Development of Smartphone Application for Real-Time Steel Rust Recognition

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Abstract –

In recent years, most smartphones are equipped with high-pixel camera and powerful CPU. Our research aims to develop an Android App which can do steel rust recognition not only fast but also well. Eventually, become a smartphone application for real-time rust recognition.

Keywords –

Real-Time, Image Recognition, Smartphone

1 Introduction

This research hopes to develop an application on smartphone, which can enhance efficiency and reduce the equipment costs for bridge engineers to do regular test and maintenance. The main objectives are as follows:

1. To find out a method raising the recognition accuracy and reduce processing time of digital image.
2. To find out a method for real-time steel rust recognition, and developing an application for smartphone.

Research Scope and Limitations

Our study will be limited to steel rust recognition only, and assumes there's no other external interference in the image.

2 System Development

2.1 OSTU

Otsu's method is used to automatically perform clustering-based image threshold, or the reduction of a gray level image to a binary image. It exhaustively searches for the threshold that minimizes the intra-class variance (the variance within the class).

2.2 Canny Edge

Canny Edge is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It extracts useful structural information from different vision objects and dramatically reduce the amount of data to be processed.

2.3 Erosion & Dilation

Mathematical morphology (MM) is a technique for the analysis and processing of geometrical structures, based on set theory, lattice theory, topology, and random functions. MM is most commonly applied to digital images, but it can be employed as well on graphs, surface meshes, solids, and many other spatial structures.

Topological and geometrical continuous-space concepts such as size, shape, convexity, connectivity, and geodesic distance were introduced by MM on both continuous and discrete spaces. MM is also the foundation of morphological image processing, which consists of a set of operators that transform images according to the above characterizations.

2.4 System Architecture

The study uses three kinds of suitable algorithms by literature review. After the parameters test and adjustment, we developed the corrosion recognition system OCM (Otsu-Canny edge-Mathematical morphology).

First, the original images convert to grayscale images, and use Gaussian filter to eliminate noise. Using algorithms OTSU decided threshold value into the Canny edge algorithms. Then, Canny edge detection algorithms can identify corrosion image edge. Finally, the study use erosion and dilation by mathematical morphology method to solve the problem of broken images and eliminate noise.

In this study, we combine the corroded recognition

system OCM with smartphone equipment, and achieve research objectives.

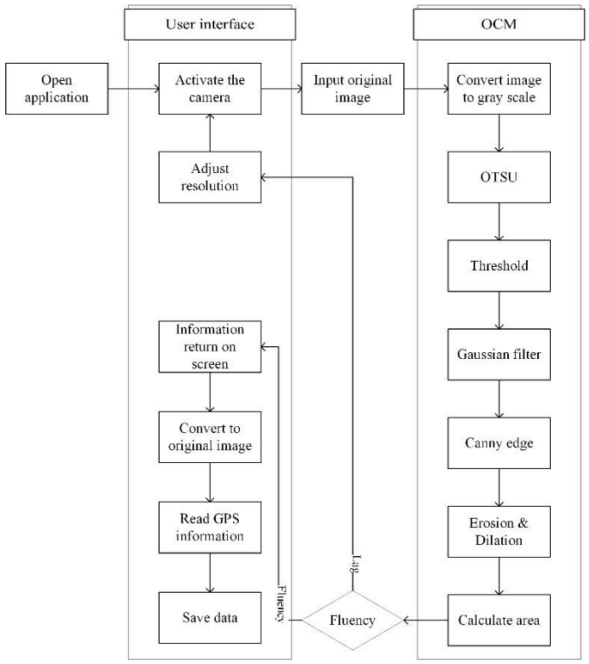

Fig 1. System Architecture

2.5 Artificial Rust Images

In this study, we produce 28 artificial images of steel coating which resolution are 3000 pixels * 4000 pixels with 7 different background color. All images are non-uniform illuminations. And, in order to imitate the real situation, we add some noise in these rust images.

3 Data Analysis and Discussion

In order to understand the pros and cons of our system, we decide to use FT-DEDA algorithm and K-means algorithm to do comparison, and using real pictures corrosion test. Because, according to the literature review, FT-DEDA is the latest and the more rapid the proposed algorithm.

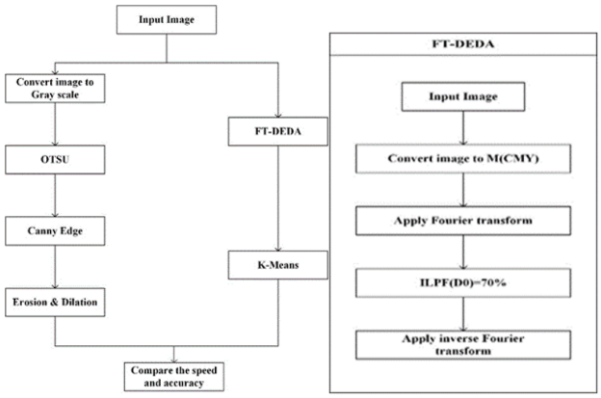

Fig 2. Data analysis and comparison

To verify the advantages and disadvantages, the study use real images to detect corrosion. Following is one of the diagrams (a) the original image, (b) according to the results of this research and development of detection systems, (c) the results of FT-DEDA has been tested with the K-means.

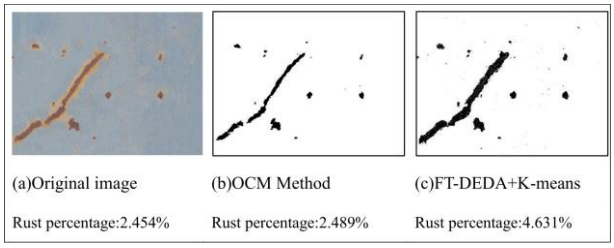

Fig 3. Comparison

4 Conclusions of Research

The research and development of corrosion recognition system OCM (Otsu-Canny edge-Mathematical morphology), according to artificial rust images and real images corrosion detection results, can be summarized in the following conclusions:

1. In this study, the corrosion detection system identifies relevant technologies through the edges, reducing more computational complexity than past detection method, can significantly reduce the detection time, with a 3000 pixels * 4000 pixels size image. For example, computation time is about 1/12 to 1/15 operation time that FT-DEDA + K- means method is required.
2. If the detection target image is a clean steel surface, ACC detection results of this research and development of corrosion recognition system falls to 96.2% to 99.5%.
3. If there are a lot areas covered by rust water, dirt or non-uniform illuminations on steel

surface, the detection accuracy can lead to errors, and ACC detection value falls to 95% to 99.7%.

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