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Fast R-CNNs-Based Manhole Cover Detection

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ABSTRACT

Manhole cover is a removable plate on the road surface to cover manholes and sewer wells. It is used to prevent people and other things from falling in. But sometime manhole cover may be broken or removed. For maintaining manhole covers effectively, we proposed a manhole cover detection method using fast R-CNNs based on road digitalimagery. We use fast R-CNNs to recognize manhole covers from these interesting candidates. In experiments, the manhole covers can be detected from road surface accurate and effective.

Keywords: Manhole Cover, CNNs, R-CNNs, Fast R-CNNs

I. Introduction

Manholes are sewer wells are used to conduct rainwater, drainage, power cables telecommunication cables and other things. Manhole covers are used to prevent people falling in and unauthorized persons get in. But they may be break or removed sometimes. The manhole without cover is then very easy to get people injury. Consequently, manhole detection is necessary solution in order to prevent the accidents and damages for traffic people.

There are various methods for manhole covers detection. They are mostly based on digital image processing. These methods are based on the imaging devices, like laser, satellites and cameras [1, 2]. The laser can get a high resolution imaging result then get an accurate result. But the application restricts and the cost of laser equipment, the manhole cover detection methods based on laser cannot be applied extensively. Other researches [3, 4] proposed a better method that is based on satellites imaging for a large area but meanwhile it easily to be influenced by weather and obstacles; and proposed algorithm based on machine learning and it has more accurate recognition rate.Consequently, there are some proposed methods for manhole cover detection but authors mostly gave the techniques based on digital image processing. Those are conventional works and their accuracy is very low. In this paper, we would like to propose a method to help people detect manhole cover based on fast R-CNNs. In order to clarify the proposed method, our paper is organized as follows: the proposed method is described in Sec. 2; experimental results are shown in Sec. 3; and conclusion will be explained in Sec. 4.
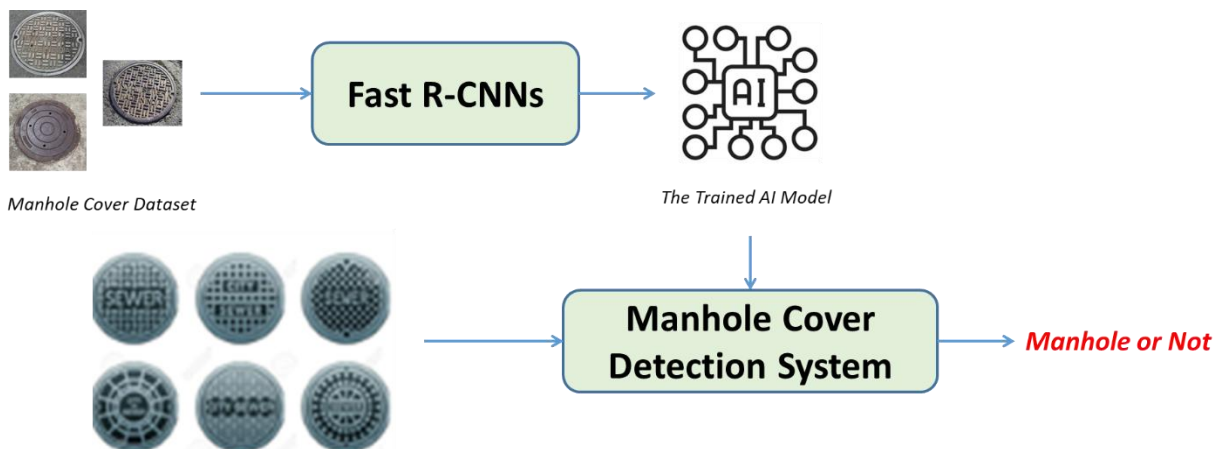
II. The Proposed Method

Fig. 1: The Proposed Method.

