Effect of light intensity on Epinephelus malabaricus's image processing

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Abstract. This paper briefly introduced the experimental environment of Epinephelus malabaricus's image acquisition, brief description of the simulation Setting of the three kinds of light intensities , aslo introduced the steps to acquisition images by Matlab . Described in detail about the methods of how to use RGB Image Analysis, The Histogram Equalization, Gaussian Filtering, Medium Filtering, Image Thresholding Segmentation to process images which obtained under different light intensities. Finally, the results were analyzed and discussed. The results shown as follows: Using gaussian filtering and median filtering to restore a image, Light intensity had little influence on the results of image processing. Using RGB Image Analysis, The Histogram Equalization, Image Thresholding Segmentation to process a image, Light intensity had different influence on the results of the image processing.

Introduction

Image is the main source for human to obtain and exchange information[1], The image processing results directly affect people's understanding of image. Epinephelus malabaricus's delicious meat and strong adaptability to environment making it became an important object of mariculture off the southeast coast of China[2], Monitoring it's behavior can effectively enhance the survival rate of fish and promote the development of aquaculture. image acquisition and processing is an important part of understanding and analysis fish's behavior. The main factors affects Epinephelus malabaricus's image processing results are: the image acquisition devices, the light and angle when acquisitioning a image, image processing methods and so on. Light intensity on the results of the Epinephelus malabaricus's image processing was issued in this paper.

Experimental Environment and Image Acquisition

The experimental environment. The experimental environment including: 1. The circulating water aquaculture system, as shown in figure 1 (A). The system is divided into three layers: the first layer for cleaning water, the second layer for aquaculture, the third layer is a filter layer, and the breeding layer's back , left and right sides were covered by a blue film; 2. HD wide-angle USB camera, as shown in figure 1 (B); 3. lighting equipment, as shown in Figure 1 (C). The aquarium lamp voltage frequency is 50 Hz, it has two light tubes and each power of the tube is 30W. The aquarium lamp has two gears, one light opened by the first gear and both lights opened by the second gear.

