



Crack Detection and Parameters Estimation on Road Images: Review

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Abstract--Roads act as a bridge for the persons to reach their destination. If a person wants to reach their destination then it can be done with the help of roads. Hence roads are the medium which is constantly used by the persons. The thing that is constantly used gets deteriorates easily and cracks come on it. To detect and measure that cracks some system is needed. If these cracks are detected by the human beings, then it will consume time. But if these cracks are detected with the help of some computerized system, then it will take less time. So this paper contains the information regarding the techniques that is used for detection and classification of the cracks on the road images. This detection and classification is done in MATLAB tool with the help of digital image processing techniques.

Keywords: detection, deteriorate, classification, digital image processing, cracks

I. INTRODUCTION

Roads are the best medium which is used by all the people of the world to reach their destination. With the advancement in the technology, the use of roads also increased for various purposes. The students use the roads for going to schools, colleges, tuition centers and universities. The workers use the roads to go to their working station. The farmers use the roads for trading of their crops. The traders use the roads for trading. The businessman uses the roads to go to their organization. Like this different people use the roads for various purposes. Hence roads are constantly used which results in deterioration of the roads and cracks come on it. These cracks are also come on roads due to environmental factors as well as by human factors. The environmental factors include earthquake, tsunamis, sun, cyclones, weather, etc. The human factors include overweight of the things, bad quality of the materials, etc. These cracks on the roads may prove very dangerous to the life of human beings and the progress of the country because roads are the most important way of the communication.[1]

Roads play a very important role in trading business because transportation of the things become very easy. Moreover with the development of roads social assimilation and finance development also becomes easy. If someone has to transport the goods then they use the road network for the transportation of the goods because it is the cheapest medium for the transportation of the goods than any other medium. Roads play an important role in the extending of the market which ultimately leads to the development of the country. In India, transportation of persons and goods are generally done

by the road network. In early years, roads are not developed so it also has effect on the development of the country. Hence for the development of the country roads play an important role.

Road network plays an important role for the people of the country, so its maintenance is also very important. If the maintenance of the cracks is done on regular interval then cracks will not come on the roads and the problem faced of the people of the country due to cracks may be solved. And they use the facilities of roads network for longer period.

It is very difficult for human beings to go to the site and then detect cracks in the road. To remove this difficulty computerized systems are developed which detect the cracks in the roads. These systems take less time and efforts to detect the cracks and their results are very efficient and accurate. [7]

The various systems are developed which detects the crack and classified them as longitudinal, traverse and alligator. These systems are developed by using different techniques like:

- The first technique for Crack detection is Artificial Bee Colony technique and classification is done with the help of Artificial Neural Network technique. [2]
- The next technique for crack detection is Entropy and the classification is done by Dynamic Thresholding. [3]
- The next method for detecting the cracks on the roads is the Digital Image Processing. [5]
- The next method for detecting cracks on roads and then classifying it is Anisotropy measure. It is used for removing shadow on the images of the roads. [9]
- The next method for detecting the cracks is neural network and classification of cracks is done with the help of Supervised Learning Algorithm. [11]
- The next method is Continuous Wavelet Transform for detecting and classifying the cracks. [18]
- The next method for detecting the cracks on the roads is Beamlet Transform. [22]

II. LITERATURE REVIEW

Literature review is the scholar papers which provide us information about the particular topic. Hence, the following

table 2.1 shows the literature survey regarding crack detection and classification.

Table 2.1: Literature Review

Author's Name	Year of paper published	Technique Used	Limitations
B. HariPrasath, S. Karthikeyan	2016	Gaussian filter for enhancement, Sobel edge detection, threshold for segmentation.	System performance= 89% Recall= 94.5% only. But does not calculate others parameters. [1]
Suwarna Gothane, Dr. M.V. Sarode	2015	Neural networks for crack identification, Supervised learning algorithm for segmentation, Gabor filter for enhancement.	Only classify potholes, cracks, patches. [7]
Anan Banharnsakun	2015	Artificial Bee Colony for detection of cracks, Artificial Neural Network for Classification of cracks.	Works on linear, block and alligator cracks only. Does not calculate parameters.[2]
Shiqing Liang, Bocheng Sun	2014	Continuous wavelet transform for detection, median filter for enhancement, canny edge detection for edge detection, thresholding for segmentation.	Only detect the cracks but does not classify it. [12]
Ouyang Aiguo, Wang Yaping	2012	Beamlet method for extraction of crack, thresholding for segmentation.	Show satisfactory result in case of low signal to noise ratio.[22]

AiguoOuyang, ChagenLuo et al.	2011	Median filter for enhancement, canny for edge detection, histogram modification for segmentation.	Median filter provide us blurring image and edges are not clear. [5]
Henrique Oliveira, Paulo Lobatocorreia	2010	Anisotropic Diffusion for enhancement, Gaussian function to model histogram for calculating intensities of pixel for segmentation.	Only reliable to low noise images. [4]

III. PROBLEM FORMULATION

The earlier proposed system can detect the cracks and classified the cracks as horizontal cracks, vertical cracks and potholes. The systems do not calculate the parameters associated with the cracks. But some systems calculate the parameters related to their performance.

The proposed system will detect the cracks as well as calculate the parameters. The cracks are detected with the help of edge detection technique and parameters like length, width and shape are calculated by using mathematical formulae.

After that, performance of the system is checked by finding precision and recall. With the help of these parameters we can compare our system with other system.

Precision is calculated as:

$$\text{Precision} = \frac{\text{Number of regions correctly classified as cracks}}{\text{Total number of crack regions detected.}}$$

Recall is calculated as:

$$\text{Recall} = \frac{\text{Number of regions correctly classified as cracks}}{\text{Total number of crack region.}}$$

Therefore, Performance criterion metric is calculated as:

$$\text{PC} = 2 * \text{precision} * \text{recall} / (\text{precision} + \text{recall}).$$

IV. TOOL USED

All the system that is used for crack detection is made in MATLAB. MATLAB stands for Matrix Laboratory. It was designed by Cleve Moler and developed by MathWorks in 1984. MATLAB helps in creating user interface, plotting of the data and functions, matrix manipulation, implementation of the algorithms and interfacing with other programming languages like C, C++, Java, and Python. Moreover it is also used for data visualization, algorithm development, numerical calculations and data analysis, etc. The files in MATLAB are

saved with .m extension. It is compatible with Windows, Linux and macOS operating systems. The main advantages of MATLAB over other tools are:

- Programming skills are not required.
- Mathematical calculations become very easy using MATLAB.
- Affordable cost.
- Data interpretation and analysis become easy.
- Plotting of graphs become easy.
- Implementation and development of algorithms become very easy.

V. CONCLUSION AND FUTURE SCOPE

Roads are used for various purposes. As a result, its maintenance is very important. Its maintenance is done when someone know that there is cracks on the road. So crack detection is very important. This paper includes the various techniques that are used for detecting cracks. It also includes the information regarding the tool that is used for detecting the crack. This system can detect the cracks and find few parameters in pixels only. In future other parameters like depth, intensity, etc can be measured. Moreover, this system may be used in the vehicles which help the driver to get information about width, shape and length about the cracks.

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