The proposed method is described in Fig. 1. Manhole cover dataset is used in the training/testing processes by Fast R-CNNs [5] to generate AI model. The trained AI model is then used in the manhole cover detection system to detect the input is manhole cover or not.
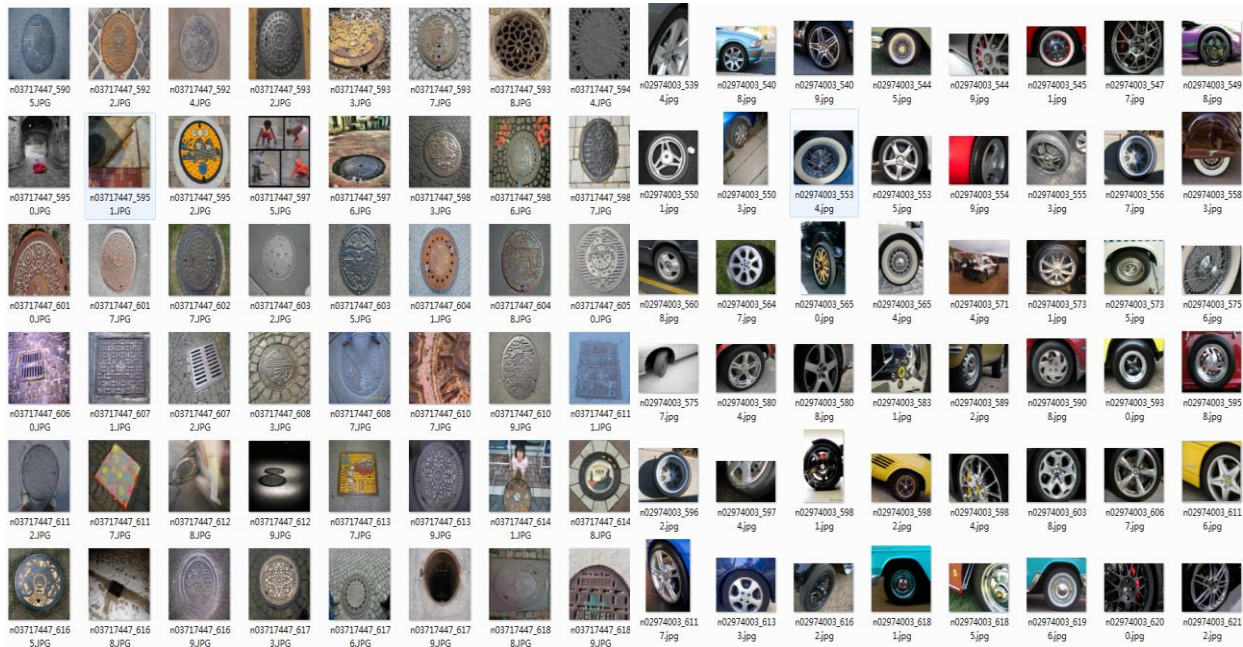
III. Experimental Results

Fig. 2. Training image samples.

We collect 3600 manhole cover images and 2600 car wheel images for the training, 1000 manhole cover images and 1000 car wheel image for the testing as shown in Fig. 2. After 1500 iterations, the recognition rate can reach 93.2 percentage. In testing process, we only used CPU. The configuration of computer is Intel core-i7, 32 GB memory and 64 bit Windows 10 operating system. From Fig. 3 we can see that the program has a good recognition rate for the manhole cover detection.

We totally ran 4000 iterations by CPU. Because using a small dataset and relatively bigger learning ratio, the loss reducing and accuracy increasing are very fast at the beginning 1000 iterations. After that, the performance is continually improved with iteration time, but the improvement will be not outstanding like the beginning. If we want to reach the state-of-the-art, more data and more time training are necessary. Meanwhile it needs fine-tuning. In our tuning experience, the dimension and sparse of data influence the result. Usually ignore the training cost, the more data the better. In the training process, some parameters and methods which we used have more influence than the algorithm itself, like pooling and convolution. To imagine, more features are usually helpful, meanwhile we need sufficient data for the training, otherwise the data will become relatively sparse to specific feature.
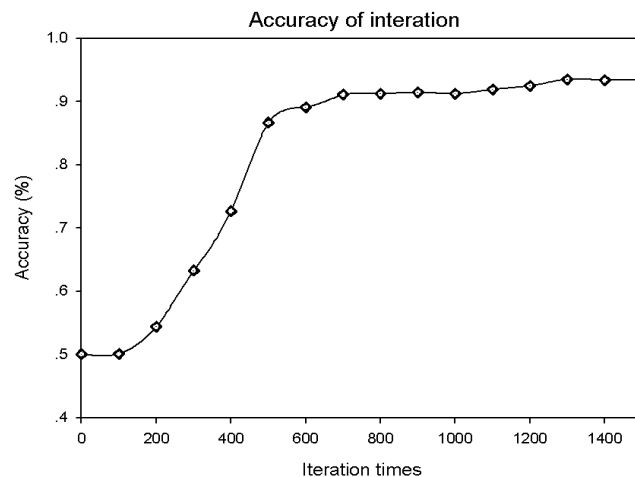

Fig. 3. Training accuracy.

IV. Conclusion

Manholes are sewer wells are used to conduct rainwater, drainage, power cables telecommunication cables and other things. Manhole covers are used to prevent people falling in and unauthorized persons get in. Manhole cover detection is needed. Our method is based on vehicle-mounted camera. We proposed a method to realize the detection through road surface label, ellipse detection and manhole cover recognition, using fast R-CNNs recognition process and the ImageNet testing model. According to the experiment, the proposed method can detect manhole cover with a good accurate result. Meanwhile the performance of processing time is also rapid.

Acknowledgement

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