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Diagnosis of Buildings Physical Fitness Using Image Processing Techniques

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ABSTRACT: Cracks on the concrete surface are one of the earliest indications of degradation of the structure which is critical for the maintenance as well the continuous exposure will lead to the severe damage to the environment. Manual inspection is the acclaimed method for the crack inspection. In the manual inspection, the sketch of the crack is prepared manually, and the conditions of the irregularities are noted. Since the manual approach completely depends on the specialist's knowledge and experience, it lacks objectivity in the quantitative analysis. So, image-based crack detection is proposed as a replacement. This study develops an intelligent model based on image processing techniques for automatic recognition and analysis. In the new model, a solid gray matter repair method, called Min-Max Gray Level Discrimination (M2GLD), it is proposed to use the Otsu-blocked image. The Experimental results indicate that the integration of M2GLD with the Otsu method, followed by other structural analysis algorithms, can effectively detect digital imagery. Therefore, the constructed model can be a useful tool for building management agencies and construction engineers in the task of structure maintenance.

KEYWORD: Crack Detection, Accuracy, Image processing

I.INTRODUCTION

Cracks are of major concern for ensuring the safety, durability, and serviceability of structures The reason is that when cracks are developed and propagate, they tend to cause the reduction in the effective loading area which brings about the increase of stress and subsequently failure of the concrete or other structures . Since there always exist constraints in reinforced concrete structures and buildings deteriorate overtime, cracking seems unavoidable and appears in all types of structures, for example, concrete wall, beam, slab, and brick walls (Figure 1). Particularly for concrete elements, cracks create access to harmful and corrosive chemicals to penetrate into the structure, which consequently damage their integrity as well as esthetics .

In the present work, an image processing model that automatically detects and analyzes cracks on the surfaces of building elements in the digital image is established. The proposed model does not only automatically recognize crack pixels out of image background but also per- form various measurements of crack characteristics including the area, perimeter, width, length, and orientation. At the center of the proposed model, an image enhancement algorithm called Min-Max Gray Level Discrimination (M2GLD) is put forward as a preprocessing step to improve the Otsu binarization approach, followed byshape analyses for meliorating the crack detection performance. The crack detected by the proposed approach was compared with that acquired by the conventional technique. The experimental results show that the crack on various structure surfaces can be accurately recognized and analyzed using the proposed image processing model. The paper is organized as follows: the next section reviews previous works pertinent to the current study; the third section describes the improved Otsu method based on the M2GLD, followed by the proposed image processing model for the detection of surface crack; the model experimental results are reported in the fifth section; and the final section provides some conclusions of the study. Each image captured by camera

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needs to be evaluated to track the crack formations. To save time, this task can be done by applying image processing techniques to automatically detect and report cracks rather than using a human to identify them.

Figure 1: Cracks in building structures:(a)concrete wall,(b)concrete beam and(c)brick wall with mortar surface

1.1The Gray Intensity Adjustment Method Based on Min-Max Gray Level Discrimination

Significantly, in digital camera images, the amount of light in different parts of the earth's surface can vary considerably. Therefore, the background light of the image is not the same. In addition, building structures tend to have low brightness, uneven light, and high noise disturbances. To rectify this situation, treatment is needed to improve crack performance. Object direction.Due to the characteristic of the cracks containing the dividing lines and curves, the amount of gray matter splitting is usually the minimum area within the image. In order to divide the pixels of an image into split and non-split groups, it is beneficial to plan a method that best distinguishes two pixel groups of interest. This study prioritizes a process called Min-Max Gray Level Discrimination (M2GLD)

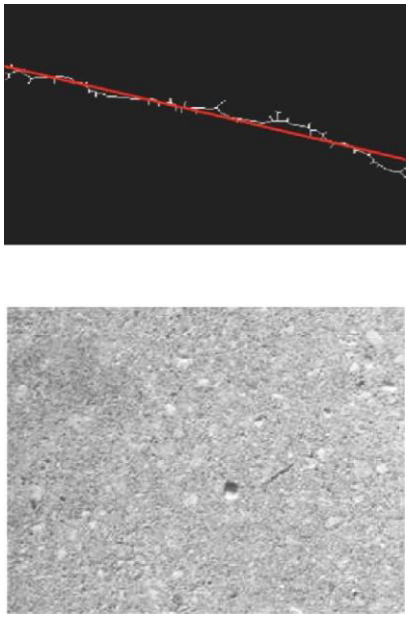

Figure2: Testing image by using the M2GLD method

II.OBJECTIVES

An image processing model that automatically detects and analyzes cracks on the surfaces of building elements inthe digital image is established. The proposed model does not only automatically recognize crack pixels out of image background but also per- form various measurements of crack characteristics including the area, perimeter, width, length, and orientation. At the center of the proposed model, an image enhancement algorithm called Min-Max Gray Level Discrimination (M2GLD) is put forward as a preprocessing step to improve the Otsu binarization approach,followed by shape analyses for meliorating the crack detection performance. The crack detected by the