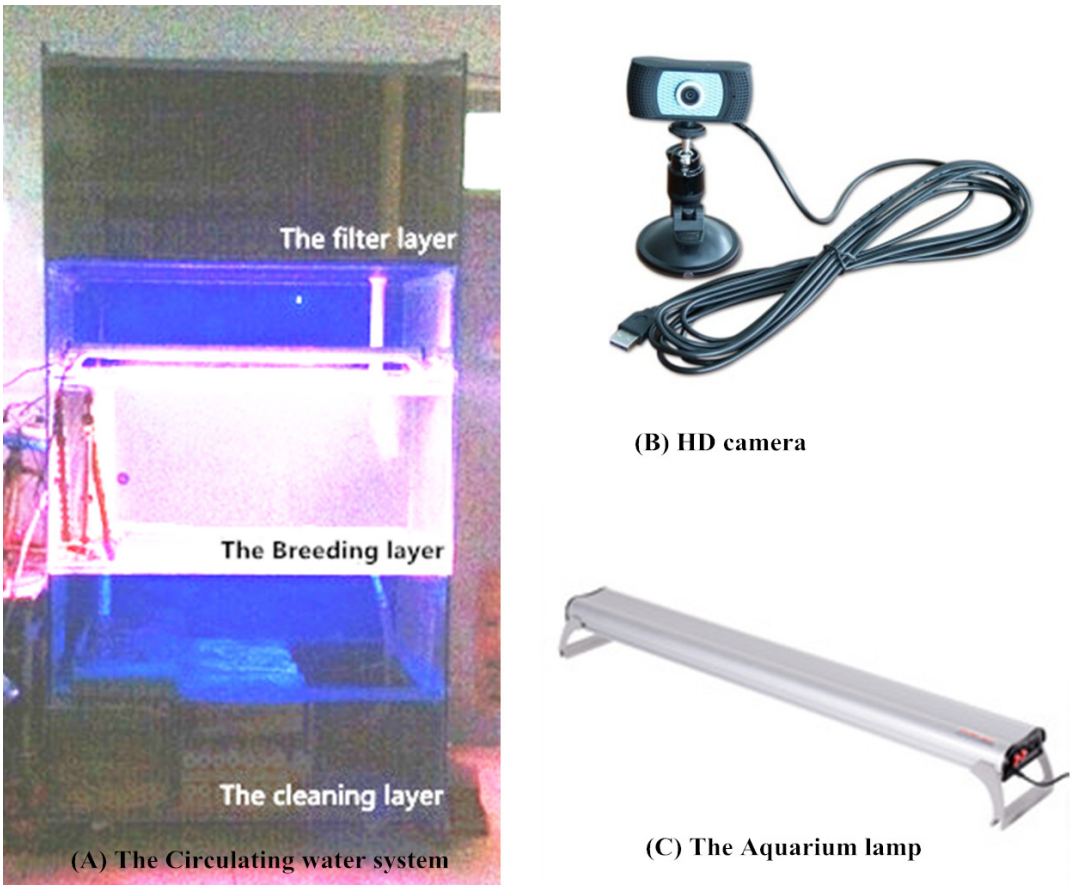

Fig.1 the experimental environment and image acquisition

Image Acquisition. This experiment set the natural light, aquarium lamp's fisrt gear light, aquarium lamp's second gear light as the image acquisition conditions. The Corresponding light intensities were 16umol/m-2/s-1, 38mol/m-2/s-1, 68mol/m-2/s-1. Using matlab to write a program, while tirggering the automatic photograph button, the program will automatic take picture every second and stop when Continuous Shooting 30 pictures. Camera UI was shown in figure 2. Choosing the natural light, aquarium lamp's fisrt gear light, aquarium lamp's second gear light in turn, activating continuous shooting to collect images and choosing three as the original images, Respectively named image 1, image 2, image 3, as shown in figure 3.

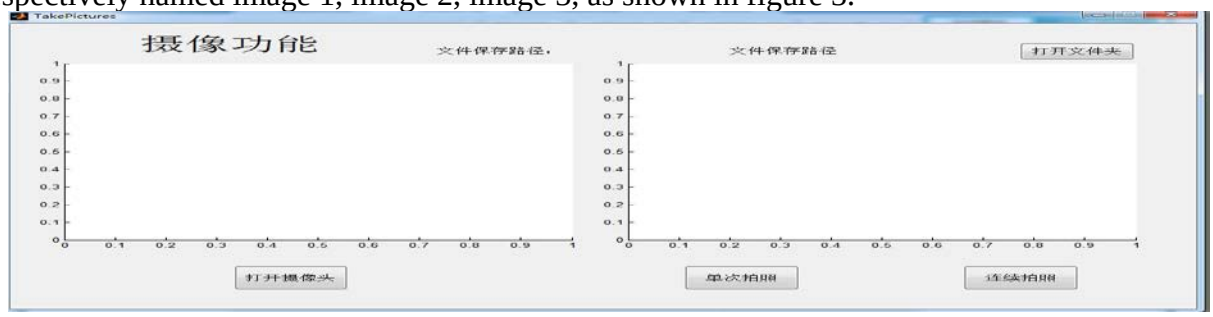

Fig.2 image acquisition UI

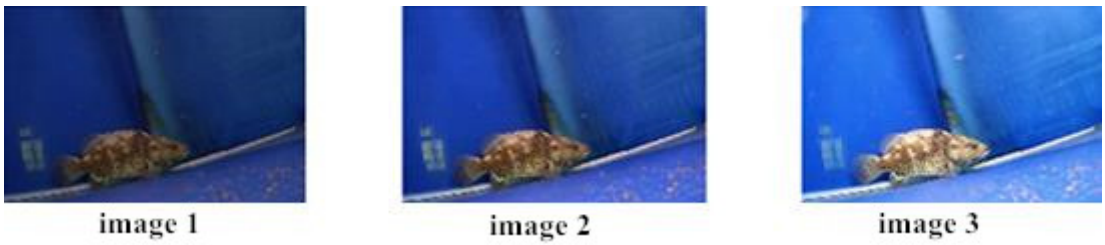

Fig.3 The original images

The Image Processing

Comparison of RGB. Processing a colour image, it's necessary to select the appropriate color space and the processing strategies and methods suitable for this space. Color space model commonly used as RGB, HSI, HSV and so on. Digital images are mostly stored in RGB [3], In the RGB image, each pixel consisted of red, green, blue 3 bytes, each byte is 8 bit, means the different brightness value between 0 ~ 255.

