IDENTIFICATION OF DAMAGE TO THE GAS PIPELINE INNER

WALL USING AN IMAGE SEGMENTATION

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Abstract.

In order to overcome obstacles like low visibility, humidity, sand, and electronic interference, this study investigates image processing for gas pipeline damage detection. It presents a method that improves image quality for analysis by lowering image noise. In order to distinguish between pipeline sections that are damaged and those that are intact, the study focuses on image segmentation. Accurate damage measurement is made possible by this procedure. For accurate damage detection, the system also extracts important characteristics of the inner pipeline wall. The excellent images that are produced facilitate additional research and decision-making. The ultimate goal of this strategy is to increase the safety and effectiveness of pipeline maintenance.

Keywords: pipeline inspection, image processing, and defect detection,

Edgedetection,Median filtering

1. INTRODUCTION

City natural gas pipelines are susceptible to corrosion, which raises the possibility of damage and leakage. Degradation is accelerated by elements such as mechanical stress and soil characteristics. Because of the dangerous circumstances inside the pipes, direct examination is challenging. Robotic image processing technology makes it possible to remotely detect damage for safer pipeline maintenance.

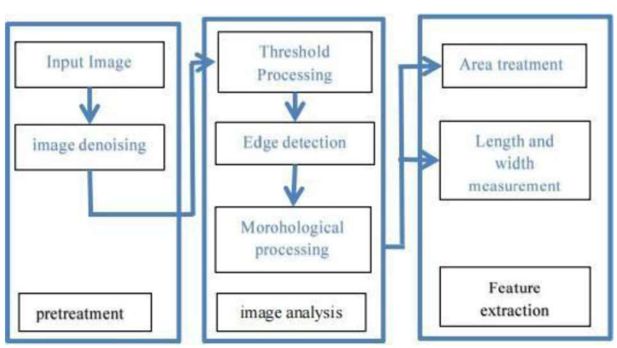

Figure 1.1 Block diagram of Image processing

2. IMAGE PROCESSING SYSTEM DESIGN

The majority of the photos we take and send from the front end are in color, and noise is unavoidable. Gaussian noise or Poisson noise is the term used to describe the release of photons, or packets of light, according to Poisson statistics. In Poisson noise, the probability that x events will transpire over a specified duration is ascertained by:

$$f(x) = \lambda x e - \lambda / x! \qquad (1)$$

Figure 2.1 Image marred by cracks and noise

Figure 2.2 :Noise-polluted pipe wall

3. IMAGE ANALYSIS

In computer vision, edge detection is an essential procedure for locating features and boundaries in an image. It facilitates the extraction of structural data, which is necessary for tasks like segmentation and object recognition. Sobel, Canny, and Laplacian of Gaussian are popular techniques that identify notable variations in image intensity.

3.1 Processing at the threshold

In image segmentation, selecting the appropriate threshold is crucial to preventing the retention of excessive or insufficient information. While a large threshold may miss crucial edges, reducing detection accuracy, a small threshold captures too many details. Iterative approaches and thresholding strategies such as maximum interclass variance aid in segmentation optimization. These techniques improve edge detection and lower noise in complex images when paired with local statistics.

3.2 Edge Detection

By separating target information from the background, edge detection is crucial for image segmentation. To find edges, the Sobel operator uses the first derivatives in the x and y directions to determine the gradient magnitude. By using Gaussian smoothing, gradient computation, non-maximum suppression, and double thresholding, the Canny operator enhances edge detection. This method reduces noise and precisely connects edge points. Both techniques are frequently applied in practical settings to improve image analysis and segmentation.

