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Damage Estimation of Sewer Pipe using Subtitles of CCTV Inspection Video

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ABSTRACT

Recent frequent occurrence of urban sinkhole serves as a momentum of the periodic inspection of sewer pipelines. Sewer inspection using a CCTV device needs a lot of time and efforts. Many of previous studies which reduce the laborious tasks are mainly interested in the developments of image processing S/W and inspection H/W. And there has been no attempt to find meaningful information from the existing CCTV images stored by the sewer maintenance manager. This study adopts a cross-correlation based image processing method and extracts sewer inspection device's location data from CCTV images. As a result of the analysis of location-time relation, it show strong correlation between device stand time and the sewer damages. In case of using this method to investigate sewer inspection CCTV images, it will save the investigator's efforts and improve sewer maintenance efficiency and reliability.

1. INTRODUCTION

Domestic CCTV sewer inspection process has been required a significant amount of time because an inspector make a report manually by playing each inspection video. This labor-intensive approaches decrease the objectivity and reliability of the report and it is hard on the manager to identify and verify the report. This research introduces cross-correlation method (CCM) (Kim et al., 2015) to detect characters from an inspection video. The time and moving distance relation of a sewer inspection device has been analyzed using the extracted letters from the inspection video.

2. DIGITAL IMAGE PROCESSING AND APPLICATION

Sewer CCTV inspection video is hard to be recognized the subtitles because it

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has less resolution and rapid changes in background brightness. Therefore this study adopts cross correlation method to detect letters. CCM needs all kind of letter samples but it can distinguish the each letter and quantify the difference of these. Cross correlation coefficient r can be calculated by Eq. (1) and it has the value from -1 to 1. It means the two letter images are same when the absolute value of the coefficient close to 1. (Lewis, 1995)

$$r(u,v) = \frac{\sum_{xy}[f(x,y)-\bar{f}_{u,v}][t(x-u,y-v)-\bar{t}]}{\left\{\sum_{xy}[f(x,y)-\bar{f}_{u,v}]^2 \sum_{xy}[t(x-u,y-v)-\bar{t}]^2\right\}^{0.5}} \quad (1)$$

Fig. 1 Sewer CCTV Image

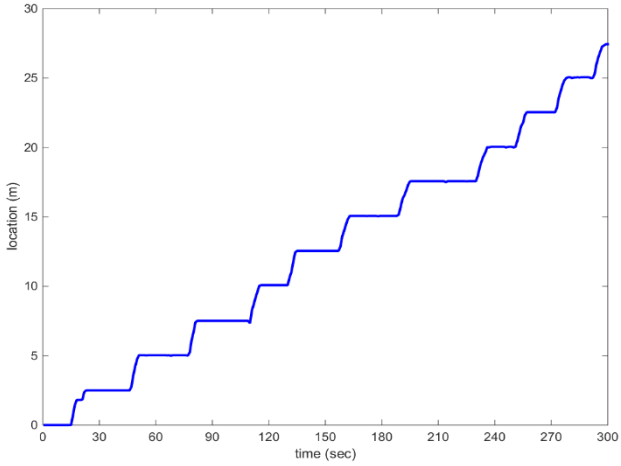


Fig. 2 Time-Distance Relation of Sewer Inspection Device

Table 1 The information of sewer video

Character 1		Character 6	
Character 2		Character 7	
Character 3		Character 8	
Character 4		Character 9	
Character 5		Character 0	

