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Road Crack Detection Based on Video Image Processing

[1]B.Akash, [2]B.Varshith, [3]D.Siva Nanda, [4]D.Hari Krishna Vamsi
[1,2,3,4] Bachelor of technology,
[1]Electronics and Communication Engineering,
[1]Narayana Engineering College, Nellore, Andhra Pradesh, India.

Abstract: Multi The damage of road surface reduces its service life. In order to improve road maintenance and management efficiency, detection and recognition of pavement are studied based on video images in this paper. Firstly, we collect a large number of road surface images of 3 different conditions including transverse crack, longitudinal crack and turtle crack separately to construct road surface conditions library. Secondly, deal the road damaged image with gray, gray transform and image smoothing. Then, use mathematical morphology method to deal with crack image and projection to identify crack category. Finally, develop the pavement crack recognition software based on MATLAB. Selecting the pavement samples for experiment, the results show that this identification algorithm can accurately identify the category of crack.

I. INTRODUCTION

Street systems have an imperative influence of our reality these days since it makes a critical commitment to society. Individuals can't do their business and exercises effortlessly without great street systems. Unfortunately, pavement frameworks weaken after some time essentially because of weariness. This weakening to asphalt increments with the fourth energy of the hub heap of the vehicles going on it. Actually, early asphalt decay contains four unique sorts of split: transverse break, longitudinal split, square break and crocodile split. Potholes are shaped making the street turns out to be more perilous if these early weakening are left untreated. Restoration medications, such as settling potholes will cost around 10 to 20 times more than the cost of resealing breaks.

Therefore, pavement detection and rating are so important to keep the cost of fixing the road deterioration low and keep the road networks in good condition. The United States Department of Transportation (DOT) is a federal Cabinet department of the United States government who takes care of transportation systems. Its mission is to "Serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future." DOT needs to hire lots of people to inspect road networks in order to know which roads should be repaired. section three-dimensional Reconstruction can realize intelligent detection to the road crack, roughness, rut and pit slot diseases data, as well as evaluate the road conditions and generate the test report. Liu Jinwei developed a road detection vehicle ZOYON- RTM which collects pavement cracks image through high resolution linear CCD, completing the road crack, rutting roughness and other pavement diseases detection.

In view of the above literature, the crack identification are all based on the road video images, but the recognition accuracy and the classification problems of the pavement crack haven't get a good solution. Therefore, this article makes projection about crack on X axis and Y axis based on projection method, and then recognizes the crack type according to the projection coordinate point of crack number in different axes.

II. CLASSIFICATION AND FEATURES OF ROAD CRACK DAMAGE

According to the present classification method, road pavement damage is generally divided into crack, patch, pit, surface defects, surface deformation and mixed damage. The article divides crack damage into transverse crack, longitudinal crack and turtle crack.

Transverse crack is perpendicular to the centreline of the road and accompanied by a small amount of seam. Longitudinal crack is substantially parallel to the centreline of road and accompanied by a small amount of seam. Turtle crack shows that a large mesh intertwines together.

III. PRETREATMENT OF THE ROAD CRACK IMAGE

Making pre-treatment to the road crack image collected before can be helpful to the later recognition, it can also increase the accuracy greatly. The process of image pre-processing includes format conversion, graying, gray transform, image smoothing, image smoothing and image sharpening.

A. Graying

Transforming color image into grayscale image can reduce the amount of calculation, and the image of the converted will still be able to reflect the whole image of global and local distribution characteristics of chromaticity and brightness level.

B. Gray-scale Transformation

Image gray-scale transformation is an important branch of image processing which uses a series of techniques aims at extending the dynamic range of image gray and enhancing the contrast of the image, then highlighting the gradation information of interest. Histogram equalization is a kind of method which use gray transform to adjust the image contrast quality automatically, it is a histogram correction method based on the cumulative distribution function.

C. Image Smoothing

The high frequency domain of the image focuses on the details, false contour and noise, but the most effective image information is mainly concentrated in the low frequency do- main. Image filtering is a better way to remove the image noise and high frequency interference composition. Median filtering method is a nonlinear processing technology which can protect image edge and filter out noise very well. First, ranking the neighborhood pixels according to grayscale, and then selecting the middle value of the group as the output pixel. This method not only removes the isolated point noise, but also protects the boundary of the target area and keeps the image from fuzzy away.

