space discrimination

RGB is designed based on the principle of color luminescence. In popular terms, its color mixing method is like red, green and blue Three Lamps District. When their lights overlap with each other, the colors are mixed, while the brightness is equal to the sum of the brightness of the two. The higher the mixing brightness, the more additive mixing is.

In RGB three-color space, the pixel value range of the green object is in the pseudo-triangular pyramid (the bottom surface of the cone may be a curved surface) body with G point as the vertex (as shown in Figure 1). Vertex G (0,255,0) is pure green. According to the principle of color gradient, it can be inferred that the points in the space below point G may be light green, gray green, etc. Therefore, it can be assumed that there is a relationship in the pixel value range of the green object surface.

In the above-mentioned conditions, each pixel point includes RGB three channels, and the pixel points of the green channel larger than the other two channels (blue channel, red channel) are summed here.

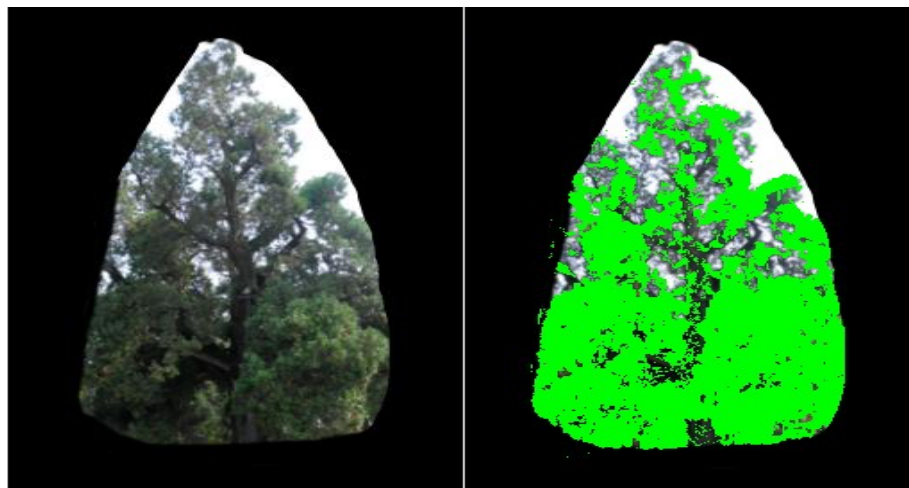


Figure 1. RGB to Green Comparison of Healthy Trees

As shown in fig. 1, 80% of the leaf colors on the image meet the discrimination conditions, while 20% of the leaf colors (black ash and dark green) still do not meet the above conditions. Because RGB is designed to meet the characteristics of screen display, color discrimination does not meet the standards of human eyes for color discrimination, and cannot be separated from three channels to distinguish colors. After comparing other color models, we select HSV's color model to distinguish colors

2.2. Discrimination Based on HSV Color Space

HSV is a relatively intuitive color model, so it is widely used in many image editing tools. HSV is used instead of RGB color model

Because RGB is an additive primary color model, which defines colors in the way of primary color combination, while HSV is similar to the way human senses colors, has strong perception, and encapsulates information about colors in a way more familiar to human beings; HSV is a relatively intuitive color model. The parameters of color in this model are: hue (H, Hue), saturation (S, Saturation), lightness (V, Value). Hue is the basic attribute of color, that is, color name, such as red, yellow, etc. Saturation refers to the purity of the color. The higher the color, the purer the color, and the lower the color, the gray will gradually change, taking a value of 0-100%. HSVHSVRGBRGBHSVHSV



Figure 2. Green Contrast Map of HSV Judgement for Healthy Trees

As shown in fig. 2, this is an image of a grade 2 healthy cypress with normal light and obviously green leaves. HSV color space is used to find the green range of leaves.

With a single formula, it is not possible to distinguish all leaf colors (green, dark green, yellow). In order to accurately distinguish the colors of leaves, various colors are counted separately, and pixel points belonging to a certain color are counted. We use color histogram to make further accurate judgment.

2.3. Realization of Color Histogram Based on Mean Value

The histogram aggregates colors into several regions (designated as 16 here) according to H channel (hue channel) of HSV color space, traverses each pixel point, sums the colors in the same region to take the average value, and sets it as the color of the designated bar, which is displayed in the figure.