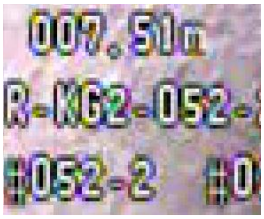
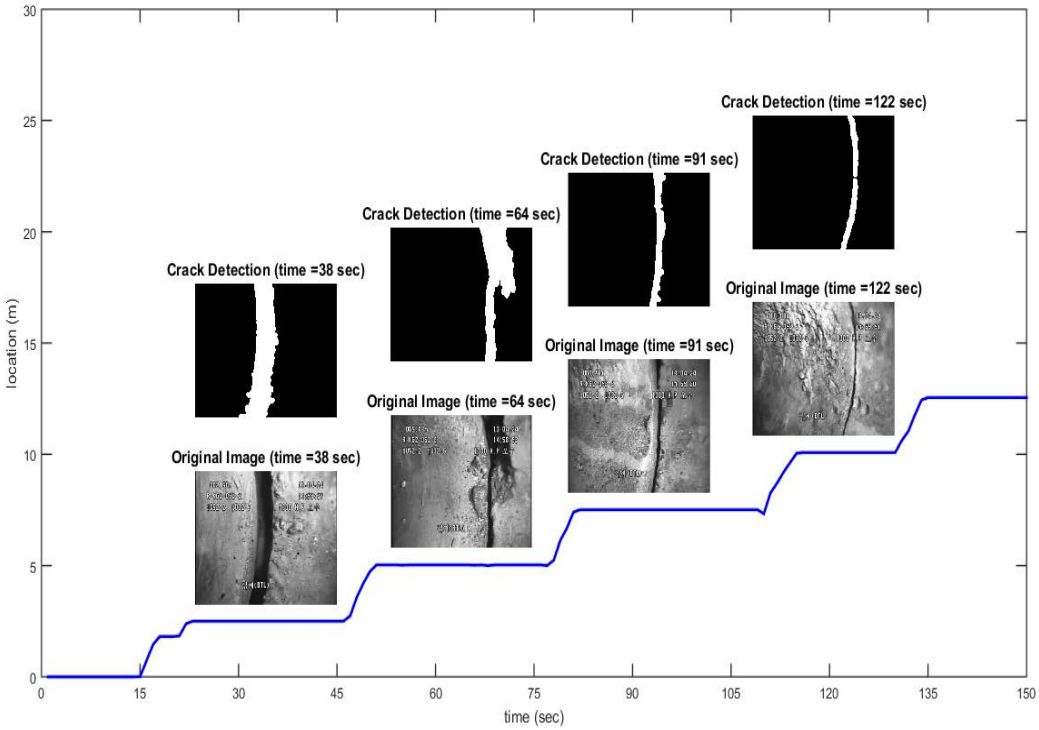
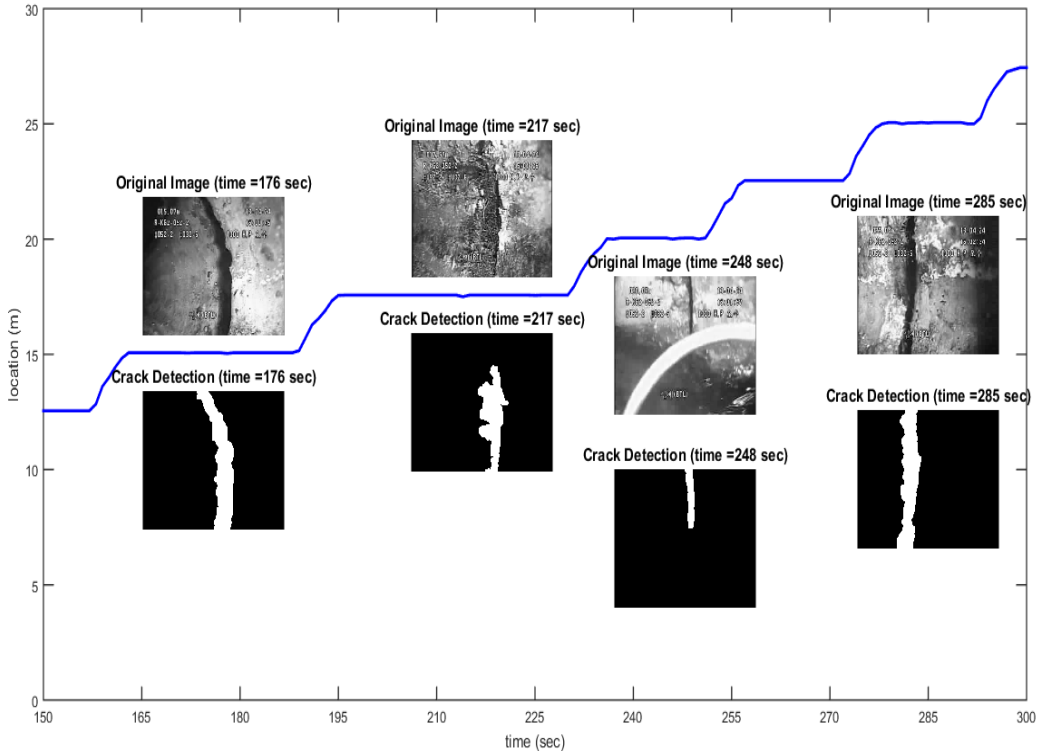


Fig. 3 Enlarged image



(a) Time 0-150sec



(b) Time 150-300sec

Fig. 4 Sewer inspection device location-time and corresponding damages

3. CONCLUSIONS

This study adopt a digital image processing method, CCM, and analyzes a sewer inspection video's subtitle information. In case of using digital image processing, the damage level and location of the sewer line can be indirectly estimated at once. This application can be an effective alternative to manage a number of sewer lines and will increase the objectivity and the reliability of the sewer inspection process.

REFERENCES

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