New approach for extracting depth of structure crack by Computer Vision

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1. Introduction

Mankind has been fighting disasters for a long time. In the process of overcoming disasters, humans have been researching how to minimize the damage and have developed skills for disaster forecasting. However, as technology has become more advanced, risk has also become more serious, such as nuclear disaster. In particular, nuclear disasters generate not only primary accidents by explosions but also secondary accidents by radiation

In this paper, we developed an automatic crack detection system using computer vision processing in nuclear structure. Through this, we can conduct not only usual safety management, but also the checking direction and depth of crack using robot vision in a human district area.

2. Methods and Results

In this paper we used an image-processing method for automatic extracting of crack depth.

2.1 Preprocessing of image

In this paper, we conducted image preprocessing for clear crack detection. Preprocessing is first, converting an original image into a gray-scale by image integral, and calculating the optimum thresholds through iterative binarization. Fig. 1 shows the processing of integral image and extracting of thresholds through iterative binarization.

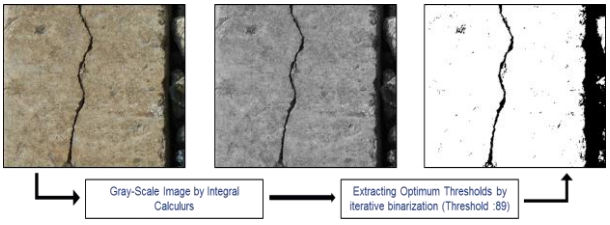

Fig.1. Image Preprocessing

2.2 Processing of image filtering

Based on the preprocessing image, in this paper we conducted three different filtering methods.

The first filtering method is an un-sharp masking for improving the sharpness of the image. The process of un-sharp masking is first blurring the image and minus from original image. The minus image and original image are then put together.

The equation for a minus image is as follows (1).

$$Ir = Ib + (w \bullet Im) \quad (1)$$

Ir : un-sharp mask image
Ib : minus image
w : weight
Im : mask image

Through this, we can emphasize the boundary of an image without chrominance distortion and solve the noise problem such as an under/over shoot.

The second filtering method is median filtering. Median filtering is sorting the brightness values within pixels, and the output inter-median value from sorting values. Why using the median filtering is easily delete impulse noise such as salt and pepper noise. Fig. 2 shows the impulse noise (salt and pepper noise). To remove impulse noise, we repeatedly perform and as a result, we can confirm the deletion of noise after performing a total of 28 repetitions.

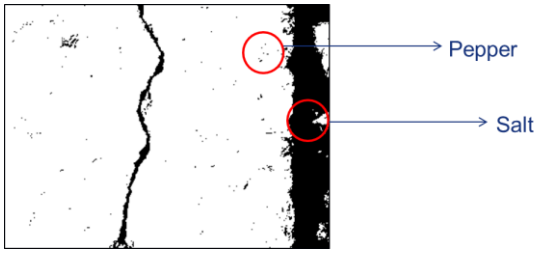

Fig. 2 Impulse Noise(Salt & Pepper)

The last filtering method is Gaussian filtering. Gaussian filtering deletes white noise by a set of high and low frequency limits. Through this, it has an effect on image smoothing. Fig. 3 shows the process of image filtering.

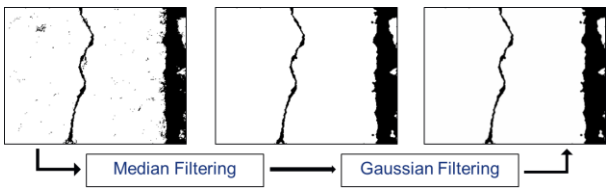

Fig. 3. Filtering Process

2.3 Image processing of the result extraction

After the preprocess and filtering, we set the region of interest (ROI) for the resulting extraction. The reason for setting the ROI is to remove a non-crack region. After setting the ROI, we calculate the depth of the crack through an image histogram. As shown in Fig. 4, we analyze the image histogram to calculate both the maximum depth and mean depth.

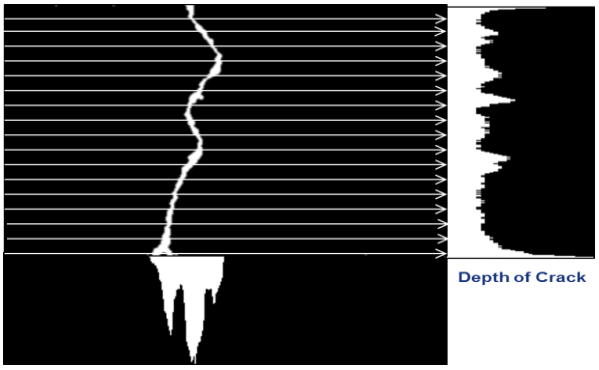

Fig. 4 Extracting depth of crack by Histogram

2.4 Test and result

After completing the previous steps, we select a test subject to extract the results. The test subject is a concrete structure with a crack. We take an image using a poor resolution camera. Because of maximize the performance of the algorithm. Also the algorithm is run using OpenCV library in Visual C++. As shown in Fig .5, all steps of the crack extraction are recorded on the same program.

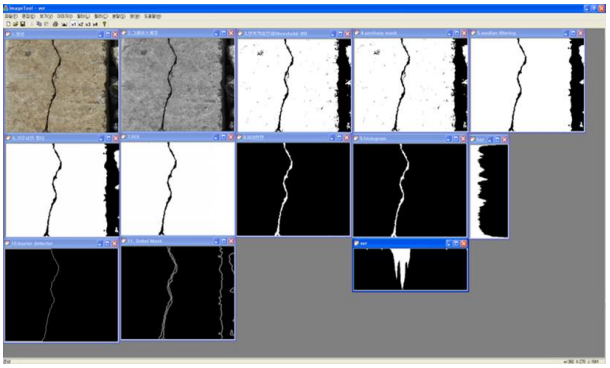

Fig. 5 Image Processing of crack extracting

3. Conclusions

In this study, we are developing an automatic extraction system of a structure crack and verified it through testing.

First, we can calculate the depth of a crack through a crack detection system using image processing.

Second, the result of bad condition to evaluate performance of algorithm, we can improve the performance using a filtering method. However, in actual situation, we need a high resolution image.

Through this study, we conducted crack extraction using a computer vision programming. In addition, we improve the performance using a filtering method. However, this will not be smoothly extracted in case that crack is not clear in structure or lines exist which is similar to crack. We therefore need more studies on the above-mentioned problems.

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