Making statistical of image 1's, image 2's, image 3's R, G, B channel pixels' distribution, the corresponding results were shown in figure 4.

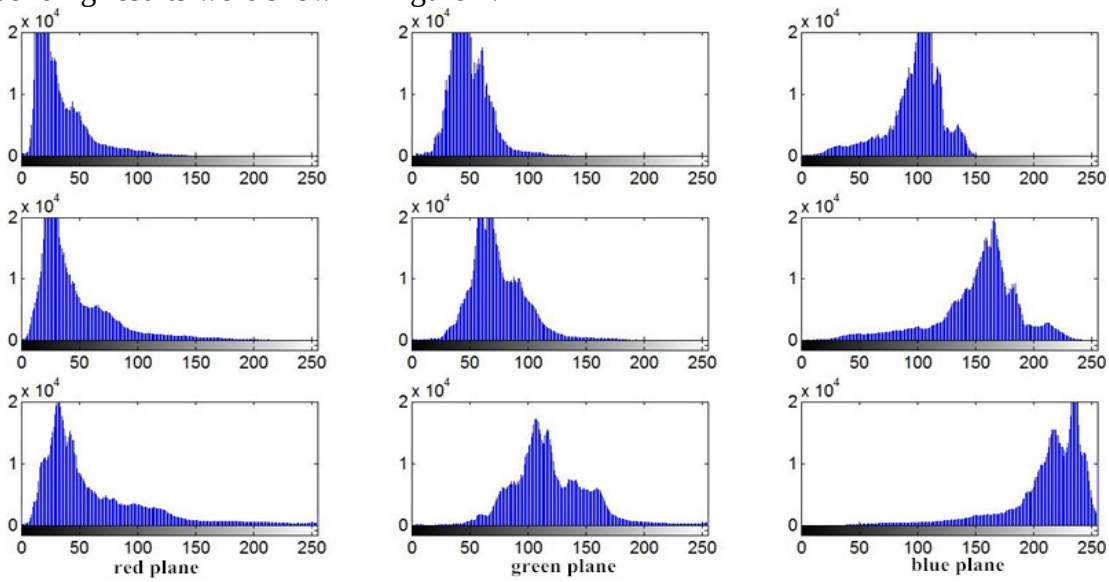

Fig.4 The histogram of RGB corresponding to the original image

The main codes were shown follows:

```
A=imread('1.jpg');
Rimdata=A(:,:,1);
Gimdata=A(:,:,2);
Bimdata=A(:,:,3);
figure(1);
subplot(3,3,1); imhist(Rimdata); title('red plane(picture1)'); set(gca,'ylim',[0 20000])
subplot(3,3,2); imhist(Gimdata); title('green plane(picture1)');set(gca,'ylim',[0 20000])
subplot(3,3,3); imhist(Bimdata); title('blue plane(picture1)');set(gca,'ylim',[0 20000])
```

Histogram Equalization. Processing images in figure 4 through Histogram Equalization, the results as shown in figure 5.