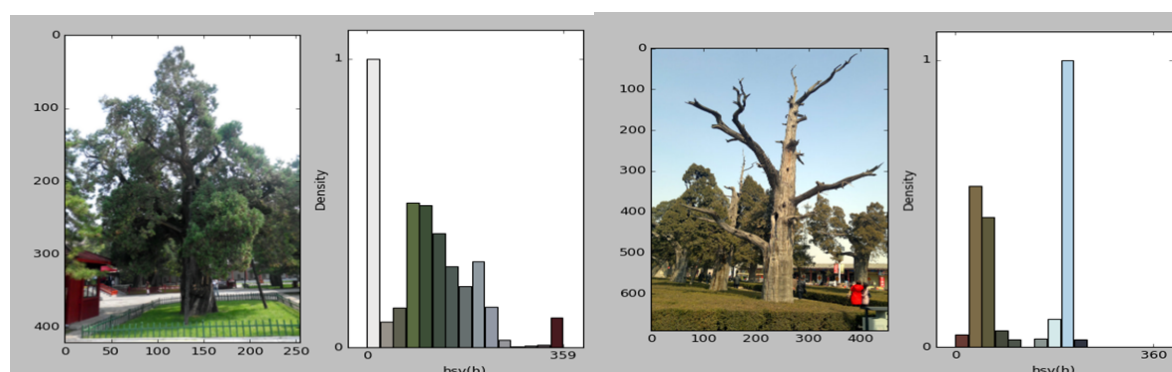


Figure 3. Percentage of H-value Region in Histogram of Different Types of Trees

As shown in fig. 3-7, the right picture is changed into a color histogram that is more in line with the human eye recognition effect (at the expense of some accuracy). the abscissa is still the h channel of HSV color space, because the range of h channel (0-180) is smaller than that of s channel (0-255) and v

channel (0-255). in OpenCV, in order to improve the accuracy, twice the range (0-360) is used as the reference. Compared with the color histogram map implemented by OpenCV, in Figure A, the color with more pixel points is green, while in Figure B, the color with more pixel points is green and blue of the sky.

2.4. Matching Grading Based on Genetic Algorithm and Leaf pixel fraction

Genetic algorithm (GA) is a random search method that draws lessons from the evolution law of survival of the fittest and survival of the fittest in biology.

We exclude those parts that do not belong to green (such as the sky color that accounts for more), select the mean value of H-green part in the histogram as array I, input the H-mean value that has been determined to be a healthy old tree as array M, and define the similarity measurement between the input color feature I_k and the template healthy old tree $M_k=D_k$ as distance function G, and the matching degree can be obtained

$$F = [\sum_{k=1}^n G(I_k, D_k)]/n \quad (1)$$

where F is the matching degree. when it is less than 30%, it is judged as grade 4, when it is more than 30% but less than 50%, it is judged as grade 3, when it is more than 50% but less than 80%, it is judged as grade 2, and the last item is judged as grade 1

The tree image health diagnosis process is divided into three steps, and the leaf pixel score, ratio and health grade are obtained in turn.

A. leaf pixel score score

The number of pixels x_i for each color sets the weight w_i by specifying the health level represented by each color, and the formula is as follows:

$$\text{score} = \sum_{i=0}^n x_i w_i \quad (2)$$

B. ratio

The number of healthy crown pixels Crown is the rectangular area $h*w$ - polygon outer circle area se , and the formula is as follows:

$$\text{ratio} = \text{score} / (h*w - se) \quad (3)$$

C. ratio compartmentalization n

Set the number of grades to n and the maximum value of the ratio to 1. The formula is as follows:

$$\text{rank} = n - \text{ratio} / (1/n) \quad (4)$$

Make a specific weight of the two and output the final grade.

3. Result

(1) Classified Leaves image patterns Training

In order to distinguish the leaf colors of different health grades, leaf samples of different colors were collected from the original growing areas of Xuanyuanbai and *Platycladus orientalis*, and the approximate range of the proportion of different leaf colors in leaves of different health grades was identified through color histogram training. When taking pictures in the experiment, it is ensured that the pictures are taken indoors, thus reducing external interference (different sunlight and shade, wind degree, etc.), ensuring that the data are valid, and comparing the data has great reference value. The leaf color is divided into three parts: yellow leaf color, healthy leaf color and dead leaf color. The color range

ratio of each leaf color is found according to the color histogram. In order to aggregate the errors caused by some natural factors on leaf statistics, the color histogram is divided into 16 segments instead of 360 values of H channel in HSV.

