CRACK DETECTION ON CONCRETE SURFACES USING IMAGE PROCESSING

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Abstract: Due to environmental changes and poor quality of construction materials, cracks may develop in the walls of the building which is critical for maintenance as well as the continuous exposure will cause the severe damage to the environment. One of the initial signs of the degradation of a concrete surface or a material is cracks. Manual inspection has many drawbacks like invisibility of the crack, time consuming and it completely depends upon specialist's knowledge and experience. So automatic image-based crack detection is used as replacement for manual inspection which reduces the cost when compared to the manual approach. The proposed algorithm has been tested against various concrete crack images to study how effectively the algorithm is working, and how effectively it is overcoming the drawbacks of the present manual approach. The algorithm is projected to serve the purpose of various people by estimating the parameters of the crack so the bricklayer can take the necessary actions from the degradation of concrete structures.

Index terms – **Image based detection, Concrete structures etc.**

I.INTRODUCTION

Cracks are of major concern for ensuring the protection, durability, and serviceability of structures. the reason is that when cracks are developed and propagate, they need an inclination to cause the reduction within the effective loading area which brings about the increase of stress and failure of the concrete or any other structures. Since there always exist constraints in ferro concrete structures and buildings deteriorate overtime, cracking seems unavoidable and appears altogether forms of structures, as an example, concrete wall, beam, slab, and brick walls. Particularly for concrete elements, cracks create access to harmful elements to go inside of the structure which consequently damages their integrity.
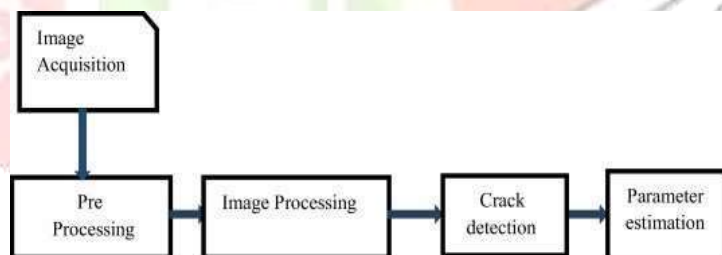
Primarily the fundamental question is Why Concrete Cracks? Concrete doesn't require much water to realize maximum strength, however, a way of concrete utilized in residential pours tends to possess an excessive amount of water added to the concrete on the duty site. Water-Cement ratio must be in between 0.45 to 0.60 for the higher concrete material, if any changes within the water to cement ratio then there'll be an opportunity of degradation of concrete surfaces.

II. LITERATURE SURVEY

Cracks are often broadly classified into two categories namely active and dormant. In active cracks, the change in direction, width or depth occurs over a measured period whereas in dormant cracks it remains unchanged. If left unrectified, both active and dormant cracks provide passage for moisture penetration, which might cause future damage. a number of the active cracks are longitudinal crack, transverse crack, miscellaneous crack, crocodile crack and reflection crack. Dormant cracks are very fine in nature and auto healing occurs over a period of time. the varied varieties of crack supported their structure are micro crack, thin crack, sealed crack, mixed crack, line-like crack, minor crack, tiny crack, medium crack, large crack and sophisticated crack.

III. PRELIMINARY

Cracks on the concrete surfaces are captured by using high resolution cameras, those images are analysed which is a field of Image Processing. There are several steps involved in the image processing which is shown in Fig (1); (1) Image Acquisition (2) Pre- Processing (3) Image Processing (4) Crack Detection (5) Parameter Estimation

For any edge detection algorithm, the primary process is to remove blurriness of the image or removing noise from an image which can be done by filtering algorithms.

There are several filtering algorithms, but the foremost effective for any quite the image is Gaussian Filtering. The second step after filtering algorithm is that the sting detection around the image which can be done by using various algorithms like Roberts Edge Detection, Sobel Edge Detection, Prewitt Edge Detection, Canny Edge Detection. A good edge detection algorithm should provide a tough and hardest solution which is adaptable to varying noise levels. variety of the alternative edge detection techniques are: (1) Roberts Edge Detection: It