D. Image Sharpening

In order to highlight the edge of the image texture information, we should use image sharpening to eliminate or weaken the low frequency component of the image. We need to enhance the contour information of image in the target area, so that the outside edge of the pixel gray scale values tends to zero.

IV. IMAGE SEGMENTATION TECHNIQUES

This section presents the road division utilizing the fractal hypothesis. The asphalt pictures should be improved before applying thresholding. A nonlinear filter is utilized as a part of this section so as to enhance the complexity, which can make effectively discover the thresholding. The fractal thresholding gets helpful double asphalt pictures, which is the establishment for the consequent advances.

A. Image Improvement

The aim of pre-processing in pavement image inspection is to suppress the unwanted information from the image data and enhance the desired image features important for further processing. Preprocessing is an important step in the sense that, with an effective process, much of the subsequent analysis will be simplified. Due to non-uniform lighting or weather conditions, the contrast between distress and background is often very low. In addition, the image is often corrupted with noise and undesired features. Therefore, an image enhancement method capable of removing non-uniform background illumination effects and noises is required.

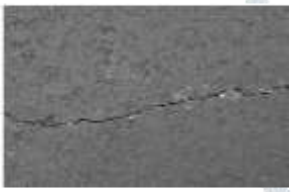

Fig1: Original pavement image.

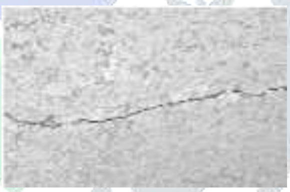

Fig2: Image after improvement.

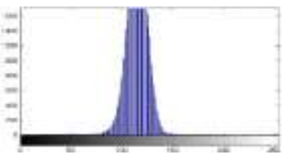

Fig3: Histogram of original image

Fig4: Histogram of improvement image

B. Thresholding Using Fractal Theory

Thresholding is a widely used technique for image segmentation and feature extraction. For a given image, most thresholding techniques involve creating a histogram of the gray level values to be used to find the peaks that exist in the image. A threshold is then chosen according to the valley between these peaks or modes (usually two prominent peaks are assumed). Adaptive thresholding applies a different threshold to different regions of the image and results in better segmentation. Pavement cracks usually involve abrupt changes in the gray level of two adjacent regions of variant gray levels. With an appropriate threshold that is extracted from the block and lies somewhere between the means of the two regions, the block can be converted into a binary form.

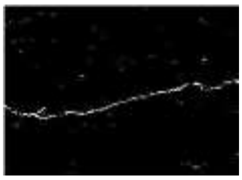

Fig5: Binary image.

Fig6: Image after improvement.

V. RESULT AND DISCUSSIONS

In this project we proposed and developed a novel approach for road crack detection based on video image processing. The proposed approach captures the real time road video and convertsit into the discrete frames and teach frame converted into the discrete images. All the images are processed in sequence to get the crack features from them and then all the extracted crack features are combined together to get the clear crack pattern. The proposed approach is designed, coded, implemented and tested in the MATLAB environment and the simulation results are presented as follows.

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Fig8: Contrast Stretched Crack Image.

Fig9: Gray Scale Contrast Stretched Image

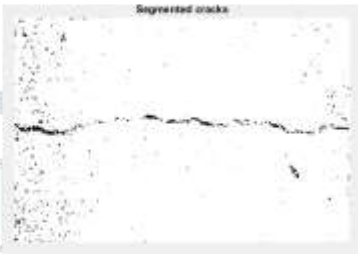

Fig10: Segmented Crack Image.

Fig11: Resized Crack Image

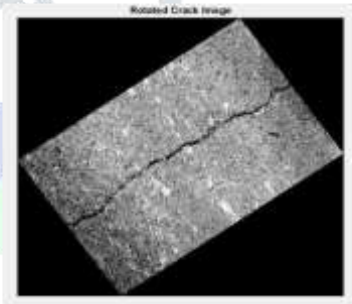

Fig12: Rotated Crack Image.

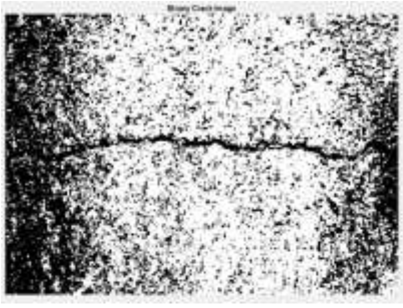

Fig 13: Binary Crack Image.