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proposed approach was compared with that acquired by the conventional technique. The experimental results show that the crack on various structure surfaces can be accurately recognized

III. LITERATURE REVIEW

Cracking is an important indication of the degradation of structures. Detection of cracks is often required in the stage of building maintenance. In addition, inspections of the structural integrity based on crack analyses become sub stantialfor the service life prediction of structures [16]. Since the manual process for crack measurement is painstakingly time consuming for large- scale structures (e.g., high-rise buildings and bridges), many researchers have proposed models based on image processing, which enable a faster and more efficient way of measuring the cracks in concrete surfaces. Lee et al. [8] presented an automated technique-based image processing for detecting and analyzing concrete surface cracks; the crack detection is recognized from an image of a concrete surface, and the crack analysis calculates the characteristics of the detected cracks, such as crack width, length, and area. Adhikari et al. [3] developed a model that numerically represents the crack defects; the proposed approach is also capable of crack quantification and detection. Toroket al. [5] proposed an image based automated crack detection model for post disaster building assessment; based on the numerical experiment, the authors show that the proposed method can bring about great benefits in a post disaster analysis of building elements. Recently, Alametal.[17] propelled the hybrid acquisition process by combining digital image integration with acoustic output. Talabet al. [2] found cracks in digital photography using Otsu's method and Sobel's reduction in image processing techniques.Ebrahimkhanlouetal.[18] performed a multifractal analysis of crack patterns with applications in reinforced concrete shearwalls.Yuetal.[19] introduce an effective way to detect cracks in the upper channels based on infrared images; the proposed method is able to overcome challenging challenges such as low contrast, uneven light, and the heavy noise pollution that is usually present in an image with a tunnel.

IV. METHODOLOGY OF PROPOSED SURVEY

The Proposed Image Processing Model for the Detection of Surface Crack

This section describes the overall architecture of the pro- posed image processing model for detecting the surface crack in building structures. After construction, the model can be used to identify and analyze cracks in the surface of various building materials, for example, concrete beam, slab, floor, wall, and mud-brick brick wall. It is known that the model is encoded in place of MATLAB. The first image captured on a digital camera works as a mode input. Otsu's proposed improved method consists of M2GLD described in the previous section and the standard Otsu algorithm. The photo capture process is followed by a photo-cleaning process in which the removed pixels and non-cracked pixels are removed.

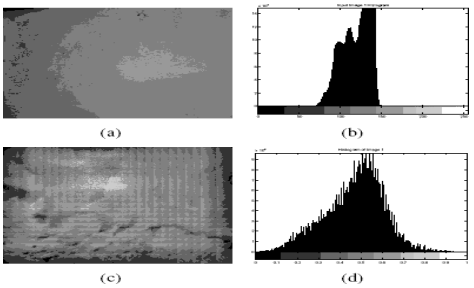

Figure 3: (a) Less Visible Mould Growth before Pre Processing stage (b) Histogram Showing Intensity for LessVisibleMouldGrowthbeforePreProcessingstage(c)LessVisibleMouldGrowthafterPreProcessingstage(d)HistogramShowingIntensityforLessVisibleMouldGrowthafterPreProcessingstage

V. DATA DESCRIPTION

Cracking cycle is calculated as the number of pixels in an object's boundary. The location of a broken object is simply the sum of the pixels found within the object's boundary. Fragmentation calculation can be converted into a simple linear problem where the independent variable is the pixel position next to the x-axis and the dependent variance is the pixel position next to the y-axis.

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Comparison of results is reported. In all experimental images, the crack pixels exposed to the proposed method are very clear and well separated from the terrain compared to the Otsu method. Moreover, the correctness of crack detection is greatly enhanced with the newly constructed model.

Datasets	No of classes	No of instance	No of features
Testing Image	7	100	5
Mean crack Width	5	50	4
Max crack width	8	60	3

Table1: Data set Description for Dataset Used in building crack

VI. APPLICATIONS

The proposed program for crack detection and analysis is verified with a set of testing images. The parameters of the program are empirically set as follows: The adjusting ratio: *RA* =2. The margin parameter: $\tau = 0.5$. The crack detection results are reported from **Fig. 4**to **Fig. 6**. In all testing images, the crack pixels revealed by the proposed method are apparently clear and well separated from the surface structure. In addition, the cracks found by the proposed program clearly resemble the actual crack objects in the digital images. Thus, it is able to conclude that the newly constructed program can be a useful tool for practical application of crack detection in building structure.