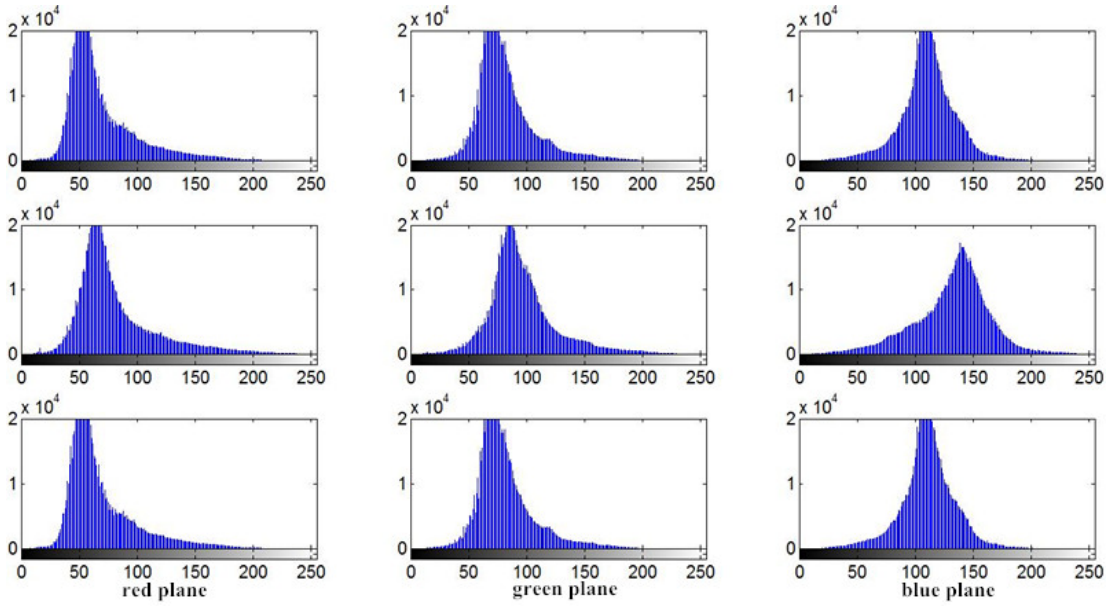

Fig.5 The histogram of RGB image after equalization

Merging the histogram of RGB image after equalized into a new RGB image.The results as shown in figure 6.

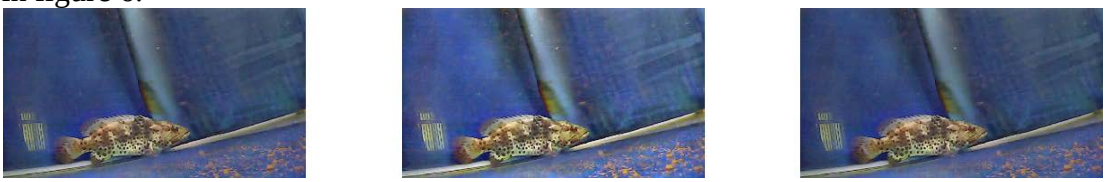

Fig.6 RGB image processed by histogram equalization

The main codes were shown follows:

```
A=imread('1.jpg');
Rimdata1=A(:,:,1);
Gimdata1=A(:,:,2);
Bimdata1=A(:,:,3);
R1= adapthisteq(Rimdata1,'Distribution','rayleigh');
G1= adapthisteq(Gimdata1,'Distribution','rayleigh');
B1= adapthisteq(Bimdata1,'Distribution','rayleigh');
figure(1)
subplot(1,3,1);imshow(cat(3,R1,G1,B1));title('picture1-1');
figure(2)
subplot(3,3,1); imhist(R1); title('red plane(picture1-1)');
set(gca,'ylim',[0 20000])
subplot(3,3,2); imhist(G1); title('green
plane(picture1-1)');set(gca,'ylim',[0 20000])
subplot(3,3,3); imhist(B1); title('blue
plane(picture1-1)');set(gca,'ylim',[0 20000])
```

Image Restoration. The noise has a certain effect on each link of image's input, acquisition, output and the final output results[4-7].Gaussian filter has a good smoothing effect and flexible filter adjustment scale, and fast Fourier transformation making the filtering with a high efficient[8].Median filtering is a nonlinear filtering method make the results less fuzzy edge, Not only reduce or even remove the random noise and impulse noise, but also keep the image edge information well. Adding the same salt and pepper noise on image 1's, image 2's, image 3's gray-scale image , the results as shown in figure 7.

