Development of a query system for pothole 2D DB

Taehyeong Kim*, Seung-Ki Ryu**
*,**Korea Institute of Construction Technology, South Korea
E-mail : tommykim@kict.re.kr*, skryu@kict.re.kr**

1. Introduction

Recently, due to the climate change such as heavy rains and snow, damaged pavement like potholes are increasing, and thus complaints and lawsuits of accidents related to potholes are growing. Also, pavement distress detection such as cracks, potholes, etc. mostly performed manually is a labor-intensive and time-consuming. To solve this problem, a new research is being conducted for developing a method that contributes to improvement of survey efficiency and pavement quality by prior investigation and situational action with developing a technology which can detect and recognize potholes based on images.

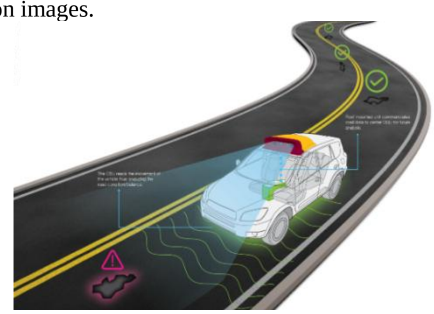

Figure 1. The concept of smart detecting system for pothole

In this study, before developing a technology detecting and recognizing potholes based on images, we collect images of potholes through video recording on a moving vehicle, categorize potholes by type of shape based on collected images, and develop a query system for the built pothole 2D DB.

By collecting the data of locations and shapes for potholes and processing DB, it is possible to collect variouspothole data by shape, to maximize user-friendly convenience and the search efficiency, and to build quick inspection and implementation system. Also, the obtained pothole video data and a query system for pothole 2D DB will be utilized for testing algorithms that will be developed to detect and recognize potholes based on images and video data.

2. Review on detection and recognition of potholes based on images

Generally, a pothole is defined as a bowl-shaped depression in the pavement surface and minimum plan dimension is 150 mm [1]. Also, severity levels of potholes are divided into three groups such as low (< 25 mm deep), moderate(25 mm to 50 mm deep), and high(> 50 mm deep).

Koch and Brilakis presented a method for automated pothole detection in asphalt pavement images [2]. Under the proposed method, the image is first segmented into defect and non-defect regions. The potential pothole shape is then approximated according to the geometric characteristics of a defect region. Next, the texture of a potential region is extracted and compared with the texture of the surrounding non-defect region. If the texture of the defect region is coarser and grainier than the one of the surrounding surface, the region of interest is assumed to be pothole. In order to test the proposed method, it was implemented in MATLAB utilizing the Image Processing Toolbox, and images were cropped from video files captured using a remote-controlled robot vehicle prototype equipped with a HP Elite Autofocus Webcam which was installed at an altitude of about 2 feet as shown in Fig 1. Total 120 images were collected, and 50 images of them were used for training and others for testing. The resulting accuracy was 86% with 82% precision and 86% recall.

However, the method by Koch and Brilakis was limited to single frames and therefore cannot determine the magnitude of potholes in the frame of video-based pavement assessment. In order to complement and improve the previous method, Koch et al. presented an enhanced pothole-recognition method which updates the texture signature for intact pavement regions andutilize vision tracking to track detected potholes over a sequence of frames [3]. The proposed method was implemented in MATLAB and tested on 39 pavement video containing 10,180 frames. The resulting total recognition precision and recall were 75% and 84%, respectively. Consequently, compared with the previous method, the texture-comparison performance was increased by 53%, and the computation time was reduced by 57%. They assumed that only one pothole enters the viewport at a time, and therefore additional work is needed for considering multiple potholes in the viewport.

Recently, Buza et al. proposed a new unsupervised vision-based method which does not require expensive equipment, additional filtering and training phase [4]. Their method deploys image processing and spectral clustering for identification and rough estimation of potholes. The proposed method is divided into three steps such as image segmentation, shape extraction using spectral clustering, and identification and extraction. The proposed method was implemented in MATLAB and tested on 50 pothole images which were selected from Google image collection. The accuracy for estimation of a pothole surface area was about 81%. So, this method can be used for rough estimation for repairs and rehabilitation of pavements.

3. Video collection of potholes

For video collection of potholes, a high resolution camera (1980*1080, 30 f/s) and a blackbox (1280*720, 30 f/s) are mounted at the height of a room mirror and they records the road surface ahead during movement as shown in Fig 2.

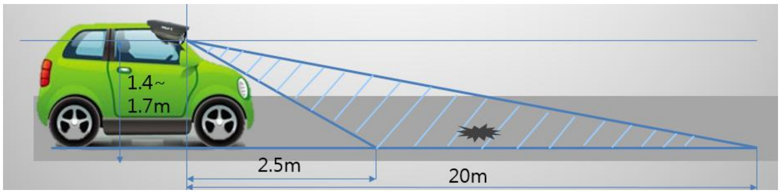

Figure 2. The height and distance of a camera for video collection

Also, the coordinates of potholes and route information can be obtained using the GPS.

4. A query system for pothole 2D DB

We categorize potholes by type of shape through the collected pothole video clips, build 2D image DB of potholes, and implement a query system for pothole 2D DB as shown in Fig 3.

System specification

- System (DB + PC + viewer)
- DB storage and PC
  - Core i5-3230M(Dual 2.6GHz), RAM 4G, HDD 500G
- MS-SQL DBMS SW based Windows
- Viewer : Query and display function

Figure 3. Example and specification of a query system for pothole 2D DB

The built DB contains at least 100 of potholes video clips. A query system for pothole 2D DB consists of DB, PC, and operating S/W (viewer). This system has a query function by condition and can display 2D image, point cloud data, and additional information of a corresponding pothole for a selected video.

5. Conclusions

In this study, before developing a technology detecting and recognize potholes based on images, we collect pothole images through video collection on a moving vehicle, categorize potholes by type of shape based on collected images, and develop a query system for built pothole 2D DB. The obtained pothole video data and developed query system for pothole 2D DB will be utilized for testing algorithms that will be developed to detect and recognize potholes based on images and video data.

6. Acknowledgement

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7. References

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