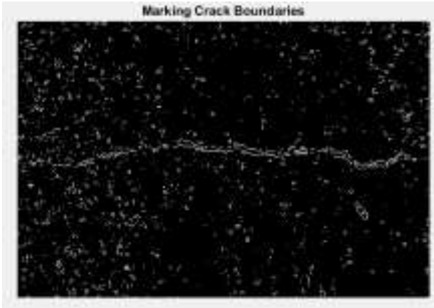

Fig14: Crack boundaries marked image.

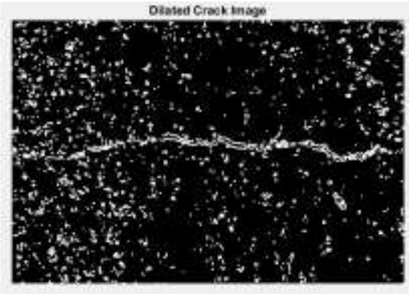

Fig15: Morphological dilated crack Image.

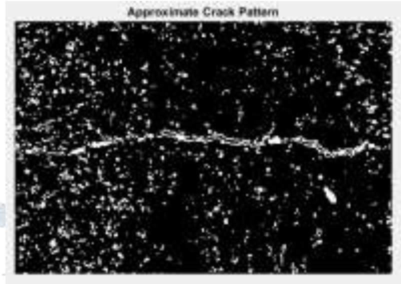

Fig16: Extracted Approximate Crack Pattern.

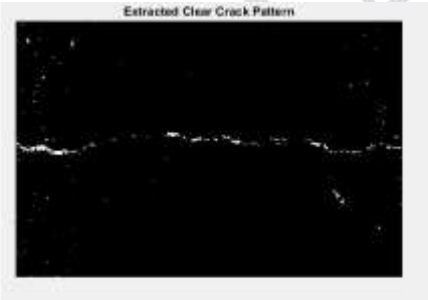

Fig 17: Extracted Clear Crack Pattern.

Fig18: Cleaned and improved crack pattern.

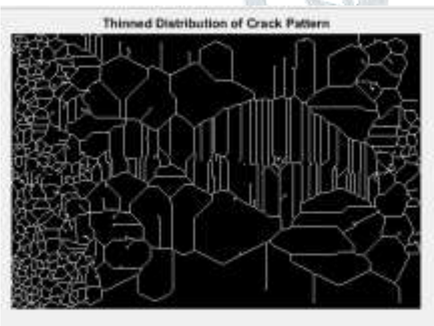

Fig19: Thinned Crack pattern.

Fig20: Enhanced Crack Image

Fig21: Morphologically Binary opened crack pattern.

Fig22: Crack Pattern after being dilated.

Fig23: Extracted Crack Pattern after being eroded.

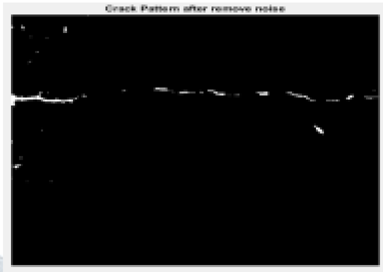

Fig24: Clear Crack Pattern After Removing the Noise.

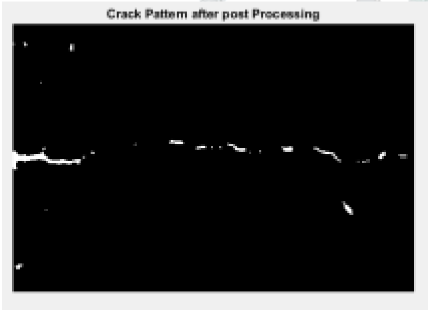

Fig25: Clean Crack Patter after Post Processing.

VI.CONCLUSION

A novel algorithm for the extraction of both transverse and longitudinal cracks from Pavement images is presented in this Project. The first step of the proposed method Involve pre-processing which consists of enhancement, thresholding, morphological operations using dilation and erosion to fill in the discontinuities between cracks. Two Noise reduction methods are compared in this Project. The result shows that median Filtering is ineffective for crack detection. One of the major components of the Algorithm is the determination of break points and their connection to extract the crack Features followed by skeletonization.

The noise is easily removed by the connected Component because the crack pixels have much longer connection than the noise pixels Experimental results clearly demonstrate that the method can effectively and Efficiently extract the crack features from the pavement images. The results from the Pre-processing steps give a good usable input for the break points connectivity algorithm. Further work is needed to modify the break points connectivity algorithm so that it can be able to segregate and classify transverse and longitudinal cracks in block cracks and alligator cracks accordingly.

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