Fig.7 salt and pepper noise

Using gaussian filtering to process the picture added salt and pepper noise,the results as shown in figure 8.

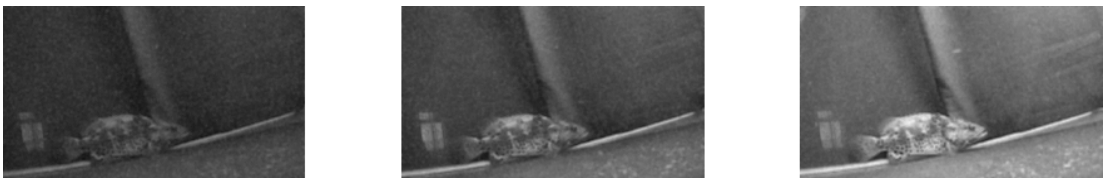

Fig.8 gaussian filtering

Using Median filtering to process the picture added salt and pepper noise,the results as shown in figure 9.

Fig.9 Median filtering

The main codes were shown follows:

```
A=imread('1.jpg');
A1=rgb2gray(A);
J1=imnoise(A1,'salt & pepper', 0.1);
K1=medfilt2(J1,[3,3]);
h = fspecial('disk',7);
H1 = imfilter(J1, h, 'replicate');
```

Image Segmentation. Image segmentation can help people more intuitive understanding of the image, Image segmentation based on Matlab mainly includes: the segmentation method based on threshold, the segmentation method based on region, the segmentation method based on edge and segmentation method based on the theory of the specific, etc.We then mainly discussed the segmentation method based on threshold .

1) Histogram Threshold Selection Method

In terms of a image, if the image has the obvious contrast between the background and the subject, it should has two peaks of histogram. Two peaks correspond the internal and external of the image subject's points with lager numbers, the valley between the two peaks corresponding to relatively few objective point near the edges. At this time, you can pick and choose the troughs in the middle of the two peaks as a threshold. Greater than the threshold point is set as white, less than the threshold is set as black. In this way, it can divided the subject from the background image. Using histogram threshold selection method to process image 1, image 2, image3, the results as shown in figure 10.

Fig.10 histogram threshold

The main codes were shown follows:

```
A=imread('1.jpg');
R1=A(:,:,1);
G1=A(:,:,2);
B1=A(:,:,3);
imhist(R1);
R11=im2bw(R1,45/255);
```

2) OSTU

OSTU derived according to the principle of least square method on the basis of gray histogram, the basic principle is using the best threshold value to divid the image's gray histogram into two parts and making the variance between the two parts to achieve maximum value, in another words the separability is the largest. Using OSTU to procee image1, image2, image3, the results as shown in figure 11.

Fig.11 OSTU

The main codes were shown follows:

```
A=imread('1.jpg');
T1=graythresh(A);
BW1=im2bw(A,T1);
```

Conclusion

Observing figure 4, it was concluded that: with the enhancement of light intensities, distribution range of RGB channel were in the constantly changing; the image brightness was higher, the distribution range of image pixels were more tended to 255. Because the original image's background was blue, so the distribution had the maximum amplitude of the blue channel, while red was not obvious.

Through figures 5, 6, by histogram equalization processing, the distribution of RGB channel had different degree of concentration towarded to the center. Distribution curve were also became smooth; For the image is too bright or dark, the image histogram equalization processing can effectively adjust the light intensity, and then adjust the brightness of the image.

Compared figure 7, figure 8, figure 9, it can found that light intensity had little effect on the median filter and Gauss filter results and the median filter image restoration effect was obviously better than Gauss filter.

From the figure 10, figure 11, it was clearly that using the histogram threshold segmentation method for image segmentation, with the increased of light intensity, image details were losing, so using histogram threshold segmentation method, the natural light is the best light; Using the OSTU threshold image segmentation method, stronger light can preserve the image characteristics of the main body.

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