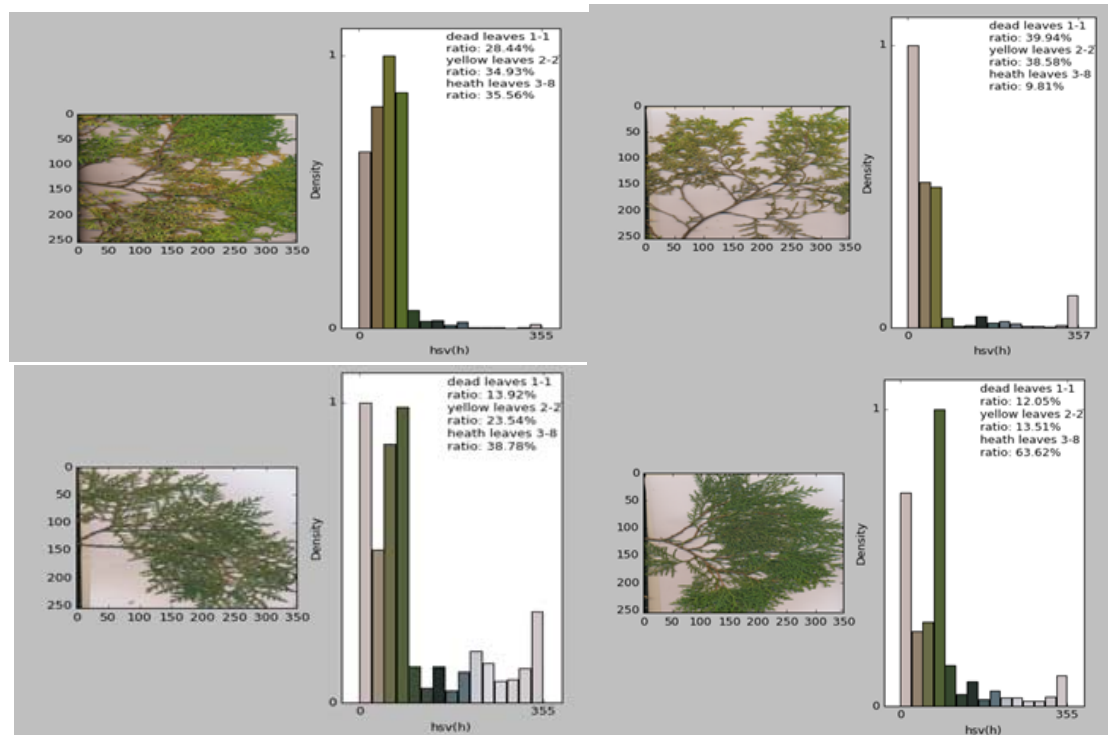


Figure 4. (a) (b) (c) (d) Histogram of Different Types of Healthy

Trees As shown in fig. 4 (a) this is a green and yellow image of *Platycladus orientalis* leaves. In the color histogram on the right, the color bars 0 and 15 belong to the background color and are not included in the leaf color range. The first color bar is brown, which is the color of dead leaves and branches. The second color bar is green and yellow (due to the relatively close distance between yellow and part of green in H channel of HSV color space, the two colors converge), which includes yellow leaves and part of green leaves. The third color bar to the eighth color bar are the color of green leaves and the color of overlapping shadows of leaves. The text description in the upper right corner is the basis for training. 1 color bar is set to dead leaves, 2 color bars is set to yellow leaves, and 3 to 8 color bars are set to healthy green leaves.

In the figure, the proportion of dead leaves is 28.44%, that of yellowed leaves is 34.93%, and that of healthy leaves is 35.56%. The ratio of the three is close to 1:1:1.

As shown in fig. 4 (b) this is an image of yellowed *Platycladus orientalis* leaves. The color division standard is the same as Figure 3-8. In the figure, dead leaves account for 39.94%, yellowed leaves account for 38.58%, and healthy leaves account for 9.81%. The ratio of the three is close to 4:4:1.

As shown in fig. 4 (c) this is a healthy and green image of *Platycladus orientalis* leaves. The color division range standard is the same as in the figure above. In the figure, dead leaves account for 13.92%, yellowed leaves account for 23.54%, and healthy leaves account for 38.78%. The ratio of the three is close to 1:2:4.

As shown in fig. 4 (d) this is a healthy and green image of *Platycladus orientalis* leaves. The color division range standard is the same as the figure above. In the figure, dead leaves account for 12.05%, yellowed leaves account for 13.51%, healthy leaves account for 63.62%, and the ratio of the three is close to 1:1:6.

(2) Judge disease grade

The tree image health diagnosis process is divided into three steps, and the leaf pixel score, ratio and health grade are obtained in turn. The following table shows the experimental data and grade distribution

Table 1. score and radio

Numbler	Dead leaves	Yellowing leaves	Healthy leaves	Rank	Matched-degree
1	4	4	1	4	2
2	7	2	1	5	2
3	2	6	6	2	3
4	4	4	2	3	3
5	5	1	2	4	2
6	2	4	7	1	2
7	6	6	2	4	2
8	1	1	8	1	2

4. Conclusion

We will convert RGBRGB to HSVHSV for the input of the histogram, and then use the output of the histogram to turn green as the input of the genetic algorithm, and the training is matched. Finally, the histogram is used to calculate the health grade, matching grade and health grade, and finally the final health grade of ancient trees is determined. The method is novel, can well evaluate the health degree of ancient trees, further protect ancient trees, solves the problems of inconvenience and low automation of the existing artificial method, and further completes the big task of protecting the environment.

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