performs 2-D spatial gradient measurement on an image which is extremely quick and easy to compute. This method insistence regions of high spatial frequency which regularly correspond to edges. The input to the operator is same because the output which may be a grayscale image. (2) Sobel Edge Detection: The Sobel edge detector computes the gradient by using the discrete differences between rows and columns of a 3*3 convolution matrix. The Sobel operator could also be predicted on rolling the image with a tiny low, separable, and integer valued filter. (3) Prewitt Edge Detection: A discrete differential operator is Prewitt operator which computes the approximation of the gradients. It uses 3x3 convolution mask to detect horizontal and vertical fringe of an image.(4) Canny Edge Detection: Canny edge detection may be a multistage algorithm to detect an oversized range of edges in images. This detector finds edges by trying to seek out local maxima of the gradient of f (x, y). The gradient can be calculated by using the derivative value of a Gaussian filter. If the pixel has value greater than high thresholding, then it set as edge pixel and a pixel value encompasses a worth below than low threshold value, then it doesn't set as edge pixel. By analysing of those algorithms for several file Canny Edge detection algorithm provides better results for any quite file

IV. IMPLEMENTATION

There are four phases in our implementation. They are

1.Gaussian Filtering
2. Canny Edge Detection
3. Morphological Approach
4. Parameter Estimation

Gaussian Filtering:

Gaussian filter could be a linear filter which is employed to blur the image or to scale back noise. If we apply Gaussian filtering and Median filtering to a picture and subtract their outputs, final output are often used for unsharp masking (edge detection). The Gaussian filter itself will blur the edges and also reduce the contrast. From the image perspective, during Gaussian filtering each individual pixel is modified with a Gaussian shaped blob with the identical total weight because the original intensity value. This Gaussian is additionally referred as convolution kernel.

Canny Edge Detection:

Canny edge detection [8] may be a way to extract useful structural information from different vision objects and dramatically reduce the quantity of data to be processed. it has been applied in various computer systems. Canny algorithm has found that the necessities for the applying of edge detection on a diverse vision systems are similar. . Detection of edge with lower rate, which suggests that the detection should accurately catch as many edges. This algorithm contains a many adjustable parameters, which can affect the computation time and

effectiveness of an algorithm. Primarily the smoothing filter employed within the primary stage of Gaussian filter directly affects the results of the canny edge detection algorithm. to reduce blurring effect and to detect small, sharp lines we are able to use small filters. But there's are some disadvantages of using large filters. They increase the amount of blurring effect within the image and value of particular pixel slights out over large area of image
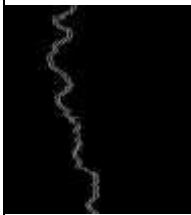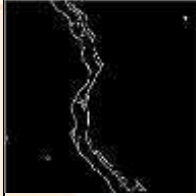
Morphological Approach:

Morphological Image Processing may be a collection of non-linear operation associated to the form or morphology of features in a picture. Morphological processing is capable of removing noise and has the flexibility to edit a picture supported the scale and shape of objects of interest. it's utilized in place of Linear Image Processing, because it sometimes distorts the geometric kind of a picture but within the case of Morphological approach the knowledge of a picture isn't lost. within the Morphological Image Processing the initial image are often reconstructed by using Dilation, Erosion, Opening and shutting operations for a finite number of times. There are basically four Morphological transformations: (1) Dilation: Dilation causes objects to dilate or grow in size. It can make an object larger by adding the pixels around its edges. (2) Erosion: Erosion makes an object smaller by removing or eroding away the pixels on its edges and causes objects to shrink. (3) Opening: Opening generally smoothness the outline of a picture and eliminates thin inflammations. it's structured removal of image region boundary pixels. (4) Closing: Closing fuses narrow breaks, eliminates small holes and fills gaps within the contour. it's structured filling of image region boundary pixels. it's a robust operator, obtained by combining Erosion and Dilation.

Parameter Estimation:

   Implementing the above proposed algorithm, we will calculate the height, depth, width, direction of propagation and severity of the crack

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V. RESULTS:

S. No	Original Image	Crack Image	Length (in pixels)	Width (in pixels)
1.			165	78
2.			226	79
3.			165	59
4.			178	49

VI. CONCLUSION

The manual approach for the estimation of cracks in concrete surfaces is tedious. So, the proposed automatic crack detection algorithm identifies the cracks on concrete surfaces with better results compared to manual approach. In the proposed crack detection algorithm the cracks are identified using the canny edge detector algorithm which provides a better results for any kind of an image The proposed algorithm is tested with nearly 100 images and the different parameters related to crack such as length, width are measured, this can be used by various construction workers so that necessary remedies can be taken from the degradation of concrete material. Direction of Propagation and Life Span of the concrete material are measured further with different high-quality techniques.

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