An algorithm is the Sobel operator. The second rule states that the Canny operator is a more effective way to find edges. Any pixel's brightness vector amplitude can be easily found using the Sobel operator:

$$\nabla F = g_{x2} - g_{y\,2} = [(z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)]_2 + [(z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)] \qquad (2)$$

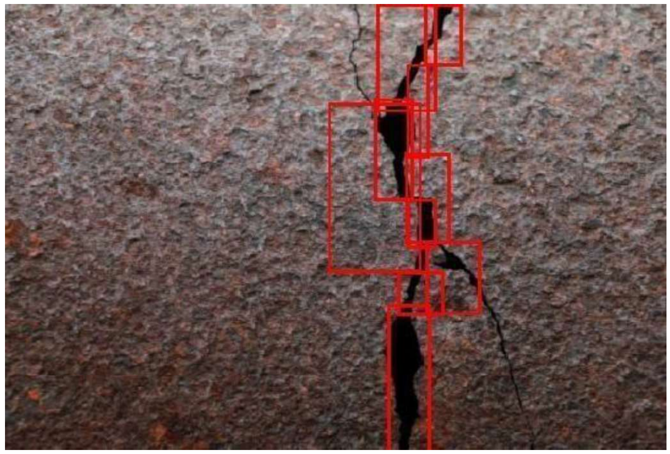

Figure 3.1 Impact of Median filtering with varying template sizes

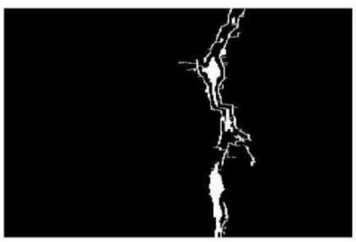

Figure 3.2 processed using Sobel Operator

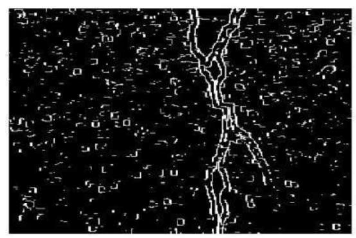

Figure 3.3 Canny Operator-Processed Image

4. FEATURE EXTRACTION

This paper's feature To extract, you have to measure the By mapping binary images to a matrix where white (gray value: 255) corresponds to 1 and black (gray value: 0) corresponds to 0, the number of statistics 1 can accomplish the measurement's objective. This would also include the maximum spans thus obtained, as well as the widest longitudinal and transverse position

4.1 Measurement of area

The results of extracting the area of the selected figure 6 using a MATLAB code are as follows:

Table:-1 Measurement of area

Method of Image Processing	Area value	
	Unit	pixel
image processing system based on edge detection	upper crack	43976.635
	lower crack	27627.975
	total area	71976

4.2 Length information measurement

In image analysis, there are two types of direction measurement: broadside and slender. The maximum span length is the distance between two points in the same direction. The image is marked with the horizontal and vertical coordinates that MATLAB computes. The widest areas of the object are identified by the maximum width measurement. After that, MATLAB extracts and verifies the width and length, noting important detail

Table:- 2 Length information measurement

Image processing method	Length value(unit : pixel)				
		Maximum transverse span	Maximum longitudinal span	Widest in horizontal direction	Widest in longitudinal direction
Image processing system based on edge detection	Upper crack	457	658	121	255
	Lower crack	193	504	89	343
Image processing system based on region growing	Upper crack	409	635	134	201
	Lower crack	214	520	112	215

4. CONCLUSION

The algorithm has been developed for median filtering, threshold, edge detection, morphological operations, and feature extraction of the actual gas pipeline crack image, effectively processing the gas pipeline crack image. This paper designs an image processing technology applied to a gas pipeline damage detection system. The experimental findings demonstrate that the system created
in this work may achieve its intended purpose and act as a particular guide for the creation of image processing products that are based on systems for detecting faults in gas pipelines.

5. REFERENCE

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4. Biographies

Mr Rebaka Suneel Kumar, post graduate in VLSI Design and Pursuing Ph.D in the area of Bio-medical Signal Processing at GITAM University. Currently he is an Assistant professor in the Department of ECE at Dadi Institute of Engineering and Technology. He has over 12 years of teaching experience in Electronics and Communication based subjects. His areas of interest include Antenna and Wave Propagation, Microwave Engineering, Random variables and Stochastic Process, Digital image processing etc.,