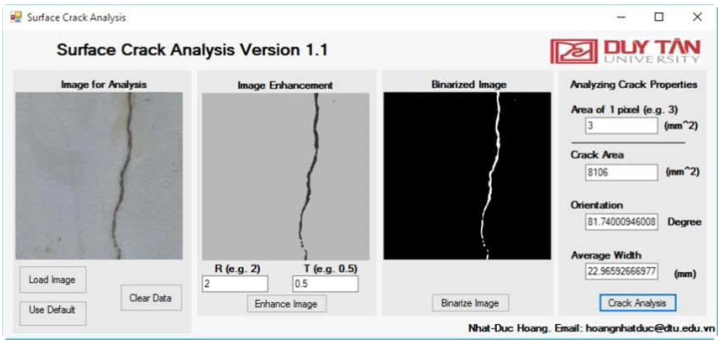

Figure 4. Analysis result of the testing image number1

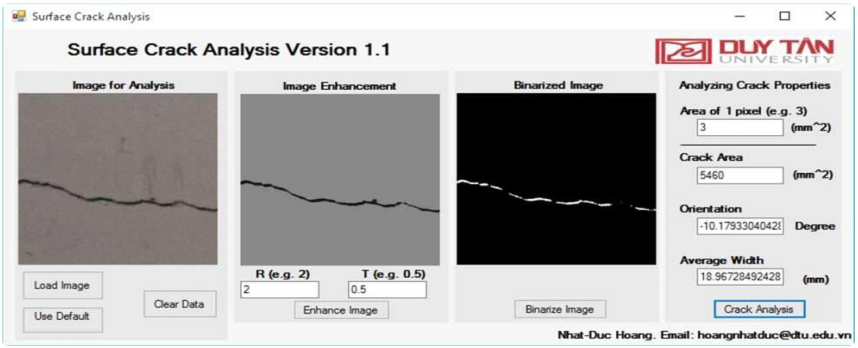

Figure.5 Analysis result of the testing image number2

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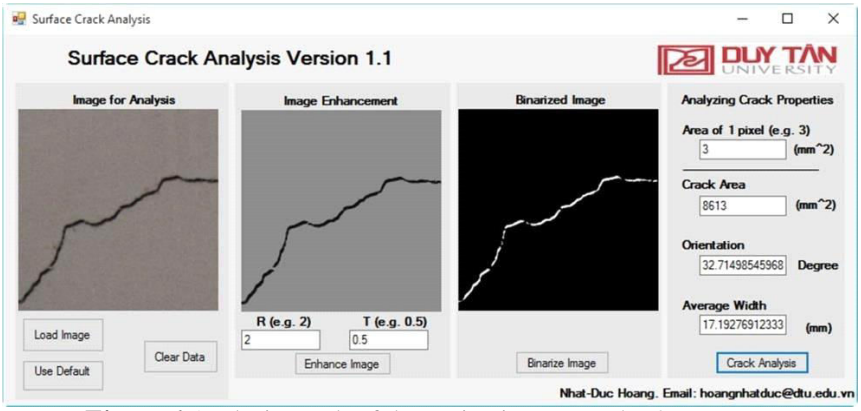

Figure.6 Analysis result of the testing image number3

VII. CONCLUSION AND FUTURE WORK

This study developed an image processing model for detecting fractures in the surface of buildings. Since digital images taken for the purpose of fragmentation analysis incorporate a variety of complexity (e.g., low contrast, uneven light, and noise pollution) of the image analysis process, the discovery of cracks relying on the standard Otsu process cannot produce satisfactory results. The new model uses an image-enhancing algorithm called Min-Max Gray Level Discrimination (M2GLD) to improve the Otsu method. The newly built model is able to identify cracks and analyze their characteristics including location, perimeter, width, length and shape. Test results ensure that cracks in test images are accurately identified. M2GLD could certainly improve Otsu's performance. The M2GLD method followed by the Otsu method described in the current work can be easily integrated into many fragmentation models and phase models developed in the future. The first reason is that the proposed route is straightforward. The second reason is that the method, as indicated in the test results, is able to deliver accurate crack detection performance. Since the cracked material was successfully separated in the background, further analysis of these cracks found is more reliable. Therefore, the model can be used for crack detection and testing by the building repair agency.

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