Development of technologies to measure the green coverage ratio using AI

(Study period: FY 2018–2020)

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1. Research of methods for quantitative evaluation of the effect of greening to improve the urban environment

The NILIM is conducting research in the methods for quantitative evaluations of the effect of greening in improving the urban environment[1] to develop methods for quantitative measurements and evaluations of green areas in cities and to build technological knowledge to effectively utilize the various functions of green areas for use in urban planning. This article introduces the technology to measure the green coverage ratio using AI that is now under development in this research project.

2. Advancement of green coverage ratio survey by AI

This research aims to reduce the workload and cost of green coverage ratio surveys by automating the process of extracting green areas from images using the image recognition technology of artificial intelligence (AI). This research is also examining methods to improve the awareness of the private sector toward greening and spread green areas on private land by creating a smartphone application of this technology and develop mechanisms where local governments and residents together conduct green coverage surveys.

3. Utilization of image recognition through deep learning

In the early 2010s, deep learning enabled a breakthrough in the limits of conventional neural networks, which led to rapid progress in AI research. Image recognition through deep learning includes semantic segmentation. This is a technology that can classify items, such as buildings, cars, the sky, and pavement, in the image of cities captured by cameras mounted on cars by capturing the outline of individual classes, for example (Figure 1). Classes categorized here are determined by training data used for AI learning. Many training datasets are now released for AI researches to accelerate the development of more advanced neural network models.

The training datasets of urban images often include the class of vegetation as one of the class categories. AI models that have learned using this class will enable the identification of green areas, such as trees and lawns, in images. This research first created an AI model for identifying vegetation using the AI model, SegNet[2] and the dataset, CamVid[3] developed and released by Cambridge University. Then, their effectiveness was examined by computing the green coverage ratio (the ratio of green areas in one image) and comparing it with conventional survey methods.[4,5] The research also confirmed that the accuracy of identifying vegetation could be improved by using a more advanced neural network model and the AI model that conducted learning using datasets. Meanwhile, the study found that some trees were difficult to identify using the datasets released for AI researches. Possible causes include training methods, such as over-training, while the effect of the types of trees included in the dataset of images of cities outside of Japan also seemed great. To improve the accuracy of recognition by AI, it is important that the contents of the training datasets used for training AI match the purpose of using the AI.

Thinking that using images of cities captured for the past green coverage ratio surveys for AI training would be a suitable learning method for the green coverage ratio survey, this research decided to perform AI learning using images of cities in Japan with the cooperation of local governments.

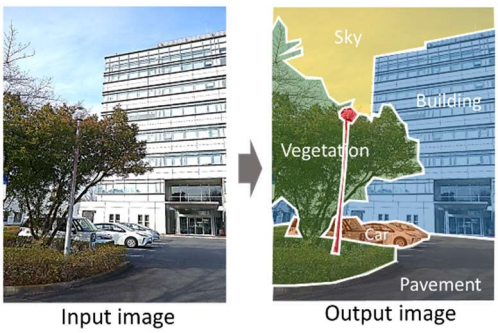

Figure 1: Semantic segmentation

4. Development of smartphone application

The smartphone has been expanding the possibility of urban sensing as multifunction sensors that are available in many parts of cities as many people are carrying smartphones with them. In addition, the System on a Chip (SoC) embedded in the latest smartphones contain AI chips for photo and audio assistance functions. Thus,

the AI processing capacity of these smartphones is quite advanced. This research focused on these characteristics and created a pilot version of the smartphone application containing the trained AI model (Photo 1).

Photo 1: Smartphone application

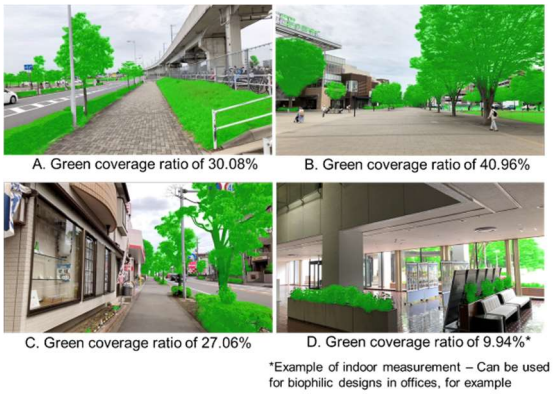

Figure 2: Example of measuring green coverage ratio using smartphone

This application can quickly and easily measure the green coverage ratio whenever and wherever just by holding up a smartphone (Figure 2). When the conditions of green areas are shown quantitatively, slight differences in the amount of green become visible. For example, when continuously watching the front from the passenger seat of a car through this application, a user can notice differences in the range of green coverage ratios of trees along different roads even when the measurement is conducted by holding the smartphone with the hand, which tends to be unstable (Figure 3).

5. For the use of this technology for future green coverage ratio surveys

A green coverage ratio survey needs to be conducted by clearly defining the green coverage ratio, such as how images are to be captured. Future research activities are going to cover the development of measuring methods based on the characteristics of smartphones and methods for evaluating the environment with visible green areas, which correspond to the green coverage ratio, as well as

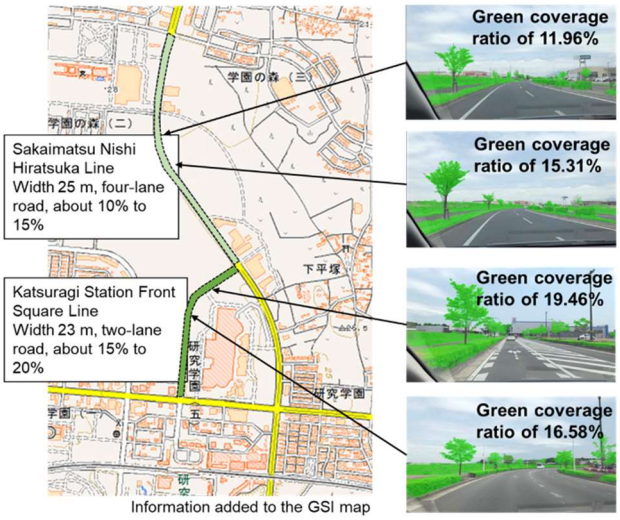

Figure 3: Differences in the green coverage ratio on different roads

the exploration of ways to increase public awareness toward greening, such as surveys conducted through the cooperation of residents (Figure 4).

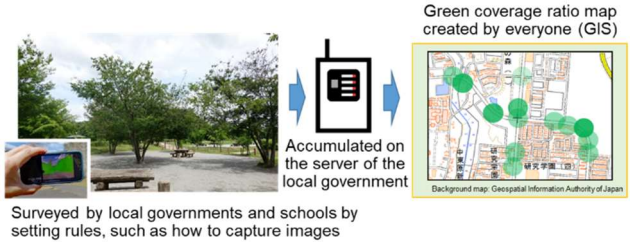

Figure 4: An image of the green coverage ratio survey with the cooperation of residents

The smartphone application for the green coverage ratio survey is going to be released in FY 2020.

☞For more information:

1) NILIM press release: Rough estimate of NILIM budget for FY 2018. p. 6 http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20170829.pdf
2) Segnet http://mi.eng.cam.ac.uk/projects/segnet/
3) CamVid http://mi.eng.cam.ac.uk/research/projects/VideoRec/CamVid
4) The Architectural Institute of Japan - Compilation of Academic Lectures in the FY 2019 Conference Environmental Engineering I. pp. 739-740 DVD-ROM
5) The FY 2019 Environmental Research Facility Interaction Seminar - Proceedings of Posters pp. 27-28 http://kankyorenrakukai.org/seminar_01/pdf/yousisyu.pdf